

Educate Elevate Enlighten

JSS Mahavidyapeetha
JSS Science And Technology University
(Established Under JSS Science and Technology University Act No. 43 of 2013)
(Formerly Known as SJCE)



JSS MAHAVIDYAPEETHA
JSS SCIENCE & TECHNOLOGY UNIVERSITY, MYSURU

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME - III TO VIII SEMESTER
2022 Batch (Amendment – I of 2022 batch – Inclusive of elective 22EC648)
SYLLABUS - III TO VIII SEMESTER

Scheme of Teaching and Examination for B.E (E&CE)

(For the students admitted during 2022 - 2023)

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About JSS Science and Technology University

JSS Science and Technology University is one of the recent additions to the institutions administered by JSS Mahavidyapeetha, and is the second University being established besides a Medical University at Mysuru. India's higher education system is on the verge of major reforms and JSS Science and Technology University has been established envisioning creating a bright future and a desired learner centric eco-system and transforming into a futuristic global University. The Availability of skilled human resources and trained technical manpower in engineering and technology is a major reason for growing investments in the state. In this context higher education system has a key role and more particularly JSS S&T U with an objective of transforming the students at all levels of higher education including research and innovation with measures to improve quality of workforce.

National Focus:

We'll orient our efforts towards overall development of students', aligning our investments with our strategic priorities to cater to the Nations' Vision. We'll streamline our systems and processes to make the most of our resources, and minimise bureaucracy.

Global reach:

We'll broaden our efforts to meet the global needs of the larger world community with focused priorities including a multi-cultural community of students and staff and become a truly international university. We'll prepare students for diversified technological environments worldwide, and develop international alliances and partnerships.

Multi-disciplinary approaches.

We'll strategically provide encouragement to multi-disciplinary approaches by supporting and developing networks of students, faculty and researchers worldwide. We'll create world leading, multi-disciplinary, learning centers, research institutes that meet our Industries and funders' strategic needs.

The vision of JSS Science and Technology University is to be an effective instrument in enhancement of knowledge in the Society and thus the social transformation.

Our Strategic priority includes:

1. Prominent National Status
2. Quality Teaching & Learning
3. Research of International Repute
4. State of the art infrastructure of International Standard:
5. Open access to knowledge through Distance Education
6. Collaborations & MOU

JSS Science and Technology University strategies to utilize the very best of education technology, optimize teaching methods, and encourage new inter-disciplinary research programmes that help connect teaching and research, including applied and action research projects.

Vision of JSS Science and Technology University

1. Advancing JSS S&T University as a leader in education, research and technology on the international arena.
2. To provide the students a universal platform to launch their careers, vesting the industry and research community with skilled and professional workforce.
3. Accomplishing JSS S&T University as an epicentre for innovation, centre of excellence for research with state of the art lab facilities.
4. Fostering an erudite, professional forum for researchers and industrialist to coexist and to work cohesively for the growth and development of science and technology for betterment of society.

Mission of JSS Science and Technology University

1. Education, research and social outreach are the core doctrines of JSS S&T University that are responsible for accomplishment of in-depth knowledge base, professional skill and innovative technologies required to improve the socio economic conditions of the country.
2. Our mission is to develop JSS S&T University as a global destination for cohesive learning of engineering, science and management which are strongly supported with interdisciplinary research and academia.
3. JSS S&T University is committed to provide world class amenities, infrastructural and technical support to the students, staff, researchers and industrial partners to promote and protect innovations and technologies through patents and to enrich entrepreneurial endeavors.
4. JSS S&T University core mission is to create knowledge led economy through appropriate technologies, and to resolve societal problems by educational empowerment and ethics for better living.



Vision of Sri Jayachamarajendra College of Engineering

Be an international leader in engineering education, research and application of knowledge to benefit society globally.

Mission of Sri Jayachamarajendra College of Engineering

- 1. To synergistically develop high-quality manpower and continue to stay competitive in tomorrow's world.**
- 2. To foster and maintain mutually beneficial partnerships with our alumni, industry, state and central governments through public services assistance and collaborative research.**
- 3. To create empower individuals with sense of identity.**



Vision of the Department of Electronics and Communication Engineering

Be a leader in providing globally acceptable education in electronics and communication engineering with emphasis on fundamentals-to-applications, creative-thinking, research and career-building.

Mission of the Department of Electronics and Communication Engineering

- 1. To provide best infrastructure and up-to-date curriculum with a conducive learning environment.**
- 2. To enable students to keep pace with emerging trends in Electronics and Communication Engineering.**
- 3. To establish strong industry participation and encourage student entrepreneurship.**
- 4. To promote socially relevant eco-friendly technologies and inculcate inclusive innovation activities.**



ABOUT THE DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

The department of Electronics and Communication Engineering was established in 1968 .The department offers an undergraduate program in Electronics and Communication Engineering, three PG programs namely M.Tech in Industrial Electronics, M.Tech in Network and Internet Engineering and M.Tech in Automotive Electronics. In addition to these, it also offers M.Sc. Engineering by research and Ph.D. programs which provide a platform for bright graduates and postgraduates to conduct research in state-of-the-art technologies. The department is composed of well qualified teaching and technical staff with good retention.

The Department is also a recognized centre under the Quality Improvement Program (QIP) of the Government of India. The well designed curriculum lays a strong foundation in both the analytical and technological aspects of Electronics and Communication Engineering. It also provides ample opportunities to students to work on mini-projects, develop communication skills, explore internship opportunities in industry and take part in national and international design contests like PACE, Aero-JC, cultural and sports activities etc.

The BE degree in Electronics and Communication Engineering at SJCE, JSSSTU is one of the most sought after programs in the state and attracts top ranking students. It has a very good placement record and almost 100 % of the eligible students get placement in top companies with a very good package. Department also encourages students to pursue higher studies and to become entrepreneurs. The department has a very active IEEE student chapter which organises National level paper presentation competitions and other events such as Vacation Project Mania, Latex workshops and mini project competitions, etc.

Apart from teaching, the department also guides UG and PG students for getting Internships at renowned Industries and premier Institutes like IISc, IIT's and NIT's, organizes Industrial visits, conducts expert lectures and workshops. The department also has special labs namely Nano Dielectric and devices lab, Visual TCAD and research lab and e-yantra lab which provides space for researchers to carry out experimental investigations and UG and PG students to implement project ideas.

Programmes offered:

UG Programme:

1. Bachelor of Engineering in Electronics and Communication Engineering: 4 years duration

PG Programme:

1. Master of Technology in Industrial Electronics: 2 Years duration
2. Master of Technology in Network and Internet Engineering: 2 Years duration
3. Master of Technology in Automotive Electronics: 2 Years duration

Research Programme:

1. Doctoral Program
2. M.Sc. (Engineering) by research.

Department faculty Details:

Sl. No	Name	Qualification	Area of specialization	Designation	Years Of Experience	Date of Joining	Nature of Association (Regular/Contract/Adjunct)
1	Dr. Shankaraiah	Ph.D.	Wireless Communication and networking	Professor	25	21-02-2003	Regular
2	Dr. Mahadevaswamy U B	Ph.D.	Wireless Sensor Networks, VLSI Circuits and Signal processing	Professor and Head	33	16-11-1989	Regular
3	Dr. Gayathri S	Ph.D.	VLSI, Image and signal Processing	Associate Professor	34	28-10-1988	Regular
4	Thyagaraja Murthy A	M.Tech	Communication & Networking	Associate Professor	26	18-07-1994	Regular
5	Sujathakumari B A	M.Tech	Industrial Electronics	Associate Professor	30	18-03-1991	Regular
6	Renuka B S	M.Tech	Industrial Electronics	Associate Professor	36	27-06-2003	Regular
7	Dr. Rudraswamy S B	Ph.D.	Microelectronics and Nanotechnology	Assistant Professor	17	30-10-2004	Regular
8	Halesh M R	M.Tech	Analog and Digital VLSI	Assistant Professor	12	22-09-2016	Regular
9	Dr. SudharshanPatil Kulkarni	Ph.D.	Signals and system and Signal Processing	Professor	15	7/2/2007	Regular
10	Dr. Veena M G	Ph.D.	Nano-Dielectric Materials & MEMS Sensors	Professor	19	30-10-2004	Regular
11	Dr. Gayitri H M	Ph.D.	Nanotechnology	Associate Professor	11	2/9/2011	Regular
12	Anitha S Prasad	M.Tech	Signal Processing and VLSI	Assistant Professor	11	5/9/2011	Regular
13	Pavithra D R	M.Tech	Signal and digital image processing	Assistant Professor	15	5/9/2011	Regular
14	Shivaprasad N	M.Tech	NanoElectronics	Assistant Professor	10	5/9/2011	Regular
15	Supreetha M	M.Tech	Digital Electronics	Assistant Professor	10	6/8/2014	Regular
16	Puneeth K M	M.Tech	IoT and Mobile Computing	Assistant Professor	7	6/8/2014	Regular

17	Eshwari A Madappa	M.Tech	Power Electronics	Assistant Professor	7	6/8/2014	Regular
18	Yashwanth S D	M.Tech	Automotive Electronics	Assistant Professor	6	26-10-2015	Regular
19	Vinay Prasad M S	M.Tech	Communication & Networking	Assistant Professor	6	6/10/2016	Regular
20	KavyaShree M K	M.Tech	Digital electronics and Communication	Assistant Professor	6	7/10/2016	Regular
21	Dr. Shashidhar R	Ph.D.	Signal Processing, VLSI and Embedded Systems	Assistant Professor	7	8/10/2016	Regular
22	Chandrashekar Murthy B N	M.Tech	Digital Electronics and Communication	Assistant Professor	7	6/8/2014	Regular
23	Praveen Kumar M S	M.Tech	VLSI Design, Microelectronics and Nanotechnology	Assistant Professor	6	1/10/2016	Regular
24	Anupama S	M.E/ M.Tech	Computer Network and Engineering	Assistant Professor	10	03-09-2019	Regular
25	Madhusudan M P	M.E/ M.Tech	Biomedical Signal Processing and Instrumentation	Assistant Professor	7	5/9/2019	Regular
26	Megha K M	M.E/ M.Tech	Digital communication and networking	Assistant Professor	3	09-09-2019	Regular
27	Rakesh M D	M.Tech	VLSI Design and Embedded Systems	Assistant Professor	13	24-02-2022	Regular
28	Rohith M N	M.Tech, MBA	Digital Electronics and Communication Systems	Assistant Professor	13	4/4/2022	Regular
29	Priyanka D S	M.Tech	Networking and Internet Engineering	Assistant Professor	1	24-02-2022	Contractual
30	Roopa M	M.Tech	Computer Networks and Engineering	Assistant Professor	1	24-02-2022	Contractual
31	Dr. Rakshith B	Ph.D.	VLSI Design and Embedded Systems	Assistant Professor	1	3/3/2022	Contractual

Laboratory facilities:

SI No	Name of the Lab	Major facility
1	E-Yantra Lab	FireBird-V3 Robot, Robotics Atmega - 16A platform, Robotics Atmega - 2600 platform, Servo motor based gripper kit, programmable 32-bit ARM 9 Robotic platform, Robotic arm, depth sensor camera with adapter.
2	Networking and Simulation Lab	Computers, switches , routers, WiFi access, Exata simulator
3	Automotive Controls Lab	dSpace, computers, Power Supplies, CRO.
4	Power Electronics Lab	CRO, Power supplies, multimeters, motors, Choppers, Inverters.
5	Communication Lab	CRO, LCR meter, Spectrum Analyzer, Power Supplies breadboards, Active and Passive Components Digital Storage Oscilloscopes.
6	VLSI and DSP Lab	Computers, Cadence, TCAD software, ARM, MSP, FPGA/CPLD, DSP boards.
7	Nano dielectrics & Devices Lab	Spin coater, Megohmmeter, Electrospinning Espinnano, HV tester, analytical balance, inclined plane tracking, Vaccum Oven, Contact angle meter.
8	Data Sciences and Machine Learning facility (Central Computing facility)	10 High end client systems, 1 PARAM-SHAVAK C-DAC Server. Systems preloaded with software for deep learning and high performance computing.



Analog Electronics Lab





Digital Electronics Lab



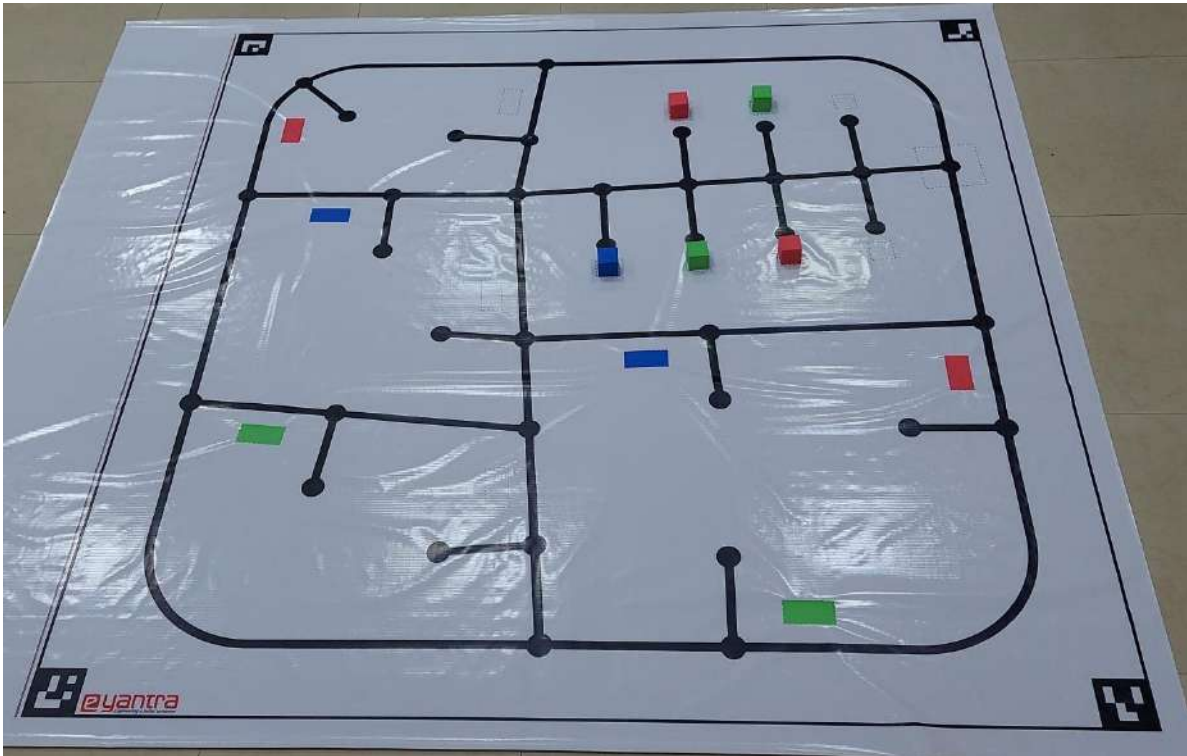
Communication Lab



Power Electronics Lab



Networking Lab/ Hardware Systems Integration and Simulation Lab



E-Yantra Lab - Robotics and Embedded Systems Labs

Research & Consultancy

Funded Projects:

#	Project Title	Principal Investigator	Duration	Funding Agency	Amount in Rs.	Date of Sanction
1	Hand Gesture Recognition And Voice Conversion System for Speech Impaired	Dr. Gayitri. H. M	1 year	KSCST (https://www.kscst.org.in/)	7000/-	2021-22
2	Cloud Laboratory: Engineering Education	Dr. Ramya M V	1 year	KSCST (https://www.kscst.org.in/)	7000/-	2021-22
3	Synthesis and Characterization of Metal Oxide Nanocomposites for Super Capacitor Application	Dr. Gayitri. H. M	1 year	KSCST (https://www.kscst.org.in/)	5000/-	2020-21
4	Wearable Assistive Device for Visually Impaired with Computer Vision and Acoustic Feedback	Dr. S B Rudraswamy	1 year	KSCST (https://www.kscst.org.in/)	6000/-	2020-21
5	Accident Prevention in Automobiles using Real-Time Tracking (APART) System	Dr. S B Rudraswamy	1 year	KSCST (https://www.kscst.org.in/)	6000/-	2019-20
6	Handwriting Robot for Regional Languages	Prof. Ramya M V	1 year	KSCST (https://www.kscst.org.in/)	5000/-	2019-20
7	Automated Geen House	Dr. Shankaraiah	1 year	KSCST (https://www.kscst.org.in/)	6000/-	2018-19
8	Detection of Non Helmet Riders using CNN and OCR Methods	Prof. Shashidhar R	1 year	KSCST (https://www.kscst.org.in/)	7000/-	2018-19
9	Dexterous Thrashbot	Prof. Eshwari A Madappa	1 year	KSCST (https://www.kscst.org.in/)	6000/-	2018-19
10	Surface Water Analyser and Notifier (SWAN) using Volumetric Analysis and GSM Module	Prof. Ramya M V	1 year	KSCST (https://www.kscst.org.in/)	5000/-	2017-18
11	Robot Mediated Imitation Learning for Children with Autism	Prof. B.A. Sujathakumari	1 year	KSCST (https://www.kscst.org.in/)	5000/-	2017-18
12	Digital Door Locking System	Dr. M.G. Veena	1 year	KSCST (https://www.kscst.org.in/)	5000/-	2017-18
13	Automation Hydroponics using Android App and Cloud Platform	Prof. Anitha S Prasad	1 year	KSCST (https://www.kscst.org.in/)	5000/-	2017-18



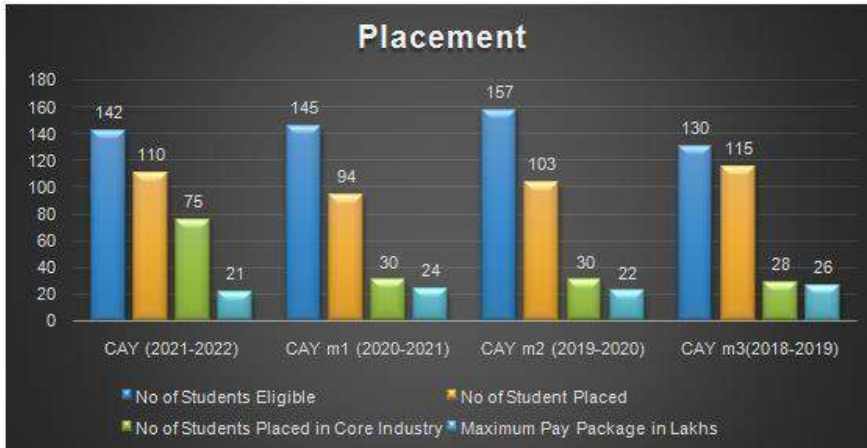
Consultancy Details:

Name of the Faculty	Year	Measurement	Revenue generated (Rs.)
Dr M G Veena	2022	Contact angle Measurement for thin PVC samples	1770/-
	2022	Contact angle Measurement	2950/-
	2022	Contact angle Measurement for polymer samples	1500/-
Dr M G Veena	2022	High frequency LCR meter Measurement	2970/-
	2022	Electro spinning (ESPIN)	10,620/-
	2022	Contact angle Measurement	3540/-
Dr M G Veena	2022	Contact angle Measurement	300/-
	2022	Contact angle Measurement	1770/-
	2022	Contact angle Measurement	300/-

Name of the teacher consultant	Name of consultancy project	Consulting/ Sponsoring agency with contact details	Year	Revenue generated (Rs.)
Dr N. M. Renukappa	Principal , JNNCE,Shivamogga	Consultancy service	2018	63,065/-
Dr N. M. Renukappa	JSSAHER	Consultancy service	2018	5000/-
Dr N. M. Renukappa	JSSATE Product Prototype development SIT, Tumkur Industries and Research Industries and Research	Consultancy service	2017	6000/-
		Texa, IIM Bangalore	2019	30000/-
		Consultancy service	2020	1,07,085/-
		Consultancy service	2020	11,001/-
		Consultancy service	2019	23,000/-



Employment Opportunities:



Higher Studies:



IIT Delhi
Indian Institute of Technology Delhi



Industry Institute Interaction:

Sl.No	Name	Semester	Details	Date
1.	Mr. Chandrashekara Murthy B N	4 th Sem students -43	Visit to NOKIA labs, Bangalore	25.09.2018
2.	Dr. Gayathri S and Prof. Sujathakumari B A	6 th Sem students	To attend BOSCH –Samukshitha - 2019 on occasion of international Women’s day	05.03.2019
3.	Dr. U B Mahadevaswamy	50 students of 4th Sem students	L&T Mysore	15,20,22 Feb 2019
4.	Ms. Supreetha M	(10 Female students)	Cisco: Women in Technology	14.03.2019
5.	Dr N M Renukappa	13 M.Tech Students	Pavagada Solar Park. SIT, Tumkur	13.04.2019
6.	Mr. Yashwanth S D Mr. Puneeth K M	45 Students	Visit to NOKIA – Labs at Bangalore	23.04.2019

Memorandum of Understanding (MOU’s):

The department has signed MoU’s with the following organizations:

1. MoU with JSSSTU and Nokia Solutions and Networks India Private Limited.
2. MHRD Funded E- Yantra lab was setup in the Dept.
3. JSS S&TU MoU with VALLES MARINERIS INTERNATIONAL PRIVATE LIMITED, Chennai
4. Bosch Global Software Technologies (BGSW), to start an industry elective course on Cyber Security and Industry 4.0.

Structure of Board of Studies:

Sl. No.	Category	Designation	Name of the Person	
1.	The Dean(s) of the Faculties	Ex-Officio Members	Dr. S B Kivade Principal, SJCE Mysore.	
2.	Dean (Academics)	Ex-Officio Members	Dr. B Manoj Kumar Professor, Dept of Environmental, Dean (Academics), JSS STU	
2.	Head of the Department	Chairperson	Dr. U B Mahadevaswamy Professor and Head, Department of E&C, SJCE-JSSSTU, Mysuru	
3.	All Professors of the Department	Members	1.	Dr.Shankaraiah N
			2.	Dr.Sudarshan Patil Kulkarni
			3.	Dr. M G Veena
4.	Two Senior Associate Professors of the concerned Department by Rotation	Members	1.	Dr S. Gayathri
			2.	Renuka B S
5.	One Senior Assistant Professor of the concerned Department by Rotation	Member	1.	Dr.Rudraswamy S B
6.	One external Subject Expert from any reputed academic/Research Institution/other universities Nominated by the Academic council	Members	1.	Dr. Hariprasad S A. Designation. Director - Faculty of Engineering and Technology Jain (Deemed-to-be University), Bengaluru-560069
			2.	Dr Ravish Aradya H V, Professor & Head, Department of Electronics and Communication Engineering, RVCE, Bengaluru -560059
7.	One external Subject Expert from any reputed academic/Research Institution/other universities Nominated by the vice Chancellor upon recommendation by theDean of Respective Faculty	Members	1.	Dr. Sushil Kumar Pandey Assistant Professor, Department of ECE, NITK, Surathkal - 575 025
			2.	Dr. P.C.Srikanth Professor & Head, Dean Planning &Development, MCE Hassan-573202.
8.	Two external Members From Concerned Industry/Government Departments/Public sectors undertakings/allied area relating to placement, nominated by the academic council upon recommendation by the Dean of respective faculty	Members	1.	Mr. Raghavendra B R Domain Manager, Intel, Bengaluru - 560103
			2.	Mr. Venkatasubramanian B Senior Systems Architect, Distinguished Member of Technical Staff (DMTS) at Nokia, Bengaluru - 560045
			3.	Dr. T Shreekanth Project Manager - Automotive, L&T Technology Services, Mysore.

9.	One postgraduate meritorious alumnus, to be nominated by the Head of the Department	Member	1.	Dr. Parameshwara S. Associate Professor & HoD, Dept. of Electronics & Communication Engineering, National Institute of Engineering, Mysuru. 570008
10.	The chairperson, Board of studies, may with the approval of the vice chancellor, co-opt as members: a) One external Subject Expert from reputed academic/Research Institution/other universities/industry/Government Departments/Public Sector undertakings, whenever special Courses of studies or to be formulated. b) Two other members of faculty of the concerned department.	Members	1.	Dr. Basavaraj Talawar Assistant Professors, Dept of CSE, NITK, Surathkal - 575 025
			2.	Dr. Suresh K V Professor, Dept. of Electronics & Communication Engineering Siddaganga Institute of Technology, Tumkur– 572103
			1.	B.A.Sujatha Kumari Associate Professor E&C Dept.SJCE-JSSSTU
			1.	A.Thyagaraja Murthy Associate Professor E&C Dept.SJCE-JSSSTU

▪ Programme Overview:

Semester Wise Credits

Semester	Credits	Total Marks
I	20	800
II	20	750
III	25	850*
IV	25	850*
V	25	850
VI	25	900
VII	19	600
VIII	16	300
Total	175	5900**

*For lateral entry students, total marks for III semester 900 and IV semester 900

**For lateral entry students total marks will be 4450

Grading System

Marks	Grade
90 – 100	S
75 – 89	A
66 – 74	B
56 – 65	C
50 – 55	D
45 – 49	E
< 45	F

Notation in the Scheme

CIE	Continuous Internal Evaluation
SEE	Semester End Examination
L	Lecture
T	Tutorial
P	Practical



Programme Educational Objectives:

1. To enable the graduates to have strong Engineering fundamentals in Electronics & Communication, with adequate orientation to mathematics and basic sciences.
2. To empower graduates to formulate, analyze, design and provide innovative solutions in Electronics & Communication, for real life problems.
3. To ensure that graduates have adequate exposure to research and emerging technologies through industry interaction and to inculcate professional and ethical values.
4. To nurture required skill sets to enable graduates to pursue successful professional career in industry, higher education, competitive exams and entrepreneurship.

Programme Outcomes:

1. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, 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 specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
4. **Conduct investigations of complex problems:** Using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of 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 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. **Lifelong Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Programme Specific Outcomes:

1. Analyze, design and provide engineering solutions in the areas of electronic circuits and systems.
2. Demonstrate the mathematical modeling techniques, nurture analytical and computational skills to provide engineering solutions in the areas of electronics and communication.
3. Ability to address multidisciplinary research challenges and nurture entrepreneurship.



Quality Policy of Department of Electronics and Communication Engineering:

1. To provide global standards of excellence in teaching and to remain accountable in our core and support functions\ through processes of self-evaluation and continuous improvement.
2. Enhancing the competence of the faculty to a very high level and to make them adopt all modern and innovative methods in teaching-learning process.
3. Inculcating moral and ethical values among the students and staff.
4. Collaborating with industry, other institutions and organizations for promoting Research and Development programme for the overall growth of the student.

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHEME OF TEACHING AND EXAMINATION FOR B.E - II - Year

SEMESTER: III

Sl. No	Subject code	Course title	Category Code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam duration in hours
						L	T/SDA	P	TOTAL		CIE	SEE	Total	
1	22MA310	Engineering Mathematics-III	BSC	Mathematics	Mathematics	3	0	0	3	3	40	60	100	03
	22MATDIP310	Foundations of Engineering Mathematics-I	BSC	Mathematics	Mathematics	3	0	0	3	0	0	50	50	03
2	22EC310	Circuit Theory and Analysis	PCC	ECE	ECE	3	2	0	5	4	40	60	100	03
3	22EC320	Sensors and Actuators	PCC	ECE	ECE	3	0	0	3	3	40	60	100	03
4	22EC330	Analog Electronic Circuits	PCC	ECE	ECE	3	0	2	5	4	40	60	100	03
5	22EC340	Digital System Design	PCC	ECE	ECE	3	0	0	3	3	40	60	100	03
6	22EC350	Communication Systems -I	PCC	ECE	ECE	3	0	0	3	3	40	60	100	03
7	22EC37L	Digital System Design Lab	PCCL	ECE	ECE	0	0	3	3	1.5	40	60	100	03
8	22EC38L	Hardware System Integration and Simulation Lab	PCCL	ECE	ECE	0	0	3	3	1.5	40	60	100	03
9	22HU311	Universal Human Values (UHV)	HSMC	ECE	HSMC	2	0	0	2	2	20	30	50	1.5
Total										25	Total marks		850*	

Note: L: Lecture/ Theory; T: Tutorial; P: Integrated Practical/ Practice; SDA: Skill Development Activities

BSC: Basic Science Course; PCC: Professional Core Course; HSMC: Humanity and Social Science and Management Course; PCCL: Professional Core Course Laboratory

*For lateral entry students' total marks is 900.

First Year Semester Credits	40
Total Semester Credits	25
Total Cumulative Credits	65

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHEME OF TEACHING AND EXAMINATION FOR B.E. IN - II - Year

SEMESTER: IV

Sl. No	Subject code	Course title	Category Code	Teaching Department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			Exam duration in hours
						L	T/SDA	P	TOTAL		CIE	SEE	Total	
1	22MA410	Engineering Mathematics IV	BSC	Mathematics	Mathematics	3	0	0	3	3	40	60	100	03
	22MATDIP410	Foundations of Engineering Mathematics-II	BSC	Mathematics	Mathematics	3	0	0	3	0	0	50	50	03
2	22EC410	Linear Integrated Circuits	PCC	ECE	ECE	3	0	2	5	4	40	60	100	03
3	22EC420	Microcontrollers and Embedded System	PCC	ECE	ECE	4	0	0	4	4	40	60	100	03
4	22EC430	Signals and Systems	PCC	ECE	ECE	3	2	0	5	4	40	60	100	03
5	22EC440	Communication Systems II	PCC	ECE	ECE	3	0	0	3	3	40	60	100	03
6	22EC450	Engineering Electromagnetics	PCC	ECE	ECE	4	0	0	4	4	40	60	100	03
7	22EC47L	Communication Lab I	PCCL	ECE	ECE	0	0	3	3	1.5	40	60	100	03
8	22EC48L	Microcontrollers and Embedded System Lab	PCCL	ECE	ECE	0	0	3	3	1.5	40	60	100	03
9	22HU412	Environmental studies***	HSMC	ENV	ENV	2	0	0	2	0	50	--	50	--
Total										25	Total marks		850**	

Note: L: Lecture/ Theory; T: Tutorial; P: Integrated Practical/ Practice; SDA: Skill Development Activities
BSC: Basic Science Course; PCC: Professional Core Course; HSMC: Humanity and Social Science and Management Course; PCCL: Professional Core Course Laboratory
*For lateral entry students total marks is 900

Total Semester Credits	25
Total Cumulative Credits	90

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION FOR B.E. IN - III - Year

SEMESTER: V

Sl. No	Subject code	Course title	Category Code	Teaching department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			SEE Duration in hours
						L	T/SDA	P	TOTAL		CIE	SEE	Total	
1	22EC510	Linear Algebra and Applications	PCC	ECE	ECE	3	2	0	5	4	40	60	100	03
2	22EC520	Microwave and Antennas	PCC	ECE	ECE	4	0	0	4	4	40	60	100	03
3	22EC530	Control Systems	PCC	ECE	ECE	3	2	0	5	4	40	60	100	03
4	22EC540	Digital Signal Processing	PCC	ECE	ECE	3	2	0	5	4	40	60	100	03
5	22EC55x	Professional Elective-I	PEC	ECE	ECE	3	0	0	3	3	40	60	100	03
6	22XX56x	Open Elective-I	OEC	ECE	ECE	3	0	0	3	3	40	60	100	03
7	22EC57L	Digital Signal Processing Lab	PCCL	ECE	ECE	0	0	3	3	1.5	40	60	100	03
8	22EC58L	Communication Lab II	PCCL	ECE	ECE	0	0	3	3	1.5	40	60	100	03
Total										25	Total marks		800	

Note: L: Lecture/ Theory; T: Tutorial; P: Integrated Practical/ Practice; SDA: Skill Development Activities

PCC: Professional Core Course; PEC: Professional Elective Course; OEC: Open Elective Course; HSMC: Humanity and Social Science and Management Course;

PCCL: Professional Core Course Laboratory

Professional Elective-I			
22EC551	Solid State Electronics	22EC554	Smart Electronics materials
22EC552	Neural Networks and Machine Learning	22EC555	Data structures and Algorithm
22EC553	Principles of wireless communication systems		

Total Semester Credits	25
Total Cumulative Credits	115

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHEME OF TEACHING AND EXAMINATION FOR B.E. IN - III - Year

SEMESTER: VI

Sl. No	Subject code	Course title	Category Code	Teaching department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			SEE Duration in hours
						L	T / SDA	P	TOTAL		CIE	SEE	Total	
1	22EC610	Information Theory and Coding	PCC	ECE	ECE	4	0	0	4	4	40	60	100	03
2	22EC620	Computer Networks	PCC	ECE	ECE	4	0	0	4	4	40	60	100	03
3	22EC630	CMOS VLSI Circuits	PCC	ECE	ECE	3	0	0	3	3	40	60	100	03
4	22EC64x	Professional Elective-II	PEC	ECE	ECE	3	0	0	3	3	40	60	100	03
5	22XX65x	Open Elective-II	OEC	ECE	ECE	3	0	0	3	3	40	60	100	03
6	22XX66x	Open Elective-III	OEC	ECE	ECE	3	0	0	3	3	40	60	100	03
7	22EC67L	CMOS VLSI Lab	PCCL	ECE	ECE	0	0	3	3	1.5	40	60	100	03
8	22EC68L	Networking - Lab	PCCL	ECE	ECE	0	0	3	3	1.5	40	60	100	03
9	22EC69P	Design and Implementation Lab (Mini Project)	PWC	ECE	ECE	0	0	4	4	2	50	--	50	--
10	22HU612	Constitution of India and Professional Ethics	HSMC	Humanities	HSMC	2	0	0	2	--	50	--	50	--
Total										25	Total marks		900*	

Note: L: Lecture/ Theory; T: Tutorial; P: Integrated Practical/ Practice; SDA: Skill Development Activities

PCC: Professional Core Course; PEC: Professional Elective Course; OEC: Open Elective Course; HSMC: Humanity and Social Science and Management Course; PCCL: Professional Core Course Laboratory

Open elective is open to all the students excluding the students of parent program Team Size for Mini project can be between 2 - 4.

*If constitution of India (22HU611) is offered in VI Semester the total marks will be 900 and if not offered the total marks will be 850.

Professional Elective-II			
22EC641	Robotics and Computer Vision	22EC645	Mechatronics
22EC642	Nanodielectrics: Challenges and Opportunities	22EC646	Operating Systems
22EC643	Modern Wireless Communication systems	22EC647	Automotive Cyber Security
22EC644	Digital Image Processing	22EC648	Advance 5G

Total Semester Credits	25
Total Cumulative Credits	140



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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION FOR B.E. IN - IV - Year

SEMESTER: VII

Sl. No	Subject code	Course title	Category Code	Teaching department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			SEE Duration in hours
						L	T / SDA	P	TOTAL		CIE	SEE	Total	
1	22EC710	Innovation, Entrepreneurship and Management	HSMC	ECE	ECE	4	0	0	4	4	40	60	100	03
2	22EC72x	Professional Elective-III	PEC	ECE	ECE	3	0	0	3	3	40	60	100	03
3	22EC73x	Professional Elective-IV	PEC	ECE	ECE	3	0	0	3	3	40	60	100	03
4	22XX74x	Open Elective-IV	OEC	ECE	ECE	3	0	0	3	3	40	60	100	03
5	22XX75x	Open Elective-V	OEC	ECE	ECE	3	0	0	3	3	40	60	100	03
6	22EC76P	Project Work Phase - 1	PWC	ECE		--	--	4	4	2	50	--	50	--
7	22EC77P	Industrial training /Internship / Technical Seminar	PWC	ECE		0	0	1	1	1	50	--	50	--
Total										19	Total marks		600	

Note: L: Lecture/ Theory; T: Tutorial; P: Integrated Practical/ Practice; SDA: Skill Development Activities; PEC: Professional Elective Course; OEC: Open Elective Course; PWC: Project Work Course
 Open elective is open to all the students excluding the students of parent program
 Team Size for Project can be between 2-4.
 Students can take SWAYAM courses from 3rd semester to 6th semester and qualification certificate is to be submitted to the department before the commencement of 7th semester for considering in Professional elective IV* offered in 7th Semester.
 HOD shall prepare the list of courses offered under SWAYAM and it should be minimum of 12 weeks (12 weeks or 8+4 or 4+4+4 or any other combination).
 Students who could not qualify/ complete the SWAYAM course from 3rd to 6th semesters should register for professional elective-IV in 7th semester.
 Open elective is open to all the students excluding the students of parent program.

Total Semester Credits	19
Total Cumulative Credits	159





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(Effective from the academic year 2022-23)

Professional Elective-III		Professional elective-IV*	
22EC721	Speech Processing using Deep Learning	22EC731	Nanoscience and Technology
22EC722	Embedded Systems	22EC732	Statistical Signal Detection and Processing
22EC723	Internet of Things (IoT)	22EC733	Cryptography and Network Security
22EC724	Quantum computing and Communication	22EC734	Wavelet and compression techniques
22EC725	Bio Medical Signal Processing	22EC735	Advanced Computer Networks
22EC726	Protocol Engineering	22EC736	Deep Learning for Computer Vision





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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHEME OF TEACHING AND EXAMINATION FOR B.E. IN - IV - Year

SEMESTER: VIII

Sl. No	Subject code	Course title	Category Code	Teaching department	QP Setting Dept.	Teaching Hours per Week				Credits	Marks			SEE Duration in hrs.
						L	T/SDA	P	TOTAL		CIE	SEE	Total	
1	22EC81x	Professional Elective-V	PEC	ECE	ECE	3	0	0	3	3	40	60	100	03
2	22EC82x	Professional Elective-VI	PEC	ECE	ECE	3	0	0	3	3	40	60	100	03
3	22EC83P	Project work Phase - 2	PWC			--	--	20	20	10	40	60	100	03
Total										16	Total marks		300	

Note: L: Lecture/ Theory; T: Tutorial; P: Integrated Practical/ Practice; SDA: Skill Development Activities; PEC: Professional Elective Course; PWC: Project Work Course

The evaluation of the project work shall be done in four phases. 70 % weightage shall be given for the performance of the student in 1st (20 Marks), 2nd (20 Marks) and 3rd phase (30 Marks) evaluation (CIE) and 30 Marks for 4th phase evaluation (SEE).

Project Evaluation (Phase 1, 2 & 3) should be done at the department Level Immediately after the 1st, 2nd and 3rd Theory test respectively.

Three-member committee shall be formed (including the guide) at the department level to evaluate the project progress in phase 1, 2 & 3.

This same committee will evaluate and finalize the CIE in all the phases along with guide.

Project team size can be 2-4.

Total Semester Credits	16
Total Cumulative Credits	175

Professional Elective-V		Professional Elective-VI	
22EC811	Automotive Electronics	22EC821	Low power VLSI
22EC812	Cloud Computing	22EC822	Mobile Computing
22EC813	Digital Compression Techniques	22EC823	Assistive Technology
22EC814	Advanced Embedded System	22EC824	Advanced Vehicular Network
22EC815	Operations Research	22EC825	Optical Networks and Sensors





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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

Category Code:

- BSC – Basic Science Course**
- ESC – Engineering Science Course**
- PCC – Professional Core Course (Including Laboratory subjects)**
- PEC – Professional Elective Course**
- OEC – Open Elective Course**
- HSMC – Humanities Social Science and Management Course**
- PWC – Project Work Course**





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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

List of SWAYAM Courses identified by the department (for Professional Elective – IV): (Students can complete 12 Weeks of SWAYAM course/s between 3-6th Semester to claim exemption for Professional Elective - IV)

(Note: Student can take any of SWAYAM course in the following list or any other SWAYAM course after taking approval from HOD)

SL. No.	Course Name	No. of Weeks	SL. No.	Course Name	No. of Weeks
1	Foundations of Cryptography	12 Weeks	26	Data Mining	8 Weeks
2	Quantum Algorithms and Cryptography	12 Weeks	27	Ethical Hacking	12 Weeks
3	An Introduction to Artificial Intelligence	12 Weeks	28	Object Oriented System Development Using UML, Java	12 Weeks
4	Introduction to Embedded System Design	12 Weeks	29	Blockchain and its Applications	12 Weeks
5	Advanced Computer Architecture	12 Weeks	30	Computer Networks and Internet Protocol	12 Weeks
6	Data Analytics with Python	12 Weeks	31	Introduction To Internet of Things	12 Weeks
7	Artificial Intelligence: Knowledge Representation	12 Weeks	32	Introduction To Industry 4.0 And Industrial Internet of	12 Weeks
8	Information Security - 5 - Secure Systems	8 Weeks	33	Embedded Systems Design	12 Weeks
9	Machine Learning, ML	8 Weeks	34	Deep Learning	12 Weeks
10	Privacy and Security in Online social media	12 Weeks	35	Hardware Security	12 Weeks
11	AI: Constraint Satisfaction	8 Weeks	36	Discrete Structures	12 Weeks
12	Programming, Data Structures and Algorithms	8 Weeks	37	GPU Architectures and Programming	12 Weeks
13	Data Science for Engineers	8 Weeks	38	Foundations of Cyber Physical Systems	12 Weeks
14	Introduction to Machine Learning	12 Weeks	39	Foundation of Cloud IoT Edge ML	8 Weeks
15	Social Networks	12 Weeks	40	Physics of Nanoscale Devices	12 Weeks
16	The Joy of Computing using Python	12 Weeks	41	Basic Tools of Microwave Engineering	4 Weeks
17	Python for Data Science	4 Weeks	42	Millimeter Wave Technology	8 Weeks
18	Deep Learning - IIT Ropar	12 Weeks	43	Fundamentals Of MIMO Wireless Communication	8 Weeks
19	Cloud Computing and Distributed Systems	8 Weeks	44	Discrete Time Signal Processing	8 Weeks
20	Systems and Usable Security	4 Weeks	45	Signal Processing Techniques and its Applications	12 Weeks
21	Secure Computation: Part I	12 Weeks	46	Communication Networks	12 Weeks
22	Advanced Computer Networks	12 Weeks	47	Analog Circuits and Systems Through SPICE	12 Weeks
23	Affective Computing	12 Weeks	48	Spread Spectrum Communications and Jamming	12 Weeks
24	Circuit Complexity Theory	12 Weeks			
25	Cloud Computing	12 Weeks			

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

List of open electives offered by the department of Electronics and Communication Engineering

Sl. No.	Semester :elective	Course Code	Course Title
1	5: Open Elective – 1	22EC561	CMOS VLSI Circuits
2		22EC562	Sensors and Actuators
3		22EC563	Wireless Communication
4		22EC564	Control Systems
5		22EC565	Smart Materials
6	6: Open Elective – 2	22EC651	Nanoscience and Technology
7		22EC652	Automotive Electronics
8		22EC653	Smart Agricultural Technology
9		22EC654	Low power VLSI
10		22EC655	Artificial Intelligence and Deep Learning
11	6: Open Elective – 3	22EC661	Bioelectronics and Biosensors
12		22EC662	Optimization Techniques for Engineers
13		22EC663	Professional Communication and technical Report Writing.
14		22EC664	Verilog HDL
15		22EC665	Power Electronics
16	7: Open Elective – 4	22EC741	Product Design and development
17		22EC742	Hybrid Vehicles
18		22EC743	Deep learning for NLP
19		22EC744	Application Specific Integrated Circuits
20		22EC745	Embedded Systems
21	7: Open Elective - 5	22EC751	Analog and Mixed Mode VLSI
22		22EC752	Wireless Sensor Networks
23		22EC753	Mobile Computing
24		22EC754	Robotics and Computer Vision
25		22EC755	Industrial Automation
26		22EC756	Fundamentals of Telecommunication systems

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23)

Subject Break up of credits AICTE / Adapted

Sl. No.	Category	Suggested break up of credits	
		AICTE	Adapted scheme
1.	Humanities & Social Sciences including Management courses	12	08
2.	Basic Science courses	25	25
3.	Engineering Science courses	24	23
4.	Professional core courses	48	70
5.	Professional elective courses	18	18
6.	Open electives	18	15
7.	Project work/internship/seminar	15	15
8.	Mandatory courses (noncredit)	3 non-credit courses	Same courses are offered
Total		160	175

Distribution of Credits among various Curricular Components

Curricular Components /Semester	I	II	III	IV	V	VI	VII	VIII	Course Total	Percentage
Humanities and Social Sciences, Management (HS)	1	1	2				4		8	4.57 %
Basic Science (BS)	9.5	9.5	3	3					25	14.28%
Engineering Science (ES)	9.5	9.5							19	10.85%
Professional Core (PC)			20	22	19	14			75	42.85 %
Professional Elective (PE)					3	3	6	6	18	10.28%
Open Elective (OE)					3	6	6		15	8.57%
Project / Mini Project(P)						2	2	10	14	8.00 %
Seminar – Internship(S)							1		1	0.57 %
Non Credit Mandatory (NC)				1	1	1				0
Total Credits	20	20	25.0	25.0	25.0	25.0	19.0	16.0	175	99.97%*

Detailed Syllabus

Evaluation Scheme for Theory (Credit) Course:

Continuous Internal Evaluation – CIE

Event	Event Type	Marks Allotted	Duration
CIE – 1	Written Test – 1	30	1 Hour
CIE – 2	Event	20	----
CIE – 3	Written Test – 2	30	1 Hour

Note:

1. Both the written test 1 and 2 (CIE – 1 & CIE - 3) shall be conducted for 30 marks each in 1 hour duration and the marks scored will be reduced proportionately to 15 marks each.
2. The Event (CIE – 2) will be conducted for 20 marks and the marks scored will be reduced proportionately to 10 marks.
3. The Event (CIE – 2) will be skill-based assessment such as Assignment/ Technical presentation/ Case study / hands-on activity / Mini projects / Sci-tech activity / Data analysis and other event that can enhance the skill development in that course.
4. A student must score an average of 50% i.e., 20 marks out of 40 from all the events (CIE - 1, 2, 3) to gain the eligibility to appear for SEE in addition to attendance requirements.
5. An additional CIE event may be provided for **slow learners** who could not score average of 20 marks.
6. Additional test may be provided for the students who could not attend either CIE-1 or CIE-3 with valid reason such as attending university events/ sports/university placement activities and on health grounds. Such students have to produce valid certificate/documents provided the student should have minimum 75 % attendance.

Semester End Examination (SEE)

Exam	Event Type	Maximum Marks	Duration
SEE	Written Examination	100	3 Hours

Note:

1. SEE will be conducted for 100 marks and the marks scored will be proportionately reduced to 60 marks. A student must score a minimum of 24 marks out of 60 in the SEE. However, for passing in a course the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24).
2. SEE Question paper will be set for 100 marks and will have two parts (Part-A & Part-B). Questions under Part-A are compulsory and questions under Part-B will have internal choices.

Evaluation Scheme for Theory (Non-Credit) Course:

Continuous Internal Evaluation – CIE

Event	Event Type	Marks Allotted	Duration
CIE – 1	Written Test – 1	30	1 Hour
CIE – 2	Event	20	----
CIE – 3	Written Test – 2	30	1 Hour

Note:

1. Both the written test 1 and 2 (CIE – 1 & CIE - 3) shall be conducted for 30 marks each in 1 hour duration and the marks scored will be reduced proportionately to 15 marks each.
2. The Event (CIE – 2) will be conducted for 20 marks and the marks scored will be reduced proportionately to 10 marks.
3. The Event (CIE – 2) will be skill-based assessment such as Assignment/ Technical presentation/ Case study / hands-on activity / Mini projects / Sci-tech activity / Data analysis and other event that can enhance the skill development in that course.
4. A student must score an average of 50% i.e., 20 marks out of 40 from all the events (CIE - 1, 2, 3) to gain the eligibility to appear for SEE in addition to attendance requirements.
5. An additional CIE event may be provided for **slow learners** who could not score average of 20 Marks.
6. Additional test may be provided for the students who could not attend either CIE-1 or CIE-3 with valid reason such as attending university events/ sports/ university placement activities and on health grounds. Such students have to produce valid certificate/documents provided the student should have minimum 75 % attendance.

Evaluation Scheme for Practical Course:

Continuous Internal Evaluation – CIE

Event	Event Type	Marks Allotted	Duration
CIE – 1	Experiments / Programs / Models	30	3 Hours/ Experiment
CIE – 2	Internal Test	20	3 Hours

Note:

1. The experiments / program / models should be designed to be conducted for three hours in each laboratory session.
2. A student will perform all the experiments / programs / models in a semester by performing experiments/ execute programs / preparing models per week and the student will be evaluated every week for each practical session as per the procedures mentioned in the evaluation policy.
3. The marks scored from experiments / programs / models will be reduced proportionately to 30 marks at the end of the semester.
4. An internal test in the 13th week of the semester will be conducted after the completion of all the practical sessions as per the procedures mentioned in the evaluation policy and the marks secured will be reduced proportionately to 10 marks.
5. The sum of marks scored from experiments / programs / models for 30 marks and from the internal test for 10 marks will be the final Continuous Internal Evaluation (CIE) marks.
6. A student must score a minimum of 20 marks out of 40 to gain the eligibility for SEE in addition to attendance criteria of 75 %.
7. SEE will be conducted for 100 marks as per the Standard Operating Procedure provided for conduction of practical examination. In SEE a student must perform or execute the experiments / programs / models in 3hours.
8. A student must score a minimum of 24 marks out of 60 marks in the SEE.
9. The total passing marks in the laboratory courses is 45 out of 100 (CIE + SEE: 20 + 25 or 21 + 24).



Evaluation Scheme for Integrated (Credit) Course:

Continuous Internal Evaluation – CIE

Event	Event Type	Marks Allotted	Duration
CIE – 1	Written Test – 1	30	1 Hour
CIE – 2	Lab Component	20	----
CIE – 3	Written Test – 2	30	1 Hour

Note:

1. Both the written test 1 and 2 (CIE – 1 & CIE - 3) shall be conducted for 30 marks each in 1 hour duration and the marks scored will be reduced proportionately to 15 marks each.
2. The experiments / program / models should be designed to be conducted for two hours in each laboratory session.
3. A student will perform all the experiments / programs / models in a semester by performing experiments/ execute programs / preparing models per week and the student will be evaluated every week for each practical session as per the procedures mentioned in the evaluation policy.
4. The marks scored from experiments / programs / models will be reduced proportionately to 10 marks at the end of the semester.
5. An internal test / CIE in the 6th week / 13th week of the semester will be conducted as per the procedures mentioned in the evaluation policy and the marks secured will be reduced proportionately to 10 marks.
6. The sum of marks scored from experiments / programs / models for 10 marks and from the internal test for 10 marks will be the final Continuous Internal Evaluation (CIE) marks.
7. A student must score an average of 50% i.e., 20 marks out of 40 from all the events (CIE - 1, 2, 3) to gain the eligibility to appear for SEE in addition to attendance requirements.
8. An additional CIE event may be provided for **slow learners** who could not score average of 20 marks.
9. Additional test may be provided for the students who could not attend either CIE-1 or CIE-3 with valid reason such as attending university events/ sports/university placement activities and on health grounds. Such students have to produce valid certificate/documents provided the student should have minimum 75 % attendance.

Semester End Examination (SEE)

Exam	Event Type	Maximum Marks	Duration
SEE	Written Examination	100	3 Hours

Note:

1. SEE will be conducted for 100 marks and the marks scored will be proportionately reduced to 60 marks. A student must score a minimum of 24 marks out of 60 in the SEE. However, for passing in a course the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24).
2. SEE Question paper will be set for 100 marks and will have two parts (Part-A & Part-B). Questions under Part-A are compulsory and questions under Part-B will have internal choices.

EVALUATION SCHEME FOR MINIPROJECT:

Evaluation Component	Marks
Interim review presentation: Relevance of the Domain and Literature survey; Open issues identification and problem statement; Aim, objectives and statement.	20
Final Presentation: Result and Discussion; Presentation and Documentation in the form of Report.	30
Total	50

EVALUATION SCHEME FOR PROJECT WORK PHASE I:

Evaluation Component	Marks
EVALUATION 1: Problem formulation, analysis and design, Relevance of the problem, Ethical and Societal issues, Communication Skills, Teamwork	20
EVALUATION 2: Design Process, Planning and scheduling, Feasibility analysis, Budgetary aspects, Teamwork	30
Total	50

EVALUATION SCHEME FOR SEMINAR:

Evaluation Component	Marks
EVALUATION 1: Problem formulation, analysis and design, Relevance of the problem, Ethical and Societal issues, Communication Skills, Teamwork	20
EVALUATION 2: Design Process, Planning and scheduling, Feasibility analysis, Budgetary aspects, Teamwork	30
Total	50

EVALUATION SCHEME FOR PROJECT WORK PHASE II:

Evaluation Component	Marks
EVALUATION 1: Presentation of the problem, Clarity and concepts, Innovative approach, Scheduling the work and adherence	20
EVALUATION 2: Progress as per schedule, Fabrication details and status, Presentation and intermediate results	20
EVALUATION 3: Demonstration of working, Completion of the work, Presentation of the work, Queries, Innovation and application.	25
REPORT	15
Total	80 Note: Total 80 Marks is reduced to 40 Marks.



Detailed Syllabus

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC110/ 22EC210	<i>Total Credits</i>	3:0:0	<i>Course Type</i>	Engineering Science		
<i>Course Title</i>	Elements of Electronics Engineering						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>		<i>Assessment in Weightage and marks</i>		
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

Course Overview: In this course student will learn about the basics of electronics which include working of diodes, transistors, FETs, Operational amplifier, digital circuits, communication system and devices. This course bridges the gap for the students by introducing them building blocks of hardware and embedded firmware in a computer system.

Pre requisites: Basic Principles Physics

Course Objective: To understand the Fundamental Concepts of Electronics Engineering.

Course Outcome: After completing this course, student will be able to:

CO#	Course Outcome	Highest Cognitive Domain
CO1	Analyze the working of various diode circuits and explore its applications.	L2
CO2	Explain the working of BJT and MOSFET with applications.	L2
CO3	Apply the digital logic to build the combinational and sequential circuits.	L3
CO4	Design the circuit using ICs for the given specifications (741, 723, and 555).	L3
CO5	Explain the principles of communication	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Unit-1 Semiconductor Diodes <i>Diode:</i> Construction and working, Characteristics (ideal and practical), Diode resistances, Load line analysis. <i>Applications of Diode:</i> Rectifiers – Half wave, Full wave (Center tapped and Bridge) with and without C filter (only qualitative analysis), Basic Clipper and Clamper circuits. <i>Zener diode and Photo diode:</i> Construction, Working and Characteristics	8	0
2	Unit-2 Transistors <i>BJT:</i> Construction and working, Common Emitter Characteristics with load line analysis. <i>Applications:</i> Switch and Amplifier <i>JFET:</i> Construction, Working and Characteristics. <i>MOSFET:</i> N type and P type (Depletion and Enhancement Mode) Construction, Working and Characteristics. <i>Applications:</i> NOT, NAND, NOR gates using MOSFETs.	8	0
3	Unit-3: Digital Electronics Review of Conversion of Data (Binary to Decimal and Vice versa), Binary arithmetic's operation, 1's and 2's Complement subtraction, Basic and universal Logic Gates, simplification and realization of Boolean expression using basic gates. <i>Combinational logic:</i> Half adder, Full adder, Half subtractor, Full subtractor, 2:1 and 4:1 MUX, 1:2 and 1:4 DEMUX, 1Bit Magnitude comparator <i>Sequential logic:</i> Latch, Flip flops (SR, JK, D, T), 4 bit Synchronous and Asynchronous up counter, 4bit Shift registers	8	0
4	<i>Differential amplifier:</i> Operation with respect to common mode and differential inputs. <i>Op-amps:</i> Block diagram, Ideal and Practical characteristics, Inverting and Non inverting amplifier, Saturable property. <i>Applications of Op-amp:</i> Voltage follower, Adder, Subtractor, Integrator and Differentiator, 78XX IC regulators, Digital IC (TTL Nand Gate), 555 Timer Circuit (Astable Multivibrator).	8	0
5	Unit-5: Communication Basics EM spectrum and Applications, Block diagram of Analog and Digital Communication System, Need for Modulation, AM and FM, ASK and FSK (Qualitative analysis only), Principles of Mobile communication, Basics of Computer Communication, MODEM.	7	0

Text Books:

1. Robert Boyelstad: "Electronic Devices and circuit theory", 11th Edition, Pearson, 2015.
2. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th Edition, Pearson, 2015

Reference Books:

1. Floyd and Jain, “Digital Fundamentals”, 11th Edition, Pearson, 2017.
2. B.P. Lathi and Zhi Ding , “Modern Digital And Analog Communication Systems: 4th Edition (Paperback) South Asia edition, Oxford 2017.

Web/Digital resources:

- 1 EBook: <http://www.freebookcentre.net/Electronics/Communication-Books.html>
- 2 EBook: <http://www.freebookcentre.net/Electronics/Devicesandequipments-Books.html>
- 3 Video Lecture: <http://nptel.ac.in/courses/108102095/>

SWAYAM/NPTEL:**PRACTICE BASED LEARNING: NIL****Self-Learning Exercises: NIL****Mini Projects: From Unit 3 and Unit 4****Course Articulation:**

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	3	3													
CO2	3	3	3													
CO3	3	3	3	2	2				2	2						
CO4	3	3	3	2	2				2	2						
CO5	3	3	3													
Avg	3	3	3	2	2				2	2						

High – 3, Medium – 2, Low – 1



DEPARTMENT	Mathematics						
Course Code	22MA310	Total Credits	03	Course Type	Basic Science Course		
Course Title	Engineering Mathematics-III (Common to ECE, EEE and E&I)						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	03		CIE	SEE	Total
	Tutorial	00	00	Weightage	40 %	60 %	100 %
	Practical	--	--	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	03	Minimum Marks	20 marks	25 marks	*45 Marks

Pre requisites: Engineering Mathematics-I and Engineering Mathematics-II

Course objectives: This course will enable students to:

1. To develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion.
2. Learn the concepts of consistency, solve linear system of equations and Diagonalization
3. To introduce the concept of analytic function and understand the concepts of calculus of functions of complex variables.
4. To introduce the concept of complex variables to evaluate the integrals.
5. Learn to represent a periodic function in terms of sine and cosine functions.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain
CO1	Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data.	L1, L2
CO2	Test the system of linear equations for consistency, Linear Independence and Dependence. Determine and describe the characteristic equation, Eigen vectors and Diagonalization.	L1, L2., L3
CO3	Examine and construct the analytic functions.	L1, L2
CO4	Classify singularities of complex functions and evaluate complex integrals.	L1, L2
CO5	Construct the Fourier series expansion of a function/tabulated data.	L1, L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3	1										
CO3	3											
CO4	3											
CO5	3	1										

High – 3, Medium – 2, Low – 1

PO1: ability to apply knowledge of Mathematics

PO2: ability to analyze engineering problems

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
UNIT 1	Statistics: Introduction, Definitions, Curve Fitting, equation of Straight line, parabola and exponential, correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines.	8	--
UNIT 2	Linear Algebra: System of linear equations, Row operations, Echelon form Reduced Echelon form, Solution of Homogeneous and Non-homogeneous equations, vector equations, Linear combinations, Linear independent/dependent vectors, Eigen values, Eigen vectors, Diagonalization.	8	--
UNIT 3	Complex Variables-I: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Construction of analytic functions and Harmonic Conjugates. Bilinear transformation.	8	--
UNIT 4	Complex Variables-II: Complex integration, Cauchy theorem, Cauchy integral formula, Taylor and Laurent series (statements only), Singularities, Poles and residues, Cauchy residue theorem.	8	--
UNIT 5	Fourier Series: Periodic functions, Fourier Expansions, Half Range Expansions, Complex form of Fourier series, Practical Harmonic Analysis.	7	--

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, 2015, Khanna Publishers
2. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition (Reprint), 2016, John Wiley & Sons.

Reference Books:

1. N. P. Bali and Manish Goyal, A Textbook of Engineering Mathematics, Vol. I & II (AICTE), 10th Edition, Laxmi Publications Pvt Ltd, 2019.
2. Maurice D. Weir, Joel R. Hass and George B. Thomas, Thomas' calculus: Early Transcendentals, 12th edition, Pearson Education, 2016.
3. B. V. Ramana, Higher Engineering Mathematics, 11th edition, Tata-McGraw Hill, 2010.
4. Peter V.O 'Neil, Advanced Engineering Mathematics, 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012.

Web/Digital resources:

1. <https://www.classcentral.com/subject/maths>
2. <https://academicearth.org/>



DEPARTMENT	Mathematics						
Course Code	22MATDIP310	Total Credits	00	Course Type	Basic Science Course		
Course Title	Foundations of Engineering Mathematics-I (For III Semester Lateral Entry Students)						
Teaching Learning Process	Contact Hours	Credits	Assessment in Weightage and marks				
	Lecture	03	00		CIE	SEE	Total
	Tutorial	00	00	Weightage	50%	--	50 %
	Practical	--	--	Maximum Marks	50 Marks	--	50 Marks
	Total	03	00	Minimum Marks	25 Marks	--	25* Marks

Note: * This course is slated for CIE only and has no SEE. For passing the student has to score a minimum of 25 Marks (CIE: 25)

Pre requisites: Basics in Differential calculus, Integral calculus and Vectors.

Course objectives: This course will enable students to:

1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.
3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain
CO1	Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the amount of bending of the curve.	L1, L2
CO2	Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions.	L1, L2
CO3	Illustrate the applications of multivariate calculus to understand the characteristics of vector field.	L1, L2
CO4	Understand how a function of single variable can be expanded as a Taylor's series and handle the indeterminate form	L1, L2
CO5	Apply the analytical methods to solve first order and first-degree differential equations and solve some Engineering problems.	L1, L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											
CO4	3											
CO5	3											

High – 3, Medium – 2, Low – 1

PO1: ability to apply knowledge of Mathematics

Course Content / Syllabus:

UNIT No.	Content	Hours
UNIT 1	Differential Calculus-I: Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof)	Lecture 8
UNIT 2	Differential Calculus-II: Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians.	Lecture 8
UNIT 3	Differential Calculus-III: Taylor's and Maclaurin's series expansions for one variable (statement only). Indeterminate forms L' Hospital Rule (without proof) (Only $0, \infty, \frac{0}{0}, \frac{\infty}{\infty}$ and $\infty - \infty$ form)	Lecture 8
UNIT 4	Vector Calculus: Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems.	Lecture 7
UNIT 5	Differential Equations-I: Solution of first order and first-degree differential equations: Variable Separable, Linear differential equations and Exact differential equations.	Lecture 8

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, 2015, Khanna Publishers.
2. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition (Reprint), 2016, John Wiley & Sons.
3. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical methods for scientific and engineering computation, 6th Edition, 2012, New Age International Publishers.

Reference Books:

1. N. P. Bali and Manish Goyal, A Textbook of Engineering Mathematics, Vol. I & II (AICTE), 10th Edition, Laxmi Publications Pvt Ltd, 2019.
2. Maurice D. Weir, Joel R. Hass and George B. Thomas, Thomas' calculus: Early Transcendentals, 12th edition, Pearson Education, 2016.
3. B. V. Ramana, Higher Engineering Mathematics, 11th edition, Tata-McGraw Hill, 2010.
4. Peter V.O 'Neil, Advanced Engineering Mathematics, 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012.

Web/Digital resources:

1. <https://www.classcentral.com/subject/maths>
2. <https://academicearth.org/>



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC310	<i>Total Credits</i>	4	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Circuit Theory and Analysis						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	26	1	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	65	4	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

Course Prerequisite: Basics of electrical engineering.

COURSE OBJECTIVE:

1. To solve electrical circuits using analysis techniques and theorems.
2. To analyze circuits using transform techniques.

COURSE OUTCOMES (COs): After completing the course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Analyze AC/DC circuit using various techniques.	L4
CO2	Apply network theorems to solve AC/DC circuits.	L3
CO3	Solve problems on resonance and transformation techniques.	L4
CO4	Demonstrate the skill sets using software tools for simulation of circuit problems.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Basic concepts: Introduction, Network terminologies, Energy sources, Mesh Analysis of DC and AC circuits, Circuits with independent voltage sources only Mesh analysis – circuits containing independent current sources and dependent sources, Concept of super mesh, Nodal analysis - Circuits containing independent current sources, Nodal analysis – circuits containing dependent sources, Concept of super node, Star – Delta transformations and network reduction using them, Source transformations and related problems.	8	6
2	Network Theorems: Superposition theorem, problems. Thevenin's theorem as applied to AC and DC circuits, Norton's theorem as applied to DC and AC circuits, Maximum power transfer theorem as applied to DC and AC circuits, Mill man's theorem, applications and problems.	8	5
3	Resonance and Initial Conditions: Series resonance, resonant frequency, reactance curves, voltage and current variable with frequency, Selectivity and bandwidth, Q – factor, circuit magnification factor Selectivity with variable C and variable L Parallel resonance, resonant frequency, impedance, selectivity, and bandwidth. Maximum impedance conditions with C, L, and f variable. Need for Initial conditions in R, L, and C elements. Final conditions and Geometrical interpretation of derivatives, Procedure to evaluate initial conditions. Initial state of a network.	8	5
4	Circuit Analysis using Laplace Transforms and Fourier series: Review of Laplace transforms, Circuit analysis with LT using partial fraction expansion and convolution integral. Natural and Forced responses, Advantages of LT techniques, Modeling R, L, and C in s – domain, DC transients, Step response of RC, RL and RLC circuits, Impulse and Pulse response of RC and RL circuits and AC transients. Applications of Fourier techniques to circuit analysis, Waveform symmetry, Line spectrum, Waveform synthesis, Application of FS in circuit Analysis.	8	5
5	Network Functions and Two Port parameters: Network functions for one and two – port networks, driving point functions and transfer functions. Short – Circuit admittance parameters, Open circuit impedance parameters, Transmission parameters, Hybrid parameters, problems, Relationships between parameters, problems.	7	5

Text Books:

1. Charles K Alexander, Mathew N. O. Sadiku (2016), “*Fundamentals of Electric Circuits*” 5th Edition, McGraw Hill Education (India) Pvt Ltd, New Delhi.
2. J. David Irwin, Robert M Nelms (2013), “*Engineering Circuit Analysis*”, 10 Edition, Wiley India Pvt Ltd.

Reference Books:

1. M.E. VanValkenburg (2006), “*Network Analysis*”, 3rd edition, Pearson/ PHI.
2. D. Roy Choudhury (2005), “*Networks and Systems*”, New Age International.

Journals/Magazines:

<https://onlinelibrary.wiley.com/journal/1097007X>

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/108102042/3>
2. <https://nptel.ac.in/courses/117106108>
3. <https://play.google.com/store/apps/details?id=com.education.nptelee&hl=en>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/ Ability
1	Unit 1 to 3	Open-source software. Viz., Tina-t, Multisim etc.	Team work, communication skill

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3									3		
CO2	3	3	3	3									3	2	
CO3	3	3	3	3									3	2	
CO4	3	3	3	3	3			2	2						

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC320	<i>Total Credits</i>	3	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Sensors and Actuators						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Students should be familiar with basic concepts and fundamentals of electronics, physics and chemistry.

COURSE OBJECTIVE:

1. To understand the working principles of sensors and actuators and explore their applications.
2. To build a system using sensors and actuators for different applications.

COURSE OUTCOMES (COs): After the completion of the course the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the working principle of transducers, sensors and actuators.	L2
CO2	Identify the type of sensor, transducers required for a particular application.	L3
CO3	Explain the application areas of transducers, sensors and actuators	L2
CO4	Develop a system by interfacing sensors, actuators and transducers.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorials
1	Instrumentation system and Transducers: Introduction, generalized functional block diagram, input output configuration, Advantages of Electronic measurement, Errors in measurement, Types of Errors, static characteristics, dynamic characteristics, calibration and standards, process of calibration. Transducers, Selecting a transducer, Electrical transducers, Resistive transducer, Resistive position transducer, Strain gauges.	8	0
2	Analog Sensors and Transducers: Introduction, principles, classification, characterization, Shaft Encoders, Incremental Optical Encoder, Variable- Inductance Transducers, Variable-Capacitance Transducers, Piezoelectric Sensors, Sensors for Electromechanical Applications, Photo emissive cells, Photoconductive cells – Measurement of physical quantities. Microsensors. Acoustic sensors, Ultrasonic based sensors.	8	0
3	Actuators: Introduction, Functional components of an actuator, Actuator as a system component, Intelligent & Self sensing actuators, micro-actuation, MEMS with micro-actuators, piezoelectric actuators, Application examples (Automatic anti-lock braking systems).	8	0
4	Smart Sensors: Smart sensors: Introduction Primary Sensors, Information coding / processing, Data communication, automation. Concept and architecture of intelligent sensors, onboard automobile sensors, home appliance sensors, biomedical application, Introduction to MEMS and Microsystems, Microsystems and Microelectronics Multidisciplinary nature of microsystem design and manufacture, applications of microsystems, Nano sensors.	8	0
5	Interfacing Methods and Circuits: Introduction, Amplifiers, Power Amplifiers, Digital Circuits, Bridge Circuits, Data Transmission, Noise and Interference.	7	0



Text Books:

1. Clarence W. de Silva, “Sensors and Actuators Engineering System Instrumentation”, CRC Press, 2nd Edition, 2016.
2. D Patranabis, “Sensors and Transducers” PHI Ltd, 2nd Ed, 2003.
3. Tai-Ran Hsu, “MEMS & Microsystems Design and Manufacture”, Tata McGraw Hill, 2007
4. Nathan Ida, “Sensors, Actuators, and their Interfaces”, SciTech Publishing Inc, 2nd Edition, 2020.

Reference Books:

1. H.S. Kalsi, “Electronic Instrumentation”, Tata McGraw-Hill, 3rd Ed, 2010.
2. Stefan Johann Rupitsch, “Piezoelectric Sensors and Actuators”: Fundamentals and Applications, Springer-Verlag Berlin Heidelberg, 2019.
3. Hartmut Janocha, “Actuators Basics and Applications”, Springer publication, 2013.
4. D.V.S. Murthy, “Transducers and Instrumentation”, PHI Ltd, 2nd Ed, 2010.

Web/Digital resources:

1. <https://www.coursera.org/lecture/interface-with-arduino/lecture-2-1-actuators-uNCa4>

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/108/108/108108147/>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Mini project (hardware)	Sensors and actuators interfacing	Hardware Interfacing
2	Simulation	Any open source tool	Programming

Self-Learning Exercises:

1. Case Study / Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3											3		
CO3	3	3											3		
CO4	3	3	2						2	2			3		

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC330	Total Credits	4	Course Type	Professional Core Course		
Course Title	Analog Electronic Circuits						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	20	1	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	59	4	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Elements of Electronics Engineering

COURSE OBJECTIVE:

1. To introduce analog electronic concepts such as frequency response, feedback, stability and compensation.
2. To develop ability to analyze and design analog electronic circuits using simulation.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the working principle of various analog electronic circuits and explore their applications.	L2
CO2	Analyze the important relations for analog electronic circuits and interpret the results	L2
CO3	Apply concepts of analog electronics to design Amplifiers and oscillators	L3
CO4	Construct/ Simulate analog electronic circuits, demonstrate their working and compare practical results with theoretical design values.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	BJT amplifier circuits: Introduction, BJT circuits at DC, small-signal operation and models, single-stage BJT amplifier, CE, CB & CC amplifiers, SPICE BJT model and simulation.	8	0
2	MOS amplifier circuits: Introduction, MOSFET circuits at DC, small-signal operation and models, single-stage MOS amplifier, CS, CG & CD amplifiers, SPICE FET model and simulation.	8	0
3	Frequency Response: General consideration, Low frequency response of BJT and MOSFET amplifiers, Miller's theorem, High frequency response of BJT and MOSFET amplifiers, SPICE simulation.	7	0
4	Feedback amplifiers and Oscillators: General feedback structure, negative feedback, feedback topologies, feedback amplifiers, loop gain and stability, phase shift oscillator, LC and crystal oscillator (BJT and FET based), SPICE simulation.	8	0
5	Output stages and Power amplifiers: Introduction, classification, Class A, B, AB, C output stage, Switched Mode Power Amplifiers, IC power amplifiers, CMOS class AB output stage, SPICE simulation.	8	0

Text Books:

1. Adel S. Sedra and K. C. Smith, "Microelectronic Circuits," 7th/8th Ed. 2018 Oxford University Press India.

Reference Books:

1. Robert Boyelstad, "Electronic Devices and circuit theory", 11th Edition, Pearson, 2015.
2. Millman & Halkias, "Electronic Devices and Circuits" 4th Edition, McGraw-Hill Education, 2015.
3. U B Mahadevaswamy, "Analog Electronics Circuits", Sanguine Publications, Revised Edition 2010.

Web/Digital resources:

1. E-Book:<http://www.freebookcentre.net/Electronics/Analog-Circuits-Books.html>

SWAYAM/NPTEL:

1. <http://nptel.ac.in/courses/108102095/>

SELF-LEARNING EXERCISES:

1. Any others: Lab Component

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open-Source Tool	Design and Programming
2.	Mini projects	Hardware	Design

SELF LEARNING EXERCISES:

1. Simulation
2. Mini projects

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Design and Testing of Clipper Circuits	2
2	Design and Testing of Clamper Circuits	2
3	Study the performance of Rectifier circuits	2
4	Study V-I characteristics of BJT	2
5	Study V-I characteristics of MOSFET	2
6	Study frequency response of single stage RC – Coupled Amplifier	2
7	Design and testing of RC – Low pass filters	2
8	Design and testing of RC –High Pass filters	2
9	Design and testing of BJT Darlington Emitter follower circuit	2
10	Design and testing of Voltage series feedback amplifier	2
11	Design and testing of Negative Feedback amplifier	2
12	Design and testing of RC and LC Oscillators circuits	2
13	Laboratory Test	2

Course Articulation:

22EC330	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			3								2		
CO2	1	1			3								2		
CO3	3	3			3								2		
CO4	3	3			3								2		

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC340	<i>Total Credits</i>	3	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Digital System Design						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Elements of electronics engineering

COURSE OBJECTIVE:

1. To understand the concepts of combinational and sequential circuits.
2. To learn the techniques for the design of digital circuits and fundamental concepts used in digital system design.
3. To understand the concept of Verilog HDL.
4. To learn the modeling of combinational and sequential circuits using various modeling styles.

COURSE OUTCOMES (COs): After the completion of the course the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Design the combinational circuits using logic gates.	L3
CO2	Construct sequential logic circuits using SR, JK, D, T flip-flops and Mealy and Moore Machines.	L2
CO3	Design combinational & sequential circuits for given applications.	L3
CO4	Develop Verilog programs in gate levels of abstraction	L3
CO5	Develop Verilog programs in dataflow (RTL), behavioral and switch modeling levels of abstraction effectively using Verilog tasks and functions	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNI T No.	Content	Hours	
		Lecture	Tutorials
1	Principles, Analysis and design of combinational logic: Definition of combinational logic, canonical forms, Generation of Boolean expressions from truth tables, Karnaugh maps-3,4,5 variables. Decoders, Encoders, multiplexers, demultiplexers, Adders and subtractors, Look ahead carry, Binary comparators	8	0
2	Flip-Flops and its Applications: Basic Bistable elements, Latches, master- slave flip-flops (pulse-triggered flip-flops): SR flip-flops, JK flip-flops, Characteristic equations, Registers, binary ripple counters, and synchronous Sequential Circuit Design: Design of a synchronous counter, synchronous mod-n counter using clocked JK and D, Design of a Sequence Detector Sequential System: Mealy and Moore models, State machine notation, Construction of state diagrams.	8	0
3	Applications of Digital Circuits: Guidelines for construction of state graphs, Design Example – Code Converter, Serial Adder with Accumulator, Design of Binary Multiplier, Design of Binary Divider. Design of Sequential Circuits using ROMs and PLAs, CPLDs and FPGAs.	8	0
4	Verilog HDL Basic Concepts: Lexical conventions, datatypes, system tasks, compiler directives. Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing. Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf /not type gates, rise, fall and turn-off delays, min, max, and typical delays.	8	0
5	Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types. Behavioral Modeling: Structured procedures, initial and always, blocking and non-blocking statements, generate statement, conditional statements, loops, sequential and parallel blocks. Tasks and Functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions.	7	0

Text Books:

1. John M Yarbrough, “*Digital Logic Applications and Design*”, Thomson Learning, 1st Edition, 2006.
2. Donald D. Givone, ”*Digital Principles and Design*”, McGraw Hill, 1st Edition, 2003.
3. Charles H Roth Jr., Larry L. Kinney – “*Fundamentals of Logic Design*”, Cengage Learning, 7th Edition. 2020.
4. Samir Palnitkar, "*Verilog HDL: A Guide to Digital Design and Synthesis*", Pearson Education, Second Edition. 2020

Reference Books:

1. R D Sudhaker Samuel,” An Illustrative Approach to Logic Design”,1st Edition, Pearson Education, 2010.
2. Morris Mano, ”Digital Design”, 6th Edition,Prentice Hall of India. 2018
3. K. A. Navas, ”Electronics Lab Manual”, Volume I, 5th Edition, PHI, 2015.

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/108106177>
2. https://onlinecourses.nptel.ac.in/noc20_cs63/preview

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Mini project (hardware)	Hardware integration	Hardware Interfacing
2	Simulation	Any open-source tool	Programming

Self-Learning Exercises:

1. Case Study
2. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3	2										3		
CO4	3	3											3		
CO5	3	3	2										3		

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC350	<i>Total Credits</i>	3	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Communication System-I						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Elements of electronics engineering

COURSE OBJECTIVE:

- To gain knowledge of analog electronic communication systems and its applications.

COURSE OUTCOMES (COs): After the completion of the course the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the importance of electronic communication systems.	L2
CO2	Analyze and demonstrate various AM modulation and demodulation techniques through analytical and simulation methods.	L3
CO3	Design and demonstrate the various frequency synthesis techniques.	L3
CO4	Analyze and demonstrate angle modulation and demodulation techniques through analytical and simulation methods.	L3
CO5	Explain the types of noise in electronic communication systems.	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNI T No.	Content	Hours	
		Lecture	Tutorials
1	Introduction: Introduction to electronic communication systems, power measurement units, EM frequency spectrum, bandwidth and channel capacity and data rate, signal analysis and mixing, brief review of modern telecommunication system.	7	0
2	AM Modulation and Demodulation: analysis of signals, amplitude modulation and demodulation, generation of AM wave: square law modulator, switching modulator, detection of AM waves: square law detector, envelop detector. Double sideband suppressed carrier modulation (DSBSC): Time - Domain description, Frequency - Domain representation. Generation of DSBSC waves: Balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves. Costas loop.	8	0
3	SSB generation and frequency synthesizers: Quadrature carrier multiplexing, Hilbert transform, properties of Hilbert transform. SSB generation, frequency - domain description of SSB wave, mathematical analysis of suppressed carrier systems, SSB reception. SSB measurements and FDM. Generation of VSB modulated wave, frequency domain description of VSB wave. Comparison of amplitude modulation techniques, Phase lock loops. PLL capture and lock ranges, PLL loop gain, phase comparators and frequency synthesizers.	8	0
4	FM modulation and Demodulation: Basic definitions of FM, Deviation sensitivity, narrow band FM, wide band FM, transmission bandwidth of FM waves, generation of FM waves: Indirect FM and direct FM. Demodulation of FM waves: Balanced slope detector, Foster seeley discriminator.	8	0
5	Noise Analysis: Noise in communication system- noise analysis, equivalent noise temperature, and cascade connection of two port network, Friss transmission formula, sampling theorem, A/D conversion of signals, SNR, Multiplexing	8	0



Text Books:

1. Wayne Tomasi– “Electronic Communication Systems” Pearson Education, 5th edition,2007
2. B. P. Lathi, “Modern digital and analog Communication systems”, Oxford University Press, 4th edition, 2010

Reference Books:

1. Simon Haykins “Communication Systems”, 5th edition, John Wiley, 2009.
2. Michael Fitz “Fundamentals of Communication Systems”, TMH, (for MATLAB exercises and mini projects), 2008
3. Sanjay Sharma “Analog Communication Systems”, 2nd edition, 2007

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/117102059>
 1. <https://nptel.ac.in/courses>
 2. <https://nptel.ac.in/courses>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Mini project (Hard ware)	Hardware integration	programming/ Hardware integration /Implementation
2	Simulation/ Implementation of advanced topics	Any open source tools	Programming/ Interfacing

Self-Learning Exercises:

1. Case Study projects :
2. Mini Projects :

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2										
CO2	3	3			3				2	2			2	2	
CO3	3	2			3				2	2			2	2	
CO4	3	2			3				2	2			2	2	
CO5	3	2													

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC37L	Total Credits	1.5	Course Type	Professional Core Course		
Course Title	Digital system design lab						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	0	0		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	39	1.5	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	1.5	Minimum Marks	20 marks	25 marks	45* Marks

COURSE PREREQUISITE: ELEMENTS OF ELECTRONICS ENGINEERING

COURSE OBJECTIVE:

1. To reinforce learning through hands-on experience with design, construction, and implementation of digital circuits.
2. To provide the student with the capability to use hardware and software tools in the implementation and simulation of digital circuits.

COURSE OUTCOMES (COs): After the completion of the course the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Design and implement the digital logic circuits as per the given specifications.	L3
CO2	Demonstrate the working of digital logic circuits using Verilog HDL	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Design and implement of Adder/ subtractor using logic gates 4-bit Parallel adder/Subtractor using IC 7483	3
2	Design and implement of Code convertors., Design One-bit comparator and Magnitude comparator using IC 7485.	3
3	Design and implement of Mod-N synchronous/Asynchronous up and down counters using 7476 JK flip-flop IC. Synchronous counter using IC 74192.	3
4	Realize and implement the following shift registers using IC 7474/7495: SISO, SIPO, PISO, PIPO, Ring and Johnson counter.	3

5	Design of Moore sequential circuits - 1's and 2's complements and few other examples	3
6	Design of Mealy sequential circuits - 1's and 2's complements and few other examples	
7	Design of 2-to-4 decoder, and 8-to-3 encoder (without and with parity)	3
8	Design of 8-to-1 multiplexer and 1-to-8 de-multiplexer	3
9	Design of 4-bit comparator and full adder using 3 modeling styles	3
10	Design of flip flops: SR, D, JK, T	3
11	Design of 4 bit binary, BCD counters (Synchronous/ asynchronous reset)	3
12	Design of adder/subtractor using Tasks/functions	3
13	Laboratory Test	3

Text Books:

1. John M Yarbrough, - "Digital Logic Applications and Design", 1st Edition Thomson Learning, 2006.
2. Donald D. Givone, -" Digital Principles and Design", 1st Edition, McGraw Hill, 2003.
3. Charles H Roth Jr., Larry L. Kinney – "Fundamentals of Logic Design", Cengage Learning, 7th Edition. 2020.
4. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition.

Reference Books:

1. R D Sudhaker Samuel, —" An Illustrative Approach to Logic Design", 1st Edition, Pearson Education, 2010.
2. Morris Mano, —"Digital Design", 6th Edition, Prentice Hall of India. 2018
3. K. A. Navas, —"Electronics Lab Manual", Volume I, 5th Edition, PHI, 2015.

***Reference Manual provided**

Course Articulation:

COURSE OUTCOME S ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2	PS O3
CO1	3	3											3		
CO2	3	3			3				3				3		

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC38L	<i>Total Credits</i>	1.5	<i>Course Type</i>	Laboratory Course		
<i>Course Title</i>	Hardware systems Integration and Simulation Laboratory						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	0	0		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	39	1.5	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	1.5	<i>Minimum Marks</i>	20 marks	25 marks	45* Marks

COURSE PREREQUISITE:

Basic Electronics

COURSE OBJECTIVE:

1. To Introduce students to various hardware subsystems, PCBs, Interfaces, standards and programmable devices
2. To Integrate various hardware subsystems into a complete system
3. To load monitoring/operating programs into computing systems
4. To Introduce various simulators and CAD soft wares
5. To promote the IDEA of Free and open software

COURSE OUTCOMES:

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

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain hardware and software sub-systems and configure them for running the simulation.	L2
CO2	Explore and run commands at various levels through CLI	L2
CO3	Demonstrate skills for Printed Circuit Board design, development and Hardware Interfacing	L2
CO4	Develop programs to verify various mathematical operations using open-sourc computational tools and simulate circuits	L3
CO5	Prepare documentation as proof of conduction using modern tools following highest ethics and standards	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Essentials of PC Hardware – subsystems, technology and standards	3
2	External interfaces to PC - Wired and Wireless	3
3	Software installation on PC and Booting process - Moonboot/Dual boot/multi-boot	3
4	Command usage practice - user/admin/network level commands	3
5	Programming practice under Unix/Linux environment	3
6	Basics of Hardware Interfacing using Arduino/Node-mcu Hardware boards	3
7	Compute and verify various mathematical operations, Matrix operations,	3
8	Compute and verify string operations, number system conversion and graphical plot commands.	3
9	Simulate and verify branch currents and voltages in DC /AC circuits using theorems	3
10	Design simple circuits using CAD Tools - Eagle CAD student version	3
11	Etching Process Soldering and Testing process	3
12	Embedded program development	3
13	Laboratory Test	3

Text Books/Reference Books/Journals/Magazines:

1.upgrading and Repairing PCs by Scott Mueller, Que Publishing

Web/Digital resources:

1. www.computergarage.org/
2. www.intel.in/
3. www.geeksforgeeks.org/
4. www.pctechguide.com/intrfaces/io-interface-standards
5. <https://ubuntu.com/tutorials/command-line-f0r-beginners/>
6. www.linuxfoundation.org/

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			3								3		
CO2	3	3			3								3		
CO3	3		2		3										
CO4	3	3	2		3									3	
CO5								2		3					

High – 3, Medium – 2, Low – 1

Course Title	UNIVERSAL HUMAN VALUES			Course Type	Humanities, Social Sciences and Management Course			
Course Code	22HU311	Credits	02	Class	III / IV Semester			
Course Structure	TLP	Credits	Contact Hours	Total Number of Classes / Semester	Assessment in Weightage and Marks			
	Theory	2	26	Theory	CIE		SEE	
	Practical	-	-	26	Weightage	40%	Weightage	60%
	Tutorial	-	-		Max. Marks	20 Marks	Max. Marks	30 Marks
	Total	02	26		Min. Marks	10 Marks	Min. Marks	13 Marks

Pre-requisites: Students Induction Program (desirable).

Course Objectives:

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

Course Outcomes (COs): After the completion of the course a student will –

1. **CO1:** Become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, keeping human relationships and human nature in mind.
2. **CO2:** Have better critical ability and also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

CO-PO Mapping (Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1	2	2				
CO2						1	1	1				

Syllabus:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
8. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility
9. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)

10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Health.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

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

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all pervasive space
21. Holistic perception of harmony at all levels of existence.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

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

Text Books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi



11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Weblinks:

1. <https://onlineethics.org/>

Evaluation Scheme:

Continuous Internal Evaluation – CIE

Event	Event Type	Marks Allotted	Duration
CIE – 1	Written Test – 1	10	1 Hour
CIE – 2	Event	10	1 Hour

Note:

7. The CIE – 1 & CIE – 2 both will be conducted for 20 marks each in 1 hour duration and the marks scored will be reduced proportionately to 10 marks each.
8. The Event (CIE – 2) will be skill based assessment such as Experiential Learning Seminars / Technical talks / Case study / Hands-on activity / Mini projects / Sci-tech activity / Data analysis.
9. A student must score on an average of 50% i.e., 10 marks out of 20 from all the events (CIE – 1 & 2) to gain the eligibility to appear for SEE.

Semester End Examination – SEE

Event	Event Type	Marks Allotted	Duration
SEE	Written Examination	50	1.5 Hours

Note:

3. The SEE will be conducted for 50 marks and the marks scored will be proportionately reduced to 30 marks. A student must score a minimum of 21 marks out of 50 in the SEE to pass.
- SEE Question paper will be set for 100 marks and will have two parts (Part-A & Part-B). Questions under Part-A are compulsory and questions under Part-B will have internal choices.

IV SEMESTER

DEPARTMENT	Mathematics						
Course Code	22MA410	Total Credits	03	Course Type	Basic Science Course		
Course Title	Engineering Mathematics-IV (Common to ECE, EEE and E&I)						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	03		CIE	SEE	Total
	Tutorial	00	00	Weightage	40 %	60 %	100 %
	Practical	--	--	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	03	Minimum Marks	20 marks	25 marks	*45 Marks

Pre requisites: Engineering Mathematics-I, II and III

Course objectives: This course will enable students to:

1. Determine the Fourier transform of a given function.
2. Use Z-transform to solve difference equations
3. Provide the knowledge about the random variable, random process and how to model the random processes in engineering.
4. Deal with multiple random variables and introduction of the most important types of stochastic processes.
5. To investigate the variability in sample statistics from sample to sample, measure of central tendency & dispersion of sample statistics and pattern of variability of sample.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain
CO1	Evaluate Fourier transforms.	L1, L2, L3
CO2	Use Z-transform to solve difference equations.	L1, L2, L3
CO3	Classify the random variables to determine the appropriate probability distributions	L1, L2
CO4	Determine the joint probability distribution, its mean, variance and covariance. Calculate the transition matrix and fixed probability vector for a given Markov chain.	L1, L2, L3
CO5	Estimate the parameter of a population, important role of normal distribution as a sampling distribution.	L1, L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3	1										
CO3	3											
CO4	3	1										
CO5	3											

High – 3, Medium – 2, Low – 1

PO1: ability to apply knowledge of Mathematics

PO2: ability to analyze engineering problems

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
UNIT 1	Fourier Transforms: Finite and Infinite Fourier transform, basic properties, convolution theorem; inverse transforms; applications to solution of ordinary and partial differential equations.	8	--
UNIT 2	Z-transforms: Z-transforms and inverse z-transforms; solution of difference equations.	7	--
UNIT 3	Random Variables: Random variables (discrete and continuous), Probability density function, Cumulative distribution function, Mean and Variance. Probability Distributions: Binomial and Poisson distributions, Exponential distribution and Normal distribution.	8	--
UNIT 4	Joint probability distribution: Joint probability distribution, Discrete and independent random variables, Expectation, Covariance, Correlation coefficient. Probability vectors, stochastic matrices, fixed point matrices, Regular stochastic matrices, Markov chains, Higher transition-probabilities, stationary distribution of regular markov chains and absorbing states.	8	--
UNIT 5	Sampling Distribution: Introduction, Objectives, sampling distribution, testing of hypothesis, level of significance, confidence limits, simple sampling of attributes, test of significance of large samples, comparison of large samples, sampling of variables,	8	--

	central limit theorem, confidence limits for unknown mean, test of significance for means of two large samples, Sampling of variables – small samples, Student’s t-distribution.		
--	--	--	--

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, 2015, Khanna Publishers.
2. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition (Reprint), 2016, John Wiley & Sons.

Reference Books:

1. N. P. Bali and Manish Goyal, A Textbook of Engineering Mathematics, Vol. I & II (AICTE), 10th Edition, Laxmi Publications Pvt Ltd, 2019.
2. Maurice D. Weir, Joel R. Hass and George B. Thomas, Thomas’ calculus: Early Transcendentals, 12th edition, Pearson Education, 2016.
3. B. V. Ramana, Higher Engineering Mathematics, 11th edition, Tata-McGraw Hill, 2010.
4. Peter V.O ’Neil, Advanced Engineering Mathematics, 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012.

Web/Digital resources:

1. <https://www.classcentral.com/subject/maths>
2. <https://academicearth.org/>



DEPARTMENT	Mathematics						
Course Code	22MATDIP41 0	Total Credits	00	Course Type	Basic Science Course		
Course Title	Foundations of Engineering Mathematics-II (For IV Semester Lateral Entry Students)						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	03	00		CIE	SEE	Total
	Tutorial	00	00	Weightage	50%	---	50%
	Practical	--	--	Maximum Marks	50 Marks	--	50 Marks
	Total	03	00	Minimum Marks	25 Marks	--	25* Marks

Note: * This course is slated for CIE only and has no SEE. For passing the student has to score a minimum of 25 Marks (CIE: 25)

Pre requisites: Basics in differential calculus, Integral calculus and vectors.

Course objectives: This course will enable students to:

1. Solve second and higher order differential equations.
2. Find the Laplace transform of the function $f(t)$.
3. Find the Inverse Laplace transform of the function $F(s)$.
4. Apply the knowledge of numerical methods in the models of various physical and Engineering phenomena.
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals.

Course Outcome: After the completion of this course, students will be able to:

CO#	Course Outcome	Highest Level of Cognitive Domain
CO1	Explain various physical models through higher order differential equations and solve such linear ordinary differential equations.	L1, L2
CO2	Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions.	L1, L2
CO3	Apply the concept of Laplace transform in solving Linear Differential equations.	L1, L2
CO4	Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method.	L1, L2
CO5	Apply the concept of to evaluate multiple integrals and Beta and Gamma functions	L1, L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Articulation:

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											
CO4	3											
CO5	3											

High – 3, Medium – 2, Low – 1
 PO1: ability to apply knowledge of Mathematics

Course Content / Syllabus:

UNIT No.	Content	Hours
UNIT 1	Linear Differential Equations: Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters.	Lecture 8
UNIT 2	Laplace Transform: Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at} (t)^n f(t), f^{(t)}, \frac{d}{dt}$ derivatives and Integrals. Laplace Transform of Periodic functions.	Lecture 8
UNIT 3	Inverse Laplace Transform: Inverse Laplace Transform, Convolution theorem (without proof) and problems. Applications – Solution of Linear differential equations using Laplace Transform.	Lecture 7
UNIT 4	Elementary Numerical Methods: Finite differences. Interpolation/extrapolation using Newton’s forward and backward difference formulae, Newton’s divided difference and Lagrange’s formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples.	Lecture 8
UNIT 5	Integral Calculus: Multiple integrals –Evaluation of double and triple Integrals, Beta and Gamma functions: Definition, relation between Beta and Gamma functions and simple problems.	Lecture 8

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, 2015, Khanna Publishers.
2. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition (Reprint), 2016, John Wiley & Sons.
3. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical methods for scientific and engineering computation, 6th Edition, 2012, New Age International Publishers.

Reference Books:

1. N. P. Bali and Manish Goyal, A Textbook of Engineering Mathematics, Vol. I & II (AICTE), 10th Edition, Laxmi Publications Pvt Ltd, 2019.
2. Maurice D. Weir, Joel R. Hass and George B. Thomas, Thomas' calculus: Early Transcendentals, 12th edition, Pearson Education, 2016.
3. B. V. Ramana, Higher Engineering Mathematics, 11th edition, Tata-McGraw Hill, 2010.
4. Peter V.O 'Neil, Advanced Engineering Mathematics, 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012.

Web/Digital resources:

1. <https://www.classcentral.com/subject/maths>
2. <https://academicearth.org/>



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC410	Total Credits	4	Course Type	Professional Core Course		
Course Title	Linear Integrated Circuits						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	20	1	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	59	4	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Elements of Electronics Engineering

COURSE OBJECTIVE:

1. To understand the basic concepts of operational amplifier and its various applications
2. To understand the working principles of Linear ICs
3. To design circuits using Linear ICs

COURSE OUTCOMES (COs)

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the operation of linear integrated circuits and explore their applications.	L2
CO2	Analyze linear integrated circuits to obtain the voltage and current responses at different points and the frequency response.	L3
CO3	Develop a linear integrated circuit for the given specification by applying the concepts of linear integrated circuit.	L3
CO4	Demonstrate the skill set for a given application / problem statement using linear ICs and EDA tools.	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to Operational Amplifiers and Characteristics: Introduction, Basic Information of Op-Amp, the ideal Operational Amplifier, Operational amplifier internal circuit, DC and AC characteristics, Inverting and non-inverting amplifiers, voltage follower.	08	0

2	Op-Amp Applications I: Summing Amplifiers, Instrumentation amplifier, V to I and I to V Converters, high resistance DC voltmeter, universal high resistance voltmeter, solar cell energy measurements, differentiator, integrator. Active filters - RC filters, State Variable filter, switched capacitor filters	10	0
3	Op-Amp Applications II: Comparator, Schmitt Trigger, Square/Rectangular and Triangular wave generators, sample and hold circuit, LOG and ALOG amplifiers, multiplier, divider and their applications.	07	0
4	Op-Amp Applications III: Precision rectifiers, peak detectors, dead-zone circuits, A to D and D to A Converters.	06	0
5	Voltage Regulators and 555Timer: Series op-amp regulator, IC voltage regulator, 723 general purpose regulator, Switching regulators, 555 Timer a Monostable and Astable Multivibrator.	08	0

Text Books:

1. James M. Fiore: “Operational Amplifiers & Linear Integrated Circuits:Theory and Application”Version 3.2.6, May 2021.
2. Robert F Coughlin, Frederick F Driscoll:“Operational Amplifiers & Linear Integrated Circuits”, Pearson India education services Pvt. Ltd,2017
3. D. Roy Choudhary, Shail B. Jain: “Linear Integrated Circuits”, New Academic Science, 5th Edition, 2018.

Reference Books:

1. David A. Bell: “Operational Amplifiers and Linear ICs”, 3rd Edition, Oxford university press, India, 2011.
2. Ramakanth A. Gayakwad: “Op-Amps and Linear Integrated Circuits”, 4th Edition, Pearson India education services Pvt. Ltd, 2015
3. S Rajaram, A Kandaswamy, M Alagappan, Arulalan Rajan, “Linear Integrated Circuits and its Applications”, Texas Instruments

Web/Digital resources:

1. EBook: <https://docs.google.com/file/d/0B21HoBq6u9TsbG5WdjNZeGwtMWs/preview>

SWAYAM/NPTEL:

1. Video Lecture: <http://nptel.ac.in/courses/108106068/>



PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open Source Tool	Design and Programming
2	Mini Projects	Hardware	Design

Self-Learning Exercises:

4. Simulation
5. Mini Projects

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Design and testing of Op-amp DC and AC amplifiers: Inverting amplifier, Non-inverting amplifier and Voltage follower.	2
2	Design and testing of Op-amp DC circuits: Adder, Subtractor, Difference amplifier, Average.	2
3	Design and testing of Op-amp integrator and differentiator.	2
4	Design and testing of Butterworth's Low pass and High pass filters.	2
5	Design and testing of Band pass and Band Elimination filters.	2
6	Design and testing of Schmitt Trigger Circuits.	2
7	Design and testing of Op -Amp Triangular and Rectangular Waveform Generators.	2
8	Design and testing of Voltage regulator.	2
9	Design and testing of 555 Timer Astable Multivibrator.	2
10	To Simulate and test the state variable and switched capacitor filter	2
11	To Simulate and test Switching voltage regulator & Precision rectifiers	2
12	To Simulate and test Instrumentation amplifiers & Amplitude modulation using analog multiplier	2
13	Laboratory Test	2

Course Articulation:

22EC410	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3										2		
CO2	3	3	3										2		
CO3	1			1									2		
CO4	3				3								2		

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>		Electronics and Communication Engineering					
<i>Course Code</i>	22EC420	<i>Total Credits</i>	4	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	<i>Microcontrollers and Embedded system</i>						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	52	4		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	52	4	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Programming in C and any programming language like Verilog, VHDL.

COURSEOBJECTIVE:

- To gain knowledge of Embedded systems and acquire programming skills for Microcontroller 8051 and ARM processor.

COURSEOUTCOMES(COs): After the completion of the course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the basics of Embedded system, architecture, Interrupts of 8051 microcontroller and ARM cortex processor	L2
CO2	Develop ALP / Embedded C programs using the Instruction set of 8051 microcontroller	L3
CO3	Develop ALP / Embedded C programs using the Timers /Counters and Serial communication of 8051 microcontroller with and without Interrupts	L3
CO4	Analyze various interface applications using 8051 microcontroller	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to Embedded Systems: Introduction to Embedded Systems: Embedded systems- definition, classification of embedded systems, types of embedded systems, purpose of embedded systems. Elements of embedded systems – cores, firmware, sensors and actuators, bus systems, memory. Embedded SOC and use of VLSI Circuit Design Technology.	10	0
2	8051 Microcontroller:- Architecture, 8051 hardware, i/o and o/p pins, ports and port circuits, external memory, counters and timers, serial communication. Addressing modes & instructions: - Addressing modes, external data moves, code memory read only data moves, PUSH & POP op-codes, data	12	0

	exchanges, and arithmetic, logical, jump and call instructions.		
3	Timer/counter, serial communication and interrupt programming: - Programming 8051 timer/counter, basics of serial communication, 8051 connection to RS 232, 8051 serial port programming, 8051 interrupts, programming timer interrupts, programming external hardware interrupts, programming serial communication interrupts.	10	0
4	Interfacing Applications: - Interfacing keyboard, LCD, ADC, DAC, Stepper motor & DC motor, 7 segment displays, Elevator	10	0
5	Introduction to ARM Cortex-M processors: Introduction to ARM cortex-M3, Advantages of the Cortex –M processors, Applications of the ARM cortex-M processors. Architecture: Introduction to the architecture, Programmer’s model, Behavior of the application program status word.	10	0

Text Books:

1. Kenneth J Ayala: “The 8051 Microcontroller Architecture, Programming and Application “ - 2ed Penram International 1996.
2. Muhammad Ali Mazidi and Janice Gillespie: “The 8051 Microcontroller and embedded System” Pearson Education 2003.
3. Joseph You “The definitive guide to ARM CORTEX-M3 and to ARM CORTEX-M4 processor” Third Edition-Elsevier 2014
4. Shibu K V, “Introduction to Embedded Systems”, TMH, 2009

Reference Books:

1. Andrew N. Sloss, Dominic Systems and Chris Wright- “ARM system developer Guide Designing and Optimizing System Software” Elsevier 2004.
2. Raj Kamal, “Embedded Systems Architecture, Programming and Design” , 2nd Edition, TMH, 2008.

Web/Digital resources:

1. <http://infocenter.arm.com/help/topic/com.arm.doc>
2. <http://www.keil.com>

SWAYAM/NPTEL:

1. <https://swayam.gov.in/>
2. <https://www.digimat.in/nptel/courses/video/108105102/L31.html>
3. <https://www.digimat.in/nptel/courses/video/108105102/L26.html>
4. <https://www.digimat.in/nptel/courses/video/108105102/L28.html>

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**
3. **Any others**



Course Articulation:

COURSE OUTCOME S ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2	3	3	2										2	3	
CO3	3	3	2										3	3	
CO4	3	3	3	3	3				3	3		3	3	3	

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	20EC430	<i>Total Credits</i>	4	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Signals and Systems						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	26	1	<i>Weightage</i>	40 %	60%	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	65	4	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic electronics and Mathematics

COURSEOBJECTIVE:

1. Understanding the fundamental characteristics of signals and systems. ·

COURSEOUTCOMES(COs): At the end of the course, the student will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the classification of signals and their representation in time and frequency domain	L2
CO2	Analyze continuous and discrete time LTI systems, their properties in time and frequency domains	L4
CO3	Apply frequency domain properties to continuous and discrete time LTI systems.	L3
CO4	Implement and Demonstrate skill sets related to software tools in the analysis of signals and systems in group	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Basics of Signals and Systems: Introduction, Definitions and examples of a signal and a system, Classification of signals, Basic operations on signals, Elementary signals, Systems viewed as interconnection of operations, properties of systems.	8	6
2	Time Domain Representation of LTI systems: Introduction, Impulse response characterization and convolution sum for the discrete time LTI systems, Properties of convolution sum, Impulse response characterization and convolution integral for continuous time LTI systems, properties of convolution integral, Interconnection of LTI systems, LTI system properties in terms of impulse response, Step response, Differential and Difference equation representation of LTI systems, Characterization of Systems described by differential or difference equations, Block diagram representation.	8	5
3	Fourier analysis of Continuous time signals and LTI systems: Introduction, Continuous time Fourier transform (CTFT), properties, Magnitude and Phase spectra, Frequency response of continuous time LTI systems, application of Fourier transform, relating FT to FS, Relationship between LT and FT.	8	5
4	Fourier analysis of discrete time signals and LTI systems: Discrete time Fourier transform (DTFT), properties and applications of DTFT, Relating the FT to the DTFT, Relating the FT to the DTFS, Sampling and Reconstruction. Finding inverse Fourier Transforms by using Partial fraction expansions, Parsivals Relationships, Time-Bandwidth Product. Applications of Fourier representations to mixed signal classes: Fourier Transform representations of Periodic signals and discrete time signals, Sampling, Fourier series representations of Finite duration non periodic signals.	8	5
5	Z-transforms and Applications: Introduction to z-transform, ROC and its 7 properties, properties of z- transform, Inverse z- transform, Analysis and characterization of LTI systems using z- transforms, Computational structures for implementing Discrete time LTI systems, Unilateral Z-transforms and their applications for solving difference equations, Relationship between z- transform, Laplace and DTFTs.	7	5

Text Books:

1. Simon Haykin and B. V. Veen, “*Signals and Systems*”, Wiley, Second Edition, 2013.
2. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “*Signals and Systems*”, Prentice Hall of India, 2006.
3. Yang, “*signals and systems with MATLAB*”, springer international, edition , 2014

Reference Books:

1. Michael J Roberts, “Fundamentals of signals and systems”, Tata Mcgraw Hill ,2008.
2. Ganesh Rao and Satish Tunga, “Signals and Systems”, Sanguine Technical Publishers, 2004
3. Udaya Kumar S “Signals and systems”, 7th Edition, pristine publishing House,2017.

Web/Digital resources:

1. <https://nptel.ac.in/courses/1171040741>.
2. <https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes>

SWAYAM/NPTEL:

1. NPTEL lecture Video on Signals and Systems by Prof.S.C.Dutta Roy,<http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-and.html>
2. NPTEL lecture Video on Signals and Systems by Prof. T.K. Basu, IIT Kharagpur.

Self-Learning Exercises:

Matlab /octave simulation Exercise:

1. Representation of different types signals
2. Convolution operation on continuous time and discrete time signals.
3. Evaluate the response of LTI system using convolution.
4. To study the frequency domain representation of continuous time signals.
5. To study the frequency domain representation of Discrete time signals.
6. To find Z-transform of discrete signals and representation of pole-zero plot.
7. To evaluate response of discrete time LTI systems for different inputs.
8. Stability analysis of discrete time LTI systems.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3										3		
CO2	3	3	3										3		
CO3	3	3	3										3		
CO4	3	3	3		3				3	3			3	3	

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC440	<i>Total Credits</i>	3	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Communication Systems-II						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: communication systems -I

COURSE OBJECTIVE:

1. To understand the fundamental concepts of digital communication.
2. To evaluate the performance of various digital communication systems.
3. To design and interface communication systems for a given application.

COURSE OUTCOMES (COs): After the completion of the course the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the importance of digital communication systems and apply the fundamental concepts of information theory and coding in communication systems	L3
CO2	Explain the various waveform coding techniques in digital communication systems through analytical and simulation methods.	L2
CO3	Apply the knowledge and evaluate the performance of digital modulation schemes through analytical and simulation methods.	L3
CO4	Explain digital baseband transmission and performance analysis of various line coding techniques.	L2
CO5	Analyze the performance of digital communication system	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNI T No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Digital communication system model, modulation process, analog vs. digital communication; Fundamental limitations of communication systems Information content of a discrete memory less source (DMS), Information content of a symbol , Entropy , Information rate, DMC.	8	0
2	Waveform Coding Techniques: sampling methods and significance of sampling rate Discretization in time and amplitude. Linear quantizer, quantization noise power calculation, signal to quantization noise ratio, non – uniform quantizer, A law & μ law companding encoding and pulse code modulation, bandwidth of PCM, Differential pulse code modulation, Delta modulation, Idling noise and slope overload, Adaptive delta modulation, adaptive DPCM. Comparison of PCM and DM.	8	0
3	Digital Modulation Schemes: Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) –Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM, Minimum shift keying (MSK) , Gaussian minimum shift keying (GMSK) Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).	8	0
4	Digital Baseband Transmission: Line coding and its properties. NRZ & RZ types, signaling format for uni polar, polar, bipolar, AMI & Manchester coding and their power spectra (No derivation), HDB and B&W signaling, ISI, Nyquist criterion for zero ISI & raised cosine spectrum., impulse response and peak pulse signal to noise, correlation detector decision threshold and error probability for binary Unipolar (on – off), signaling.	8	0
5	Performance analysis of digital communication: Optimum detection for binary signals, optimum receiver analysis, Matched filter receiver and its derivation, coherent receivers for carrier modulation, optimum receiver for AWGN channels.	7	0

Text Books:

1. Proakis, J.G and Salehi, M, “Digital Communications”, McGraw-Hill, 5th Edition , 2008.
2. B. P. Lathi, “Modern digital and analog Communication systems” , Oxford University Press, 4th edition, 2010,
3. Sanjay Sharma, “ Digital Communications “, S K kataria and sons , 6th edition , 2013

Reference Books:

1. Simon Haykins, “Communication Systems”, John Wiley, 25th edition ,2009.
2. Michael Fitz, “Fundamentals of Communication Systems”, TMH, 2008 (for MATLAB exercises and mini projects)
3. Roden, M.S, “Analog and Digital Communication Systems”, Discovery Press, 5th edition, 2005

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/117101051>
2. <https://nptel.ac.in/courses/108102120>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Case Study / Mini projects	Hardware project	Programing / hardware interfacing
2	Simulation/ Implementation of recent papers	multisim/ proteus/lab view	Programming / s/w Interfacing

Self-Learning Exercises:

1. Case Study Projects
2. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2										2		
CO2	3	3	3		3				2	2		3	3	2	
CO3	3	2	3		3				2	2		3	3	2	
CO4	3	2	2										2		
CO5	3	2	2										2		

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC450	Total Credits	4	Course Type	Professional Core Course		
Course Title	Engineering Electromagnetics						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	52	4		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	52	4	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Vector analysis, Differential and integral calculus

COURSE OBJECTIVE:

1. To introduce the concepts of coordinate systems, Maxwell's equations, static and time varying electric and magnetic fields
2. To understand the propagation of electromagnetic waves and their applications.

COURSE OUTCOMES (COs)

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Interpret various types of fields and charge distributions using vector calculus.	L2
CO2	Deduce Maxwells equation for electric and magnetic fields	L3
CO3	Analyse the behaviour of Electromagnetic waves in different mediums	L3
CO4	Develop the skill sets using modern tools to solve Electromagnetic problems.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Vector Analysis, Co-ordinate System, Coulomb's Law, Electric field intensity, Electric field due to various charge distribution, Electric flux and flux density, Flux density due to various charge distribution, Gauss Law, Applications of Gauss law, Divergence and Maxwell's Equations.	10	0

2	Work done & Line Integral Concept, Potential, Potential due to various charge distribution, Potential due to infinite line charge, Conservative field, Potential gradient, dipole, Energy density in ES field, Current and current density, Equation of continuity, Conductor & dielectric, Boundary conditions, Concept of capacitance, Energy stored in capacitance, Poisson's & Laplace Equations, calculating capacitance using Laplace's Equations.	11	0
3	Magnetic field & its properties, Biot Savart's Law, Computation of H using BSL, Ampere's Circuital Law, Computation of H using ASL, Curl & Stokes Theorem, Magnetic flux & flux density, Scalar & Vector Potentials, Magnetic Forces, Boundary conditions for Magnetic Field.	11	0
4	Introduction to Time Varying fields, Faraday's equations, Displacement current, Field relations for Time Varying Electric & Magnetic fields, Maxwell's Equations, Relation between field and Circuit Theory.	10	0
5	Uniform plane waves, General equations, UPW in free space & various media, Poynting Theorem, Wave Polarization, Reflection, Refraction Diffraction of waves, Fundamentals of Antennas and radiating systems.	10	0

Text Books:

1. William A Hayt, John A Buck, M Jaleel Akhtar, "Engineering Electromagnetics", 9th edition, McGrawHill Publication, 2020.
2. Matthew N.O. Sadiku, S.V. Kulkarni, "Principles of Electromagnetics", 6th edition, Pearson Education, 3rd Impression, 2016.

Reference Books:

1. David K Cheng "Fundamentals of Engineering Electromagnetics", 2nd edition, Pearson Education Asia, 2019.
2. Rohit Khurana, "Electromagnetic Field Theory", 2nd edition, Vikas Publication, 2016.
3. J. A. Edminister, "Electromagnetics", 4th Edition, McGraw Hill Publication, 2013.
4. Karl E. Lonngren, Sava V. Savov, "Fundamentals of Electromagnetics with MATLAB", 2nd edition, SciTech Publications, 2007.
5. John D kraus, Keith R Carver "Electromagnetics with applications", 6th Edition, McGrawHill Publications, 1998.

Web/Digital resources:

1. <http://ocw.mit.edu/OcwWeb/Electrical-Engineering-and-Computer-Science/6-632Electromagnetic-Wave-TheorySpring2003/CourseHome/Index.htm>
2. <http://www.plasma.uu.se/CED/Book>

SWAYAM/NPTEL:

1. <http://nptel.ac.in/courses/108106073>
2. <http://nptel.ac.in/courses/117103065>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open Source Tool	Programming
2	Mini Project (Hardware)	Hardware Interfacing	Programming/Hardware Interfacing

Self-Learning Exercises:

1. Mini Projects
2. Simulation

Course Articulation:

22EC450	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2							2				2	2	
CO2	2	2							2				2	2	
CO3	1	1							2				2	2	
CO4	1	1							2				2	2	

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC47L	<i>Total Credits</i>	1.5	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Communication Lab -I						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>		<i>Assessment in Weightage and marks</i>		
	<i>Lecture</i>	0	0		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	39	1.5	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	1.5	<i>Minimum Marks</i>	20 marks	25 marks	45* Marks

COURSE PREREQUISITE: COMMUNICATION SYSTEMS -I

COURSE OBJECTIVE: Students should gain knowledge on design, conduct and demonstrate the working of various analog modulation and demodulation circuits, sampling, PLL and synthesizer circuits.

COURSE OUTCOMES (COs): After the completion of the course the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Analyze various analog modulation and demodulation circuits and sampling theorem	L3
CO2	Demonstrate the working of FDM, PLL, synthesizers, pre-emphasis and de-emphasis circuits.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Design and test amplitude modulation and demodulation circuits	3
2	Design and test DSB SC modulation and demodulation using IC1496	3
3	Design and test SSB SC Modulation and Demodulation using IC 1496	3
4	Design and test Frequency Modulation and Demodulation using IC 8038	3
5	Design and test Pre-Emphasis - De Emphasis Circuits	3
6	Design and test Verification of Sampling Theorem	3
7	Design and test PAM Generation and Reconstruction	3
8	Design and test PWM Generation and Reconstruction	3

9	Design and test PPM: Generation	3
10	Design and test Time division multiplexing and FDM using Kit	3
11	Design and test frequency synthesis using phase locked loop using IC-565	3
12	Design and test a transistor Mixer circuit and Class c tuned amplifier	3
13	Lab Test	3

Text Books:

1. Wayne Tomasi– “Electronic Communication Systems” 5th edition, Pearson Education, 2007
2. B. P. Lathi “Modern digital and analog Communication systems”,4th edition, Oxford University Press, 2010,

Reference Books:

1. Martin S.Roden, “Analog and Digital Communication System”, 3rd Edition, Prentice Hall of India, 2002.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	0	0	0	0	2	2	0	0	3	0	0
CO2	3	2	3	0	0	0	0	0	2	2	0	0	2	0	0

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC48L	<i>Total Credits</i>	1.5	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Microcontrollers and Embedded System Lab						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	0	0		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	39	1.5	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	1.5	<i>Minimum Marks</i>	20 marks	25 marks	45* Marks

COURSE PREREQUISITE: Knowledge of digital logic Circuits.

COURSEOBJECTIVE:

1. Familiarize the basic architecture of 8051 microcontroller ARM controller.
2. Program 8051 microprocessor using Assembly Level Language and C.
3. Understand the operation and use of inbuilt hardware of 8051 and ARM controller.
4. Interface 8051 and ARM to external I/O devices using its I/O ports.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Develop and demonstrate programming skills by applying logical reasoning using instruction set.	L4
CO2	Demonstrate the programming skills based on hardware features of 8051 microcontroller for different applications.	L3
CO3	Design and develop programs related to applications using interfaces for 8051 & ARM controllers.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Programs related to data transfer and exchange.	3
2	Programs related to arithmetic and logical operations.	3
3	Programs related to programming timers in all modes with and without interrupts.	3
4	Programs related to programming serial communication with and without interrupts.	3
5	Programs related to handling external interrupts.	3
6	Interfacing LCD.	3

7	Interfacing matrix keypad.	3
8	Interfacing ADC.	3
9	Interfacing multi digit 7 segment displays.	3
10	Interfacing DAC.	3
11	Interfacing stepper motor and D C motor.	3
12	Interfacing Elevator.	3
13	Laboratory Test	3

Text Books:

1. Kenneth J Ayala : “The 8051 Microcontroller Architecture, Programming and Application”
2ed Penram International 1996.
2. Muhammad Ali Mazidi and Janice Gillespie : “The 8051 Microcontroller and embedded Systems-“ ' -Pearson Education 2003.
3. Joseph Yiu’The definitive guide to ARM CORTEX-M3 and to ARM CORTEX-M4 processor’ Third Edition-Elsevier 2014

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3								3			
CO2	3	3	3	3	3								3			
CO3	3	3	3	3	3				2				3			

High – 3, Medium – 2, Low – 1



Course Title	ENVIRONMENTAL STUDIES			Course Type	Humanities, Social Sciences and Management Course			
Course Code	22HU412	Credits	0	Class	III / IV Semester			
Course Structure	TLP	Credits	Contact Hours	Total Number of Classes / Semester	Assessment in Weightage and Marks			
	Theory	-	26	Theory	CIE		SEE	
	Practical	-	-	26	Weightage	100%	Weightage	-
	Tutorial	-	-		Max. Marks	50 Marks	Max. Marks	-
	Total	-	26		Min. Marks	25 Marks	Min. Marks	-

COURSE PREREQUISITE: NIL

COURSE OBJECTIVE: The student gains knowledge on basic concepts on Environmental aspects and understands its importance in various disciplines for safeguarding the environment.

COURSE OUTCOMES (COs)

CO #	Course Outcomes	Highest Level of Cognitive Domain
CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water attributes at regional and global scale.	L2
CO2	Develop critical thinking/observation skills - apply them to identify and analyze Environmental issues.	L2
CO3	Understand the complex ecological relationship between biotic and abiotic components.	L2
CO4	Apply ecological knowledge to illustrate and address environmental problems for better management.	L2
CO5	Understand the recent technologies and legal aspects related to the environment.	L2

Course Articulation:

COs ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

High – 3, Medium – 2, Low – 1

Course Content / Syllabus:

UNIT No.	Content	Lecture Hours
1	Introduction: Environment - Components of Environment Ecosystem: Types & Structure of Ecosystem, Balanced ecosystem Human Activities – Food, Shelter, And Economic & Social Security. Impacts of Agriculture & Housing Impacts of Industry, Mining & Transportation Environmental Impact Assessment, Sustainable Development	5
2	Natural Resources, Water resources – Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water Mineral resources, Forest Wealth Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle. Energy – Different types of energy, Conventional sources & non-conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.	7
3	Environmental Pollution – Water Pollution, Noise pollution, Land Pollution, Public Health Aspects. Global Environmental Issues: Population Growth, Urbanization, Land Management, Water & Waste Water Management.	5
4	Air Pollution & Automobile Pollution: Definition, Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures. Solid waste Management, E - Waste Management & Biomedical Waste Management - Sources, Characteristics & Disposal methods.	5
5	Introduction to GIS & Remote sensing, Applications of GIS & Remote Sensing in Environmental Engineering Practices. Environmental Acts & Regulations, Role of government, Legal aspects, Role of Non- Governmental Organizations (NGOs), Environmental Education & Women Education.	4

Text Books:

1. Benny Joseph. “Environmental Studies”, Tata McGraw – Hill Publishing Company Limited. 2005.
2. R.J.Ranjit Daniels and Jagadish Krishnaswamy. “Environmental Studies”, Wiley India Private Ltd., New Delhi. 2009.
3. R Rajagopalan, “Environmental Studies – From Crisis to Cure”, Oxford University Press, 2005.
4. Aloka Debi, “Environmental Science and Engineering”, Universities Press (India) Pvt. Ltd. 2012.

Reference Books:

1. Raman Sivakumar, “Principals of Environmental Science and Engineering”, 2nd Edition, Cengage learning Singapore, 2005.
2. P. Meenakshi, “Elements of Environmental Science and Engineering”, Prentice Hall of India Private Limited, New Delhi, 2006.
3. S.M. Prakash, “Environmental Studies”, Elite Publishers Mangalore, 2007.
4. Erach Bharucha, “Text Book of Environmental Studies”, for UGC, University press, 2005.
5. G.Tyler Miller Jr., “Environmental Science – working with the Earth”, Eleventh Edition, Thomson

Brooks /Cole, 2006.

Evaluation Scheme:

Continuous Internal Evaluation – CIE

Event	Event Type	Marks Allotted	Duration
CIE – 1	Written Test – 1	20	1 Hour
CIE – 2	Event	10	1 Hour
CIE – 3	Written Test – 2	20	1 Hour

Note:

10. The written test 1 & 2 (CIE – 1 & 3) both will be conducted for 20 marks each in 1 hour duration.
11. The Event (CIE – 2) will be conducted for 20 marks and the marks scored will be reduced proportionately to 10 marks.
12. The Event (CIE – 2) will be skill based assessment such as Seminars / Technical talks / Case study / hands-on activity / Mini projects / Sci-tech activity / Data analysis.
13. A student must score on an average of 50% i.e., 25 marks out of 50 from all the events (CIE - 1, 2, 3) to pass.



V – SEMESTER

DEPARTMENT	Electronics and communication Engineering						
Course Code	22EC510	Total Credits	4	Course Type	Professional Core Course		
Course Title	Linear Algebra and Applications						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	26	1	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	65	4	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic Engineering Mathematics

COURSEOBJECTIVE:

1. To obtain computational proficiency involving procedures in Linear Algebra.
2. To solve problems that applies Linear Algebra to Chemistry, Economics and Engineering.

COURSEOUTCOMES(COs): At the end of the course, the student should be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Summarize vector spaces with their properties and application	L2
CO2	Apply principles of matrix algebra to linear transformations and canonical forms	L3
CO3	Solve the matrix problems to calculate bases, dimensions and orthogonalization of vectors	L3
CO4	Develop the skill set to simulate the applications of Linear Algebra	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Linear equations: Inverse of a matrix, Gauss Jordan method, LU-factorization. Vector spaces: Vector spaces and its properties, subspaces and its properties, Algebra of subspaces, linear combination of vectors, linear independent sets, bases and dimension of a vector space, Rank, change of basis.	8	5
2	Linear Transformations: Definition, properties and Algebra of Linear Transformation, Linear operator, Range and Null space of Linear Transformation, Product of Linear Transformation, polynomials in linear operator Invertible linear transformation, Matrix representation of linear transformation, change of Basis, Trace of a Matrix and Linear Transformation.	8	5
3	Cayley-Hamilton Theorem, Annihilator, Eigenvalues and Eigenvectors of a linear transformation. Inner Product Spaces: Inner products; inner products spaces; orthogonal sets and projection, orthogonal bases and Gram-Schmidt process, Least square problems, applications of inner product spaces.	8	6
4	Symmetric Matrices and Quadratic forms: Diagonalization of symmetric matrices, Quadratic forms, Constrained Optimization, Singular Value Decomposition, Application to image processing and statistics.	8	5
5	Canonical forms: similarity of linear transformations, invariant subspaces, invariant direct sum decomposition, normal form, triangular form, nilpotent transformation, Jordan canonical form, Rational canonical form.	7	5

Text Books:

1. David C Lay, Steven R. Lay, Judi J. McDonald, "Linear Algebra and Its Applications", 5th edition, Pearson education, 2016.
2. Sudhir Kumar Pundir, "Linear Algebra", first edition, CBS Publishers and Distributors Pvt. Ltd, 2015
3. Gilbert Strang, "Introduction to Linear Algebra", 5th edition, Wellesley-Cambridge Press, 2016.

Reference Books:

1. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd edition, Pearson education, 2005.
2. Seymour Lipschutz, Marc Lipson "Linear Algebra", 6th edition, Tata McGraw-Hill, 2018

Web/Digital resources:

1. https://onlinecourses.nptel.ac.in/noc18_ma16
2. https://onlinecourses.nptel.ac.in/noc17_ma04/preview

Self-Learning Exercises:

1. Applications of vector space
2. Correlation, FFT and Convolution using Matrix
3. Fourier Series: Linear Algebra for functions
4. Diagonalization of convolution matrix
5. Application of LDA, PCA (dimensionality reduction)

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3										3		
CO2	3	3	3										3		
CO3	3	3	3										3		
CO4	3	3	3		3				3	3			3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC520	Total Credits	4	Course Type	Professional Core Course		
Course Title	Microwave and Antennas						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	52	4		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	52	4	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Basic Engineering Mathematics, Communication Systems

COURSE OBJECTIVE:

1. To describe the microwave properties and its transmission media, and microwave devices for several applications.
2. To understand the basics of antenna theory and select antennas for specific applications.

COURSE OUTCOMES (COs)

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the principles of microwave frequencies, sources, hazards of microwaves and system modelling using s-parameters.	L2
CO2	Apply the knowledge of microwave theory in distinguishing the applications of Microwave passive and active devices.	L3
CO3	Analyze different terminologies associated with satellite communication, TV, RADAR, their applications.	L3
CO4	Acquainted with design of antennas and feeding mechanism.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to Microwaves: Introduction, bands, advantages, application and radiation hazards, S-parameters, Problems on S Parameters, Microwave waveguides and components. Avalanche transit time devices – IMPATT diode, TRAPATT diode, Gunn diode, Tunnel diode, Varactor diodes. Microwave linear beam tubes – Klystrons, TWT, Microwave Cross field tubes – Magnetron, parametric amplifiers, Cross field amplifiers.	11	0
2	Satellite Communication: Basic Principles, Definitions, satellite orbits, ground segments, space segment, Link analysis, LEO, MEO, geosynchronous orbit satellites, Link parameters – C/N Ratio, G/T ratio, EIRP	11	0
3	Radiometry: Introduction to TV signal standards, scanning principles, composite video, VSB transmission, colour transmission, TV Signals Transmission and Reception, HDTV principles.	10	0
4	Radar Communications: Nature of Radar and Radar equations, CW and FM radar, MTI radar, Pulse Doppler Radar, Scanning and Tracking Radars, Radar Displays and Radar Beacons.	10	0
5	Antennas: Antenna Basics, Parameters, Antenna Family, Loop, slot, patch, Horn, Helical and Reflector antennas, Antennas for special applications and Antennas for mobile applications	10	0

Text Books:

1. Annapoorna Das: “Microwave engineering”, 2nd edition, McGraw-Hill, 2017.
2. Samuel. Y. Liao: “Microwave Devices and Circuits”, 3rd edition, Prentice Hall, 2004.
3. M I Skolnik: “Introduction to Radar”, 4th edition, McGraw-Hill, 2004

Reference Books:

1. Kennedy: “Communication Systems”, 5th edition, McGraw-Hill, 2011
2. D Kraus: “Antennas for all applications”, 2nd edition, McGraw-Hill, 2008.

Web/Digital resources:

1. Microwave Communication basics by Morgan Kurk, www.commscope.com

SWAYAM/NPTEL:

1. Video lecture- Microwaves, nptel.ac.in-IIT, Bombay

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open Source Tool	Programming

Self-Learning Exercises:

1. Simulation

Course Articulation:

22EC520	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1											2	2	
CO2	3	3											2	2	
CO3	3	3											2	2	
CO4	3	3			3				3				2	2	

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC530	<i>Total Credits</i>	3	<i>Course Type</i>	<i>Professional Core Course</i>		
<i>Course Title</i>	Control Systems						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	26	1	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	65	4	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Signals and Systems, Engineering Mathematics

COURSE OBJECTIVE:

1. To develop theoretical concepts and analytical skills in modeling and control of different engineering systems.
2. To inculcate modern software skills for modeling, analysis and design using transfer function and state approach from both time domain and frequency domain perspective.

COURSE OUTCOMES (COs)

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the physical systems as mathematical model.	L2
CO2	Analyze various properties of the control systems in time domain and frequency domain using appropriate tools.	L3
CO3	Design and test the controllers for transfer function and state-space models.	L3
CO4	Evaluate the state-space models of systems using appropriate tools.	L4
CO5	Demonstrate the performance of controllers using modern tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	System Modeling: Review of Signals, Systems, Fourier and Laplace transform, Concept of feedback control, transfer function and state-space modeling of mechanical, electrical and electromechanical systems, Block diagram representation and its algebra, Signal flow graphs and Mason's gain formula. SLE: Transfer function and State space model of Boeing aircraft, Satellite, Power systems	8	5

2	Time domain analysis: Effect of pole-zero location and addition, step response and impulse response of the standard first and second order systems, Stability w.r.t. transfer function and state-space (external and internal stability), Routh-Hurwitz method, Steady state error analysis of Type-0,1,2 systems. SLE: Lyapunov's stability theorems	8	5
3	Controller Design for TF: Design of classical PI, PD and PID controllers, Root-locus of a basic feedback system and rules for sketching RL, Design of Phase-lead controller using Root-Locus. SLE: PID control design using MATLAB,	8	5
4	Controller Design for SS: State-space design and its advantages, solution of state-equations, Canonical models, Controllability and Observability Properties, full-state feedback control,selection of pole locations for good design, estimator/observer design, combined control law and estimator. SLE: Linear Quadratic Regulator (LQR)	8	5
5	Design in Frequency Domain: Frequency response of LTI system and Bode plots, Nyquist stability criterion, stability margins, closed-loop frequency response, design of Phase lead compensator using Bode plots. SLE: Design of Phase-lead and lag compensator using MATLAB	7	6

Text Books:

1. G. F. Franklin., G. D. Powell., A. E. Naeini, "Feedback Control of Dynamic Systems", Pearson Education, 5th Edition, 2002.
2. M. Gopal, "Control Systems: Principles and Design", Tata Mc Graw Hill, 2012.

Reference Books:

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, 2006.
2. S. K. Bhattacharya, "Control Systems Engineering", Pearson Education, 2005.

Web Resources:

1. https://www.youtube.com/watch?v=vVFDm_CdQw
2. <https://www.youtube.com/channel/UCq0imsn84ShAe9PBOFnoIrg>

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/107106081>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open-Source Tool	Programming

Self-Learning Exercises:

1. Simulation

Course Articulation:

22EC530	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1											2		
CO2	3	3											2		
CO3	2	2											2		
CO4	2	2											2		
CO5	3	3											2		

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication						
Course Code	22EC540	Total Credits	4	Course Type	Professional Core Course		
Course Title	Digital Signal Processing						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	26	1	Weightage	40 %	60 %	100 %
	Practical	-	-	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	65	4	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Signals and Systems

COURSE OBJECTIVE: To make students learn digital signal processing techniques, DFT and FFT techniques. The course will enable students to analyze, design and realize digital filters.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain and analyze the representation of discrete-time signals in frequency domain and its properties, using discrete Fourier transform.	L4
CO2	Apply FFT algorithms to compute DFT	L3
CO3	Analyze, design and realize digital filters for the given specifications	L4
CO4	Analyze and Implement applications of Digital Signal Processing algorithms using computer aided tool	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Discrete Fourier Transform: Introduction to DFT, Frequency domain sampling and reconstruction of discrete time signals, DFT as a linear transformation, its relationship with other transforms. Direct computation of DFT, Properties of DFT. Use of DFT in linear filtering	8	6

	SLE: Sampling theorem		
2	FFT Algorithms: DIT and DIF algorithms for computing DFT and IDFT. SLE: Goertzel algorithm, Chirp-Z Transform	8	5
3	IIR Filters: Introduction to IIR filters, characteristics of commonly used analog filters, frequency transformations, design of IIR filters from analog filters using IIT and BLT techniques. SLE: Round-off and finite word length effects in digital filters	8	5
4	FIR Filters: Introduction to FIR filters, Design of FIR filters using windowing and frequency sampling techniques. Quantization of filter coefficients, SLE: Hilbert transform	8	5
5	Digital Filter Realization: Direct form-I, direct form-II, Transposed, cascade, parallel and lattice methods of realizations of FIR and IIR filters. Introduction to multirate signal processing and Digital signal processors SLE: Applications of signal processing	7	5

Text Books:

1. Proakis and Manolakis, "Digital signal processing – Principles, Algorithms and Applications", Pearson Education, 4th Edition, 2007.
2. Oppenheim and Schaffer, "Discrete time signal processing", PHI, 2003.
3. S.K. Mitra, "Digital signal Processing", TMH, 2004.

Web/Digital resources:

1. IEEE Transactions on Signal Processing.
2. <https://nptel.ac.in/courses/117102060>

Self-Learning Exercises:

1. Case Study projects
2. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3											3			
CO2	3	3											3			
CO3	3	3	3	3									3	3		
CO4	3	3	3	3	3				3	3			3	3		

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC551	<i>Total Credits</i>	3	<i>Course Type</i>	Professional Elective		
<i>Course Title</i>	Solid State Electronics						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45* Marks

COURSE PREREQUISITE: Elements of Electronics Engineering, Analog Electronic Circuits

COURSE OBJECTIVE:

1. To understand the basic physics of semiconductor electronic devices such as importance of electrons and holes in semiconductors, the charge density and distribution, the charge transport mechanisms.
2. To the physics of a p-n junction and semiconductor-metal junctions.
3. To understand the internal workings of the most basic solid state electronic devices.
4. To understand and analyze the second order effects in MESFET and MOSFET.
5. To learn the concepts of opto-electronic devices

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the crystal structures of elements used for fabrication of semiconductor devices	L2
CO2	Analyze energy band structure and charge carrier in semiconductor devices	L2
CO3	Explain the fabrication process of semiconductor devices.	L2
CO4	Demonstrate the characteristics of semiconductor devices such as GaAs MESFET and MOSFET.	L2
CO5	Explain the concepts used in optoelectronic devices.	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	CRYSTAL PROPERTIES AND GROWTH OF SEMICONDUCTORS Semiconductor materials- Periodic Structures- Crystal Lattices- Cubic lattices –Planes and Directions-The Diamond lattice- Bulk Crystal Growth-Starting Materials-Growth of Single Crystal Ingots-Wafers-Doping-Epitaxial Growth –Lattice Matching in Epitaxial Growth –Vapour –Phase Epitaxy-Atoms and Electrons-Introduction to Physical Models.	08	0
2	ENERGY BANDS AND CHARGE CARRIERS IN SEMICONDUCTORS: Bonding Forces and Energy bands in Solids-Bonding Forces in Solids-Energy Bands-Metals, Semiconductors, and Insulators – Direct and Indirect Semiconductors –Variation of Energy Bands with Alloy Composition-Charge Carriers in Semiconductors-Electrons and Holes-Effective Mass-Intrinsic Material-Extrinsic Material – Electrons and Holes in Quantum Wells-Carrier Concentrations-The Fermi Level-Electron and Hole Concentrations at Equilibrium-Temperature Dependence of Carrier Concentrations. Drift and diffusion current.	08	0
3	FABRICATION TECHNIQUES: Fabrication of P-N Junctions-Thermal Oxidation-Diffusion –Rapid Thermal Processing-Ion Implantation-Chemical Vapour Deposition Photolithography-Etching –Metallization-Equilibrium Conditions-The Contact Potential-Equilibrium Fermi Levels –Space Charge at a Junction-Forward –and Reverse –Biased Junctions; -Steady state conditions-Qualitative Description of current flow at a junction-Carrier Injection.	08	0
4	THE METAL –SEMICONDUCTOR-FET The GaAS MESFET-The High Electron Mobility Transistor –Short channel Effects-The Metal Insulator Semiconductor FET-Basic Operation and Fabrication –THE ideal MOS Capacitor-Effects of Real Surfaces-Threshold Voltage –MOS capacitance Measurements- current –Voltage Characteristics of MOS Gate Oxides -The MOS Field –Effect Transistor –Output characteristics-Transfer characteristics- Mobility Models-Short channel MOSFET I-V characteristics –Control of Threshold Voltage –Substrate Bias Effects-Sub threshold characteristics –Equivalent Circuit for the MOSFET.	08	0
5	OPTOELECTRONIC DEVICES: Photo diodes-Current and Voltage in illuminated Junction-Solar Cells-Photo detectors-Noise and Bandwidth of Photo detectors-Light-Emitting Diodes-Light Emitting Materials-Fiber Optic Communications Multilayer Heterojunctions for LEDs- Lasers-Semiconductor lasers-Population Inversion at a Junction Emission Spectra for p-n junction-The Basic Semiconductor lasers-Materials for Semiconductor lasers	07	0

Text Books:

1. Ben.G. Streetman and Sanjan Banerjee “ Solid State Electronic Devices”, PHI Private Ltd, 5th Edition, 2003

Reference Books:

1. Yannis & Tsividis” Operation & Mode line of The MOS Transistor” Oxford University Press, 2nd Edition,1999.
2. Nandita Das Gupta and Aamitava Das Gupta, “Semiconductor Devices Modelling a Technology, PHI, 2004.

SWAYAM/NPTEL:

1. <http://www.nitttrc.edu.in/nptel/courses/video/117106091/L01.html>

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3	2										3		
CO4	3	3			2								3		
CO5	3	3	2										3		

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC552	Total Credits	3	Course Type	Professional Elective - I		
Course Title	Neural Networks and Machine Learning						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Students should be familiar with basic mathematics.

COURSE OBJECTIVE:

1. To make students learn the concepts of neural network architecture and algorithms.
2. To learn supervised and unsupervised machine learning algorithms.

COURSEOUT COMES (COs):

CO #	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the theoretical foundation of neural networks and machine learning.	L2
CO2	Analyze neural network architecture and algorithms.	L4
CO3	Analyze supervised and unsupervised machine learning algorithms.	L4
CO4	Demonstrate the real-world applications using neural networks and Machine Learning	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Linear Regression and Classification: Problem Formulation, Parameter Estimation: Maximum Likelihood Estimation, Overfitting in Linear Regression, Maximum A Posteriori Estimation, MAP Estimation as Regularization, Bayesian Linear Regression, Confusion matrix, Classification matrix.	8	0
2	Dimensionality Reduction with Principal Component Analysis: Problem Setting, Maximum variance perspective: Direction with maximal variance, M-dimensional subspace with Maximal variance, Projection Perspective: Setting and objective, Finding Optimal Coordinates, Finding the Basis of the Principal Subspace, Eigenvector Computation, and Low – Rank Approximations, PCA in High Dimensions, Optimization, Optimization techniques, Contractual, nonstructural.	8	0
3	Neural Network: Introduction, Network Architectures, learning process, Rosenblatt perceptron, algorithm for linearly separable data, implementation of Boolean functions using neurons. Multilayer Perceptrons: Batch Learning and On-Line Learning, The Back-Propagation Algorithm, Back Propagation and differentiations, The Minimum Description-Length Principle, Convolutional Networks, Small-scale Versus Large-Scale Learning Process.	8	0
4	Kernel Methods and Radial-Basis Function Networks: Cover's Theorem on the separability of patterns, The Interpolation Problem, Radial-Basis-Function Networks, K-means Clustering, Recursive Least-squares estimation of the Weight Vector, Hybrid Learning Procedure for RBF Networks, Interpretations of the Gaussian Hidden Units, Kernel Regression and Its Relation to RBF Networks, The Support Vector Machine Viewed as a Kernel Machine, Design of Support Vector Machines.	8	0
5	Regularization Theory: Regularization Networks, semi supervised Learning, Manifold Regularized: Preliminary Considerations, Differentiable Manifolds, Spectral Graph Theory, Laplacian Regularized Least mean squares algorithm.	7	0

Text Books:

1. Cheistopher M. Bishop “Pattern Recognition and Machine Learning” Springer, Second Indian Reprint, 2015.
2. Simon Haykin “Neural networks and Learning Machines” Pearson, 3rd Edition. 2016.

Reference Books:

1. Tomm. Mitchell “Machine Learning” McGraw Hill Education, 22nd reprint 2018.
2. Bekkerman, Ron, Mikhail Bilenko, and John Langford, eds. “Scaling up machine learning: Parallel and distributed approaches” Cambridge University Press, 2011.
3. Frank Pane, “Hands-On Data Science and Python Machine Learning”, Packt Publishers 2017.

Journals/Magazines:

1. Machine Learning, Springer, <https://www.springer.com/journal/10994>.
2. IEEE Transactions on Neural Networks and Learning Systems, IEEE. <https://ieeexplore.ieee.org/xpl/aboutJournal.jsp?punumber=5962385>.

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/117105084>
2. https://onlinecourses.nptel.ac.in/noc22_cs29/preview
3. <https://nptel.ac.in/courses/106105152>

Self-Learning Exercises:

6. CaseStudyprojects
7. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3											3	2	
CO3	3	3											3	2	
CO4	3	3	3	3	3				3	3			3	3	3

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC553	<i>Total Credits</i>	3	<i>Course Type</i>	<i>Professional Elective Course</i>		
<i>Course Title</i>	<i>Principles of Wireless Communication Systems</i>						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of Electronic Communication

COURSE OBJECTIVE:

1. To conceptualize the system design specifications and characterize a wireless channel
2. To understand the architecture of different cellular systems.

COURSE OUTCOMES (COs)

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe the cellular concepts and propagation mechanism in wireless channels.	L2
CO2	Analyze fading mechanism for the wireless communication system	L3
CO3	Analyze the architecture and performance of different cellular systems.	L3
CO4	Demonstrate the application of wireless communication technique through simulation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction To Wireless Communication: Evolution of Mobile Radio Communication, Examples of Wireless Communication Systems. Paging system, Cordless telephones systems, Cellular telephone Systems, Cellular concept: Frequency reuse, Channel Assignment strategies, Hand off strategies. Interference and System capacity, Improving coverage and capacity in cellular systems.	8	0

2	Radio Propagation: Large Scale Fading: Free space propagation model, three basic propagation mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical link budget using path loss models. Small Scale Fading: Multipath Propagation, Types of small-scale fading, Parameters of Mobile Multipath channels, Fading effects due to multipath time delay Spread and Doppler spread.	8	0
3	Equalization: Fundamentals of Equalizers, Linear equalizers, Non-linear equalizers, Decision feedback equalizers, MLSE. Diversity Techniques: Space diversity: MRC, EGC Selection diversity, Polarization diversity, Frequency diversity, Time diversity.	8	0
4	Global System for Mobile (GSM): Historical overview, System overview, Their interface, Logical and physical channels, Synchronization, Coding, Equalizer, Circuit-switched data transmission, Establishing a connection and hand over, Services and billing.	8	0
5	CDMA: Historical overview, System overview, Air interface, Coding, Spreading and Modulation, Logical and Physical channels, Handover.	7	0

Text Books:

1. Theodore S. Rappaport, "Wireless Communications Principles and Practice", 2nd Edition, Pearson Education, 2014.
2. Andreas F. Molisch, "Wireless Communications", 3rd Edition, John Wiley, 2020.
4. Mullet, "Introduction to wireless telecommunication systems and networks", Cengage Learning 2016

Reference Books:

1. Kamilo Feher, "Wireless Digital Communications", 3rd Edition, PHI, 2015
2. W.C.Y. Lee, "Mobile Cellular Communications", 2nd Edition, McGraw Hill, 2006.
3. Yi-Bing Lin, "Wireless and Mobile Network Architectures", 2nd Edition, Wiley, 2008.

SWAYAM/NPTEL:

<https://nptel.ac.in/courses/117102062>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill / Ability
1	Simulation	Any open-source tool	Programming

Self-Learning Exercises:

1. Simulation

20EC553	Program Outcomes												Program Specific Outcomes		
	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	PSO3
CO1	3	2											2	2	
CO2	2												2		
CO3	2												2		
CO4	3	3			3				3		3		2	2	

Course Articulation:

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC554	<i>Total Credits</i>	3	<i>Course Type</i>	Professional Elective Course		
<i>Course Title</i>	Smart Electronic Materials						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Basic concepts of electronics and fundamentals of material physics.

COURSE OBJECTIVE:

1. To acquaint with various kinds of smart materials for device application.
2. To study the effect of structures on the properties of materials.

COURSE OUTCOMES (COs): After completing the course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Design simple functional structures using smart materials.	L3
CO2	Apply the mechanism to synthesize and fabricate smart electronic materials.	L3
CO3	Analyze the properties of smart materials and nanocomposites with their applications.	L4
CO4	Demonstrate the skill sets to simulate the applications of smart electronic materials.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to material science and engineering , crystal geometry and structure determination, fundamental concepts of molecular nanotechnology, current research and approaches towards nanomaterials, biomaterials, speculative, tools and techniques, applications, implications. Introduction to quantum mechanics.	8	0

2	Fullerence: Prediction and discovery, variations, buckyball, properties of Fullerence. Carbon Nanotubes: Types of carbon nanotubes and related structures, properties and applications, Boron Nitride nanotubes, selective chemistry of single walled nanotubes Nanowire: Synthesis of nanowires, physics, molecular wires and fabrication, solar nanowires.	8	0
3	Self-Assembly: Mechanism and examples of self-assembly, Nanophotonics: Components of nanophotonic system, Nanomaterial Synthesis and Application: Introduction, uniformity, properties, nanoscale and nanoshell particles, nanotoxicity.	8	0
4	Properties of Smart materials: Electrical properties, optical properties, the colored glasses. Other nanomaterials: Importance of nanomaterials, nano-Optics, nano-Magnetics, nano-Electronics materials, shape memory alloys etc.	8	0
5	Nanocomposites and their applications: Nanocomposites clay based, nanoceramic composites, metal and oxide nanocomposites, processing and characterization, nanotechnology in electronics and allied industries.	7	0

Text Books:

1. Breck, W. (2016). NANOTECHNOLOGY VOL.1. CBS Publishers and Distributors Private Limited.
2. Breck, W. (2018). NANOTECHNOLOGY VOL.2. CBS Publishers and Distributors Private Limited.

Reference Books:

1. V Raghavan. (2015). Materials science and engineering : a first course. Phi Learning Private Limited.
2. Kulkarni, S. K. (2019). Nanotechnology: Principles and Practices. Springer.



Journals/Magazines:

1. Shehata, N., Sayed, E. T., Abdelkareem, M. A., Ali, G. A. M., and Olabi, A.-G. (2022). Smart Electronic Materials. *Encyclopedia of Smart Materials*, 300–309. <https://doi.org/10.1016/b978-0-12-815732-9.00066-8>
2. <https://www.sciencedirect.com/journal/materials-today-electronics>
3. <https://iopscience.iop.org/journal/0964-1726>

SWAYAM/NPTEL:

<https://nptel.ac.in/courses/112104173>

Self-Learning Exercises:

Nanotechnology in Auto Industry, Nanomaterials for Energy storage and Conversion, Nanotechnology in Energy

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3													
CO2	3	3	3											3	
CO3	3		3	3										3	3
CO4	3	3	3	3	2				3					3	3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC555	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Data Structures and Algorithms						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Student should be familiar with basic concepts of C programming.

COURSE OBJECTIVE:

1. To get expertise in Object Oriented programming using C++ and implement various data structures in problem solving and applications

COURSE OUTCOMES (COs): After the completion of the course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Demonstrate the programming skills through Object Oriented Programming (OOP)	L3
CO2	Apply programming skills through OOPs for efficient storage mechanisms of data for an easy access	L3
CO3	Design, evaluate and implement various basic and advanced data structures for skill enhancement in problem solving	L3
CO4	Develop, analyze and demonstrate innovative programming solutions for specific problems	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Object Oriented Programming (OOP) using C++: Introduction to C++, declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Operators in C++ other than C, Functions in C++, Basic Concepts of OOP, advantages, Classes and Objects, Data abstraction and encapsulation, Polymorphism, Inheritance, Constructors and Destructors, Virtual Functions.	8	0
2	Data Structures: Space and time complexity, Introduction Data Structures, Types of Data Structures. Introduction to Arrays, Matrices, Stacks and Queues, Stacks Operation, abstract data types	8	0

	(ADT), implementation, applications of stacks. Queues, ADT, implementation of queues and its applications. Introduction to circular queues, double ended queues.		
3	Linked Lists: Introduction, Linked Lists, abstract data type, sequential and linked representations, comparison of insertion, deletion and search operations for linked lists, circular lists, skip lists and hashing: Search efficiency in lists and skip lists, hashing as a search structure, hash table. double hashing.	8	0
4	Trees: Binary trees and their properties, terminology, types and representation of trees, tree traversal methods and algorithms, Search Trees: Binary search trees, search efficiency, insertion and deletion operations, AVL trees, searching, insertion and deletions in AVL trees, applications of trees	8	0
5	Graphs: Definition, terminology, directed and undirected graphs, properties, connectivity in graphs, graph traversal – breadth first and depth first, applications of graphs. Algorithm Design Techniques: Dijkstra's Algorithm, Greedy algorithm (Minimum Spanning Tree), back tracking.	7	0

Text Books:

1. SartaSahni, S, “Data Structures, Algorithms, and Applications in C++”, 3rd Edition, McGraw- Hill Education, 2001
2. E. Balaguruswamy, “Object Oriented Programming with C++”, Sixth Edition, McGraw Hill Education, 2014.
3. Vaidyanathan, “Data Structures, Algorithms and Applications in C++”, 1st Edition, CBS Publications, 2013.

Reference Books:

1. Michael T. Goodrich, “Data Structures and Algorithm Analysis in C++”, Third Edition, Pearson Education, 2009
2. Drozdek, A, “ Data Structures and Algorithms in C ++”, Vikas Publishing House, Edition 2002

Web/Digital resources :

<https://www.classcentral.com/course/swayam-programming-data-structures-and-algorithms-2778>



SWAYAM/NPTEL :

1. [https://nptel.ac.in/courses/\(106102064 or 106106127 or 106103069\)](https://nptel.ac.in/courses/(106102064%20or%20106106127%20or%20106103069))
2. http://www.nptelvideos.com/computer_science/datastructures_algorithms.php
3. https://onlinecourses.swayam2.ac.in/cec19_cs04/preview

Self-Learning Exercises:**8. Mini Projects****9. Programming Skill Development****Course Articulation:**

COURSE OUTCOME S ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2	3	3												3	
CO3	3	3	3										3	3	
CO4	3	3	3	3	3				3	3			3	3	

High – 3, Medium – 2, Low – 1

V SEMESTER OPEN ELECTIVES

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC561	Total Credits	3	Course Type	Open Elective Course -1		
Course Title	CMOS VLSI Circuits						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Student should be familiar with basic concepts of Electronics.

COURSE OBJECTIVE:

1. To learn basic CMOS Circuits, CMOS process technology, CMOS circuits that realize specified digital functions,
2. Understanding of the characteristics of CMOS circuit, apply CMOS technology-specific layout rules.
3. To design CMOS combinational and sequential logic at the transistor level.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the basic MOS technology and circuit design processes.	L2
CO2	Apply the Lambda based design rules to generate layout of simple MOS circuit for subsystem design.	L3
CO3	Analyze the CMOS Logic structures for VLSI applications.	L2
CO4	Explain the working of CMOS sub systems.	L2
CO5	Demonstrate the working of CMOS logic circuits using EDA tool.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Basic MOS Technology: enhancement and depletion mode MOS transistors. nMOS fabrication. CMOS fabrication, MOS transistor theory Introduction, MOS device design equations, the complementary CMOS inverter-DC characteristics, static load MOS inverters.	8	0
2	Circuit Design Processes: MOS layers, stick diagrams, Design rules and layout- lambda-based design and other rules, layout diagrams, basic physical design of simple logic gates.	8	0
3	CMOS Logic Structures: CMOS complementary logic, BiCMOS logic, Pseudo-nMOS logic, Dynamic CMOS logic, clocked CMOS logic, Pass transistor logic, CMOS domino logic cascaded voltage switch logic (CVSL).	8	0
4	Basic circuit concepts: Sheet resistance, area capacitances, capacitances calculations. The delay unit, inverter delays, driving capacitive loads, propagation delays, wiring capacitances. Scaling of MOS circuits - Scaling models and factors.	8	0
5	CMOS subsystem design: Architectural issues, switch logic, gate logic, design examples-combinational logic, clocked circuits, clocking strategies. General considerations, process illustration, ALU subsystem, adders, multipliers.	7	0

Text Books:

1. Douglas. A. Pucknell, Kamran Eshragian: “Basic VLSI Design,” 3rd Edition, Eastern Economy Edition, 2005.
2. Neil H.E. Weste, David Harris, AyanBannerjee: “CMOS VLSI Design: A Circuits and Systems Perspective,” 3rd Edition, Published by Pearson Education, 2005.

Reference Books:

1. R. Jacob, W. Li, David .E. Boyce: “CMOS Circuit Design, Layout, and Simulation,” Prentice Hall India, 1998.
2. Sung-Mo Kang, Yusuf Leblebici: “Cmos Digital Integrated Circuits Analysis And Design,” 2nd Edition, McGraw Hill, 2003.

Journals/Magazines: Use APA format.

Web/Digital resources:

1. <https://youtu.be/Gv5fESGW2Ms?list=PLNhFkFk6qEgLx8XgE38cYNgI1wldYxXZ>
- 2 <https://youtu.be/1Rpt1fCHd8Y?list=PLCmoXVuSEVHIEJi3SwdyJ4EICffuyqjpk>
- 3 <https://youtu.be/o9vEnzLL-1Y?list=PLojsqdbIzJGQtub91c4fF-TcCdzVYAInM>



Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											2	2	
CO2	3	3	3										2	2	
CO3	3	3											2	2	
CO4	3	3											2	2	
CO5	3	3	3		3						2		2	2	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC562	Total Credits	3	Course Type	Open Elective Course		
Course Title	Sensors and Actuators						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of electronics, physics and chemistry.

COURSE OBJECTIVE:

1. To understand the working principles of sensors, transducers and actuators
2. To learn the simulation techniques and hardware interfacing of sensors and actuators for a given application

COURSE OUTCOMES (COs): After the completion of the course the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the fundamentals of Sensors and its working principle	L2
CO2	Select the type of sensor required for a particular application	L3
CO3	Outline the applications of sensors	L2
CO4	Apply the actuation principles involved in practical applications	L3
CO5	Demonstrate the real time applications of sensors through team work	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNI T No.	Content	Hours	
		Lecture	Tutorial
1	Sensor Fundamentals: Basic Sensor Technology, Sensor Systems, Sensor Characteristics, System Characteristics, Instrument Selection, Sensor Signal Conditioning	8	0
2	Optical Sensors: Overview of Fibre optic sensors, luminescence-based sensors, absorption-based sensors, surface plasmon resonance-based sensors Applications: Structural Health Monitoring Flow and Level Sensors, Methods for Measuring Flow, Strain Gage Sensors	8	0
3	Biosensor: Overview, Applications of Biosensors, Origin of Biosensors, Bioreceptor Molecules, Transduction Mechanisms in Biosensors, Application, Range of Biosensors.	8	0
4	Actuators: Introduction, Functional components of an actuator, Actuator as a system component, Intelligent & Self sensing actuators, microactuation, MEMS with microactuators, piezoelectric actuators, Application examples (Automatic anti-lock braking systems).	8	0
5	Nanotechnology-Enabled Sensors: Possibilities, Realities, Applications. Sensor Networking IoT: Introduction, Fields Using Sensor Networking	7	0

Text Books:

1. Jon S Wilson, "Sensor Technology handbook", Elsevier, 2005
2. John R. Vacca, "Handbook of Sensor Networking", CRC Press, 2014.
3. Nathan Ida, "Sensors, Actuators, and their Interfaces", SciTech Publishing Inc, 2nd Edition, 2020.

Reference Books:

1. Ignacio Del Villar, Ignacio R. Matias, “Optical Fibre Sensors: Fundamentals for Development of Optimized Devices”, Wiley Publications, 2020.
2. Tai-Ran Hsu, “MEMS & Microsystems Design and Manufacture”, Tata McGraw Hill, 2007.
3. Clarence W. de Silva, “Sensors and Actuators Engineering System Instrumentation”, CRC Press, 2nd Edition, 2016.

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Mini project (hardware)	Sensors, transducers, actuators, controllers	Hardware Interfacing
2	Simulation	Any open-source tool	Programming

Self-Learning Exercises:

1. Case Study
2. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO 1	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	PS O3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3											3		
CO4	3	3											3		
CO5	3	3	2		2				2	2			3		

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC563	<i>Total Credits</i>	3	<i>Course Type</i>	Open Elective Course		
<i>Course Title</i>	Wireless Communication						
<i>Teaching Learning Process</i>		<i>Cont act Hours</i>	<i>Cr edi ts</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of electronics.

COURSE OBJECTIVE:

1. To understand the principles of mobile communication
2. To study the recent trends adopted in cellular systems and wireless standards.

COURSE OUTCOMES (COs): After the completion of the course the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the cellular concept architecture and propagation models.	L2
CO2	Apply the basic knowledge of interference and system capacity, power control and propagation models in solving and designing a cellular system.	L3
CO3	Demonstrate cellular architecture, GSM roaming and handover scenarios using simulation tools.	L3
CO4	Demonstrate in teams to implement assigned tasks related to advanced topics.	L3
CO5	Demonstrate cellular architecture, CDMA roaming and handover scenarios using simulation/virtual labs tools	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNI T No.	Content	Hours	
		Lecture	Tutorials
1	<p>Radio Propagation: Antennas and channel fundamentals: Large Scale Path Loss- Free Space Model, three basic propagation mechanisms, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models – Okumura, Hata, PCS Extension to Hata Model.</p> <p>Cellular Concept: Frequency Reuse, Channel Assignment Strategies, Interference and System Capacity, Power Control for Reducing Interference, Trunking and Grade of Service, Improving Capacity in Cellular Systems.</p>	8	0
2	<p>Mobile Radio Propagation: Small-Scale Fading and Multipath: Small scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small-Scale Multipath Measurements, Parameters of Mobile Multipath Channels, Types of Small-Scale Fading, Rayleigh and Ricean Distributions, Statistical Model for Multipath Fading Channels (Clarke’s Model for Flat Fading only).</p>	8	0
3	<p>System Architecture and Addressing: System architecture, The SIM concept, Addressing, Registers and subscriber data, Location registers (HLR and VLR) Security-related registers (AUC and EIR), Subscriber data, Network interfaces and configurations.</p> <p>Air Interface – GSM Physical Layer: Logical channels, Physical channels, Synchronization- Frequency and clock synchronization, Adaptive frame synchronization, Mapping of logical onto physical channels, Radio subsystem link control, Channel coding, source coding and speech processing, Source coding and speech processing, Channel coding, Power-up scenario.</p> <p>GSM Protocols: Protocol architecture planes, Protocol architecture of the user plane, Protocol architecture of the signaling plane, Signaling at the air interface (Um), Signaling at the A and Abis interfaces, Security-related network functions, Signaling at the user interface.</p>	8	0
4	<p>GSM Roaming Scenarios and Handover: Mobile application part interfaces, Location registration and location update, Connection establishment and termination, Handover.</p> <p>Services: Classical GSM services, Popular GSM services: SMS and MMS. Improved data services in GSM: GPRS, HSCSD and EDGE GPRS System architecture of GPRS, Services, Session management, mobility management and routing, Protocol architecture, Signaling plane, Interworking with IP networks, Air interface, Authentication and ciphering, Summary of GPRS. HSCSD: Architecture, Air interface, HSCSD resource allocation and capacity issues. EDGE: The EDGE concept, EDGE physical layer, modulation and coding, EDGE: effects on the GSM system architecture, ECSD and EGPRS.</p>	8	0

5	CDMA Technology – Introduction to CDMA, CDMA frequency bands, CDMA Network and System Architecture, CDMA Channel concept, Forward Logical Channels, Reverse logical Channels, CDMA frame format, CDMA System Operations(Initialization/Registration), Call Establishment, CDMA Call handoff, IS-95B, CDMA2000, W-CDMA, UMTS,CDMA data networks, Evolution of CDMA to 3G, CDMA 2000 RAN Components, CDMA 2000 Packet Data Service.	7	0
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Text Books:

1. Theodore S Rapport, “Wireless Communications – Principles and Practice”, Prentice Hall of India, 2nd Edition, 2007, ISBN 978-8-120-32381-0.
2. Jorg Eberspacher, Hans-Jorg Vogel, Christian Bettstetter, Christian Hartmann, "GSM–Architecture, Protocols and Services”, Wiley,3rd Edition, 2009, ISBN-978- 0-470-03070-7.

Reference Books:

1. W.C.Y. Lee, “Mobile Cellular Communications", 2nd Edition, MC Graw Hill, 1995.
2. Yi-Bing Lin, “Wireless and Mobile Network Architecture”, 2nd Edition, Wiley publications 2008.



PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Hardware/ Mini project	GSM/GPS hardware interfacing	Hardware integration/pr ogramming
2	Simulation/Virtual Lab	Any open source tool	Simulation techniques

Self-Learning Exercises:

1. Case Study projects
2. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO 1	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	PS O3
CO1	3	2	2												
CO2	3	2	2		2										
CO3	3	3	2		2								2		
CO4	3	2	2		2				2	2		2	2	2	
CO5	3	2	2		2				2	2		2	2	2	

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	<i>Electronics and Communication Engineering</i>						
<i>Course Code</i>	<i>22EC564</i>	<i>Total Credits</i>	<i>3</i>	<i>Course Type</i>	<i>Open Elective Course</i>		
<i>Course Title</i>	<i>Control Systems</i>						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	<i>39</i>	<i>3</i>		<i>CIE</i>	<i>SEE</i>	<i>Total</i>
	<i>Tutorial</i>	<i>0</i>	<i>0</i>	<i>Weightage</i>	<i>40 %</i>	<i>60 %</i>	<i>100 %</i>
	<i>Practical</i>	<i>0</i>	<i>0</i>	<i>Maximum Marks</i>	<i>40 Marks</i>	<i>60 Marks</i>	<i>100 Marks</i>
	<i>Total</i>	<i>39</i>	<i>3</i>	<i>Minimum Marks</i>	<i>20 marks</i>	<i>25 marks</i>	<i>45 Marks</i>

COURSE PREREQUISITE:

Elements of Electronics Engineering

COURSE OBJECTIVE:

1. To understand the basic concepts to construct a system that has a desirable response to standard inputs.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Represent physical systems as mathematical models.	L2
CO2	Explain the concept of LTI control systems, Importance of feedback in Control System and illustrate stability concept.	L2
CO3	Analyse various properties of the control systems in time domain and frequency domain using appropriate tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	System Modeling: Basics of Signals, Systems, Fourier and Laplace transform, Concept of feedback control, transfer function modeling of mechanical, electrical and electromechanical systems, Block diagram representation and its algebra, Signal flow graphs and Mason's gain formula.	8	0
2	Time domain analysis: Effect of pole-zero location and addition, step response and impulse response of the standard first and second order systems, BIBO stability, Steady state error analysis of Type-0,1,2 systems. Root locus technique	8	0
3	Frequency Domain Analysis: Frequency response of LTI system and Bode plots, Nyquist stability criterion, stability margins, closed-loop frequency response,	8	0
4	Controllers and compensators classical PI, PD and PID controllers, Root-locus of a basic feedback system. Phase lead, Phase lag and lag-lead compensators.	8	0
5	State-space modeling: For mechanical, electrical and electromechanical systems, Relation between SS model and TF model, solution of state equation.	7	0

Text Books:

1. G. F. Franklin., G. D. Powell., A. E. Naeini, "Feedback Control of Dynamic Systems", Pearson Education, 5th Edition, 2002.
2. M. Gopal, "Control Systems: Principles and Design", Tata Mc Graw Hill, 2012.

Reference Books:

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, 2006.
2. S. K. Bhattacharya, "Control Systems Engineering", Pearson Education, 2005.

Web Resources:

1. Dr. M. Gopal https://www.youtube.com/watch?v=vVFDm_CdQw
2. <https://www.youtube.com/channel/UCq0imsn84ShAe9PBOFnoIrg>



SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/107106081>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open Source Tool	Programming

Self-Learning Exercises:

1. Simulation

Course Articulation:

22EC564OE	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1											2		
CO2	3	3											2		
CO3	3	3											2		

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC565	<i>Total Credits</i>	3	<i>Course Type</i>	Open Elective Course		
<i>Course Title</i>	Smart Materials						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of mechanics of materials, physics and chemistry.

COURSE OBJECTIVE:

1. To understand the use of smart materials in various application
2. To understand the principles of smart materials as sensors and actuators
3. To study the synthesis and fabrication of smart materials for their applications

COURSE OUTCOMES (COs): After the completion of the course the students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the evolution of smart materials	L2
CO2	Explain the design principles of sensors, actuators and transducers in smart systems	L2
CO3	Apply the fabrication techniques for silicon and polymer-based systems	L3
CO4	Demonstrate the smart material usage in different applications	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNI T No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Smart Materials, smart systems, sensors, actuators, transducers, MEMS, scaling effects, evolution of smart materials, processing of smart materials, semiconductors processing, crystal growth from the melt, epitaxial growth, metallization techniques, bulk ceramics, thick and thin films, micromachining techniques, polymers and their synthesis, classification and methods.	8	0
2	Design principles: Sensors for smart systems, capacitive sensors, piezoelectric sensor, piezoresistive sensors, with design examples, Actuators for smart systems, electrostatic transducers, piezoelectric transducers and electrothermal actuators.	8	0
3	MEMS silicon fabrication techniques: Lithography, resist and mask formation, deposition techniques, lift-off technique, etching techniques, wafer bonding, metallization, thermal oxidation for SiO ₂ , CVD for dielectrics, polysilicon and ceramic thin film deposition. Difference between surface and bulk micromachining. LIGA Process	8	0
4	MEMS polymeric fabrication techniques: Micro stereo lithography, overview, MSL by scanning methods, projection-type method, micro-injection molding, micro photo-molding, micro hot-embossing, micro transfer molding, burnout and sintering, jet molding, powder injection molding, fabrication of 3-D structures, metal-polymer structures.	8	0
5	Applications of smart materials: Agriculture and food sectors, automotive industry, defence and space sectors.	7	0

Text Books:

1. Vijay K Vardhan, K J Vinoy. S, Goplakrishnan, “Smart Material Systems and MEMS: Design and Development Methodologies”, 1 st edition, John Wiley & Sons, Inc., 2011.
2. B.S. Murthy, P Shankar, Baldev Raj, B.B. Rath, and James Murday, “Textbook of Nanoscience and Nanotechnology”, 1st edition, Universities Press, 2012.

Reference Books:

1. Tai Ran Hsu, “MEMS and Micro Systems: Design and Manufacture”, 1st edition, Tata McGraw Hill, 2002

Web/Digital resources:

1. <https://www.sciencedirect.com/topics/chemistry/smart-material>
2. <https://nptel.ac.in/courses/112104173>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Mini project/ case study	fabrication/characterization/any open source tool	fabrication/characterization
2	Simulation/ Implementation of mini project	TCAD / multi physics simulation tool	Simulation techniques

Self-Learning Exercises:

1. Synthesis of smart materials and characterization techniques.
2. Mini projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO 1	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	PS O3
CO1	2	2											2		
CO2	3	2											2		
CO3	3	3											2		
CO4	3	3			3					2		2	2		

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication						
<i>Course Code</i>	22EC57L	<i>Total Credits</i>	1.5	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Digital Signal Processing Laboratory						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	-	-		CIE	SEE	Total
	<i>Tutorial</i>	-	-	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	39	1.5	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	1.5	<i>Minimum Marks</i>	20 marks	25 marks	45* Marks

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE OBJECTIVE:

- To make students familiar with the most important methods in DSP, including digital filter design, transform-domain processing and the importance of Signal Processors

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Analyze and verify signal processing concepts and algorithms	L4
CO2	Design and demonstrate signal processing algorithms using simulation tool and/or Hardware platform	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Explore Digital Signal Processing Virtual Laboratory of Department of Electronics and Communication Engineering Indian Institute of Technology, Kharagpur http://www.digital.iitkgp.ernet.in/dsp/expts/index.php	3
2	a) Write a MATLAB code to illustrate the Nyquist sampling theorem. The program should illustrate the effects the sampling the signal at <ul style="list-style-type: none"> ◆ Exactly the folding frequency ◆ Frequency less than the folding frequency ◆ Frequency greater than the folding frequency 	3

	<p>Plot the magnitude spectrum for all the above said cases</p> <p>b) Write a MATLAB code to compute the DTFT and DFT of a sequence $x(n)$. Also plot the magnitude spectrum of both DTFT and DFT and provide the inference on the basis of results obtained. Further compute the IDTFT and IDFT.</p>	
3	<p>Write a MATLAB code to verify the following properties of DFT</p> <p>a) Linearity b) Periodicity c) Circular shift and Circular symmetry of a sequence d) Symmetry property</p>	3
4	<p>Write a MATLAB code to verify the following properties of DFT.</p> <p>a) Circular convolution and multiplication of two sequences b) Time reversal of a sequence c) Circular time shift and Circular frequency shift of a sequence d) Parseval's theorem</p>	3
5	<p>Write a MATLAB code to compute the DFT of a sequence $x(n)$ using DIT and DIF algorithm. Also indicate the speed improvement factor in calculating the DFT of a sequence using direct computation and FFT algorithm (Use the same sequence as used in Program 2). Further compute the IDFT using IDIT and IDIF algorithm.</p>	3
6	<p>Write a MATLAB code to verify the Low pass and High Pass FIR linear phase filter design using Hamming and Hanning windows (with inbuilt and without using inbuilt commands). Plot the magnitude and phase response. Also, Provide the inference on the basis of results obtained for the set of specifications. (To design should be verified by convolving the input signal with the designed filter coefficients)</p>	3
7	<p>Write a MATLAB code to verify the Band pass and Band reject FIR linear phase filter design using Hamming and Hanning windows (with inbuilt and without using inbuilt commands). Plot the magnitude and phase response. Also, Provide the inference on the basis of results obtained for the set of specifications.</p>	3
8	<p>Write a MATLAB code to verify the Low pass Butterworth IIR filter design using bilinear transformation (BLT) method and Impulse Invariant Technique (IIT) method.</p>	3
9	<p>Write a MATLAB code to implement the Low pass Chebyshev (Type 1) IIR filter design using bilinear transformation (BLT) method and Impulse Invariant Technique (IIT) method.</p>	3
10	<p>Read the data file named ecg2x60.dat from</p> <p>http://people.ucalgary.ca/~ranga/enel563/SIGNAL_DATA_FILES/</p> <p>that is corrupted with the 60Hz noise component. Write a MATLAB code to</p>	3

	remove this 60Hz noise component from the signal using Notch filter and LMS adaptive filter. Plot the magnitude spectrum of the signal filtered using both Notch filter and LMS adaptive filter and provide the inference on the basis of results obtained.	
11	a) Write a C code to obtain the impulse response of a given system and implement the same on TMS320C6713 DSK kit. b) Write a C code to compute the linear and circular convolution and implement the same on TMS320C6713 DSK kit.	3
12	a) Write a C code to compute the cross correlation and auto correlation and implement the same on TMS320C6713 DSK kit. b) Write a C code to compute N-point DFT and IDFT of a sequence and implement the same on TMS320C6713 DSK kit.	3
13	Laboratory Test	3

Reference Books:

1. Sanjit K Mitra, “*Digital Signal Processing Laboratory Using MATLAB*”, McGraw Hill International Edition, 2002.
2. Vinay K Ingle and John G Proakis, “*Digital Signal Processing Laboratory Using MATLAB*”, 3rd Edition, Cengage Learning, 2010.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3		3				3	3			3			
CO2	3	3	3		3				3	3			3			

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC58L	<i>Total Credits</i>	1.5	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Communication Lab II						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	0	0		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	39	1.5	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	1.5	<i>Minimum Marks</i>	20 marks	25 marks	45* Marks

Note: *For passing the student has to score a minimum of 45 Marks (CIE+SEE: 20 + 25 or 21 + 24)

COURSE PREREQUISITE: Communication systems-II

COURSE OBJECTIVE:

1. To study the fundamental concepts of multiplexing, various digital modulation and demodulation techniques,
2. To understand the principles of radiation and transmission using antennas and microwave test bench.

COURSE OUTCOMES (COs): After the completion of the course the students will be able to

C O#	Course Outcomes	Highest Level of Cognitive Domain
C O1	Analyze and design data converters, digital modulation and demodulation circuits and simulate using open-source simulation tools.	L3
CO2	Demonstrate the working of digital communication system and microwave experiments using microwave bench setup	L3
C O3	Prepare a documentation as proof for the conduction of the experiment by following highest ethics and standards	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 -Create

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Design an ASK modulator and Demodulator using discrete components and Kit	3
2	Design an FSK modulator and Demodulator using discrete components and Kit	3
3	Design an PSK modulator and demodulator using discrete components and Kit	3
4	Determine antenna gain , directivity, Band width and radiation pattern of Yagi- Uda and patch antenna using microwave bench setup	3
5	a) Measurement of wavelength and diffraction angle of laser light. b) Implementation of digital and analog modulation using OFC and digital trainer kit	3
6	Demonstrate the working of FDM and OFDM generation and detection using digital trained kits and matlab tool.	3
7	Simulate and demonstrate the working of PCM and DPCM using digital trained kits and Matlab simulation tool.	3
8	Simulate and demonstrate the working of Delta and Adaptive delta modulation using digital trained kits and Matlab simulation tool.	
9	Demonstrate the working Line coding technique and analyze its performance using digital trained kits and Matlab simulation tool.	3
10	Demonstrate the working principle of DPSK and QPSK Modulation and demodulation technique using digital trained kits and Matlab simulation tool.	3
11	Demonstrate the working principle of GMSK Modulation and demodulation technique using Matlab simulation tool.	3
12	Demonstrate working of directional couplers and isolation characteristics and magic tee experiment using microwave set up	3
13	Laboratory Test	3



Text Books:

1. Wayne Tomasi, “Advanced Electronic Communication Systems”, 6th Edition, Pearson Education, 2009.
2. Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons, 2004

Reference Books:

1. B. P.Lathi, “Modern Analog and Digital Communication Systems”, 3rd Edition, Oxford University Press, 2007
2. Martin S.Roden, “Analog and Digital Communication System”, 3rd Edition, Prentice Hall of India, 2002.

Web/Digital resources:

1. <https://nptel.ac.in/courses/117101051>

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3		3				3	3		2	3	2	0
CO2	3	2	3		3				3	3		2	3	2	0
CO3								3	2	3					

High – 3, Medium – 2, Low – 1

VI – SEMESTER

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC610	Total Credits	4	Course Type	Professional Core Course		
Course Title	Information Theory and Coding						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	52	4		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	52	4	Minimum Marks	20 marks	25 marks	45 Marks

Course Prerequisite: Basic knowledge of Digital Communication.

Course objective:

1. To gain familiarization in information channels.
2. To analyze various source coding algorithms and their performance.
3. To apply the knowledge of information theory for error detection and correction.

Course Outcome (COs): After completing the course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Derive equations and solve problems related to parameters of information channels.	L3
CO2	Implement various types of source coding algorithms and analyze their performance.	L4
CO3	Apply the knowledge of information theory for error detection and correction.	L3
CO4	Demonstrate the skill set to implement and verify the algorithms and applications of information theory and coding using simulation tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Information theory: Concept of amount of information, information units Entropy: marginal, conditional, joint and relative entropies, relation among entropies Mutual information, Information rate, channel capacity, redundancy and efficiency of channels Discrete channels – Symmetric channels, Binary Symmetric Channel, Binary Erasure Channel, Noise-Free Channel, Channel with independent I/O, Cascaded channels, repetition of symbols, Binary asymmetric channel, Shannon theorem.	11	0
2	Source coding – Encoding techniques, Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy, Source coding theorem. Construction of basic source codes – Shannon Fano coding, Shannon Fano Elias coding, Huffman coding, Minimum variance Huffman coding, Adaptive Huffman coding, Arithmetic coding, Channel coding theorem for DMC.	11	0
3	Codes for error detection and correction – Parity check coding, Linear block codes, Error detecting and correcting capabilities, Generator and Parity check matrices, Standard array and Syndrome decoding, Hamming codes.	10	0
4	Cyclic codes –Generator polynomial, Generator and Parity check matrices, encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, BCH codes, RS codes, Burst error correction.	10	0
5	Convolutional codes –Encoding and State, Tree and Trellis diagrams Maximum likelihood decoding of convolutional codes -Viterbi algorithm Sequential decoding-Stack algorithm.	10	0

Text Books:

1. Cover, T. M., and Thomas, J. A. (2006). Elements of information theory. Hoboken, N.J.: Wiley-Interscience.
2. Togneri, R., and Christopher J.S deSilva. (2003). Fundamentals of Information Theory and Coding Design. CRC Press.
3. P.S. Satyanarayana. (2016). Concepts of Information Theory and Coding. Medtech Publishers

Reference Books:

1. McEliece, R. J. (2004). The theory of information and coding. Cambridge: New York.
2. Ranjan, B. (2008). Information Theory, Coding and Cryptography. TataMcGrawHill.

Journals/Magazines:

1. Editorial Board of JISTap. (2013). Journal of Information Science Theory and Practice, 1(1), 92–100. <https://doi.org/10.1633/jistap.2013.e4>
2. IEEE Transactions on Information Theory publication information. (2006). IEEE Transactions on Information Theory, 52(12), C2–C2. <https://doi.org/10.1109/tit.2006.888124>.

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/117101053>
2. <https://nptel.ac.in/courses/108102117>

Practice Based Learning:

No	Topics to be covered	Tools and Techniques	Expected Skill/ Ability
1	Dictionary coding–LZ77, LZ78, LZW, ZIP coding Channel coding	Programming Techniques	C-Programming Python Matlab Programming
2	Interleaving techniques–Block and convolution al interleaving, Coding and interleaving applied to CD digital audio system	Programming Techniques	C-Programming Python Matlab Programming

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3										3	3	
CO2	3	3	3	3									3	3	
CO3	3	3	3	3									3	3	
CO4	3	3	3	3	3				3	2			3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC620	Total Credits	4	Course Type	Professional Core Course		
Course Title	Computer Networks						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	52	4		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	52	4	Minimum Marks	20 marks	25 marks	45 Marks

Course Prerequisite: Basics concepts of communication, digital electronics and computers.

Course Objective: To understand the basic concepts of data communication, layered model, protocols and interworking between computer networks.

Course Outcomes: (COs): After the completion of the course students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the basic concepts of OSI and TCP/IP reference model with its services.	L2
CO2	Apply the framing techniques and access method to verify data link Layer functions.	L3
CO3	Analyze various functions of Network and Transport Layer.	L4
CO4	Simulate and evaluate various network configuration using modern tools working as team/individual, give effective presentation and prepare documentation.	L5

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	UNIT1: Introduction Data Communications: Components, Representations, Data Flow, Networks: Physical Structures, Network Types: LAN, WAN, Switching, Internet. Network Models: Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and De-multiplexing, The OSI Model: OSI Versus TCP/IP. Data-Link Layer: Introduction: Nodes and Links, Services, Categories of link, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple Protocol, Stop and Wait protocol, Stop and	11	0

	wait ARQ, GBN ARQ, SR ARQ protocols, Piggybacking.		
2	UNIT2: Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Controlled Access: Reservation, Polling, Token Passing. Wired LANs: Ethernet: Ethernet Protocol: IEEE802, Ethernet Evolution, Standard Ethernet: Characteristics, Addressing, Access Method, Efficiency, Implementation, Fast Ethernet: Access Method, Physical Layer, Gigabit Ethernet: MAC Sublayer, Physical Layer, 10 Gigabit Ethernet.	11	0
3	UNIT3: Wireless LANs: Introduction: Architectural Comparison, Characteristics, IEEE 802.11: Architecture, MAC Sublayer, Addressing Mechanism, Physical Layer. Connecting Devices: Hubs, Switches, Virtual LANs: Membership, Configuration, Communication between Switches, Advantages. Network Layer services: Introduction, Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Class full Addressing, Classless Addressing, DHCP, Network Address Translation (NAT), Forwarding of IP Packets: Based on destination Address and Label.	10	0
4	UNIT4: Network Layer Protocols: Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams, ICMPv4: Messages, Debugging Tools, Unicast Routing: Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing, Unicast Routing Protocol: Internet Structure, Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol (BGP). Multicast addressing Scheme, Routing Protocols- PIM, IPV6 Protocol, IPV6 Packet format, Transition from IPv4 to IPv6.	10	0
5	UNIT5: Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection Oriented Protocols, User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Flow control, Error control, TCP congestion control. Congestion Control. SLE: Electronic Mail (SMTP), HTTP, FTP, socket programming: Creating network applications with both UDP and TCP on any network simulator (open source like NS2, Wire mesh etc.).	10	0

Text Books:

1. Behrouz A Forouzan, “Data Communication and Networking”, Tata McGraw-Hill Education, 5th Edition, 2017.
2. Andrews S Tannenbaum, “Computer Networks” , Pearson Education, 5th Edition

Reference Books:

1. Wayne Tomasi, “Introduction to Data Communication and Networking”, Pearson education, 1st Edition, 2007.

- James F. Kurose, Keith W. Ross, “Computer networking- A Top-Down Approach”, Pearson education, 6th Edition, 2013.

Web/Digital resources:

- James F. Kurose, Keith W. Ross, “Computer networking- A Top-Down Approach”, Pearson education, 6th Edition, 2013 (eBook available on web).

SWAYAM/NPTEL:

- <https://nptel.ac.in/courses/106105081/>
- https://nptel.ac.in/courses/106106091

Practice Based Learning:

SI No.	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any open-source tool	Programming

Self-Learning Exercises:

- Case Study Projects
- Mini Projects

Course Articulation matrix:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	
CO2	3	3											3	3	
CO3	3	3	3										3	3	
CO4	3	3	3	3									3	3	
CO5	3	3	3	2	3				2	2			3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC630	Total Credits	3	Course Type	Professional Core Course		
Course Title	CMOS VLSI Circuits						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

Course prerequisite: Student should be familiar with basics of electronics.

Course objective:

1. To learn basic CMOS Circuits, CMOS process technology, CMOS circuits that realize specified digital functions
2. Understanding of the characteristics of CMOS circuit, apply CMOS technology-specific layout rules.
3. To design CMOS combinational and sequential logic at the transistor level.

Course Outcomes (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the CMOS Logic, VLSI Design flow and the CMOS Process technology.	L2
CO2	Analyze the characteristics of MOS Transistor.	L2
CO3	Apply the concepts of VLSI design to compute the performance parameters of CMOS circuits and interpret results.	L3
CO4	Design combinational and sequential circuits using MOS transistors.	L4
CO5	Explain the working of CMOS Circuits and Semiconductor memories	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: A Brief History, MOS Transistors, CMOS Logic, CMOS fabrication and Layout, VLSI Design Flow, Fabrication, Packaging, and testing.	8	0
2	MOS Transistor Theory: Introduction, Ideal I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer Characteristics, Switch - level RC Delay Models.	8	0
3	Circuit Characterization and Performance Estimation: Introduction, Delay	8	0

	Estimation, Logical effort and transistor sizing, Power Dissipation, Interconnect, Design Margin, and Reliability.		
4	Sequential circuit design: SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, D-Latch and Edge-Triggered Flip-Flop.	8	0
5	Dynamic Logic Circuits - Voltage Bootstrapping Synchronous Dynamic Circuit Techniques High-Performance Dynamic CMOS Circuits and Semiconductor Memories: ROM, SRAM, DRAM circuits.	7	0

Text Books:

1. Neil H.E. Weste, David Harris, Ayan Bannerjee: "CMOS VLSI DESIGN: A Circuits and Systems Perspective," 3rd Edition, Pearson Education, 2005.
2. Douglas. A. Pucknell, Kamran Eshragian: "Basic VLSI Design," 3rd Edition, Prentice-Hall of India, 2006.

Reference Books:

1. R. Jacob Baker: "CMOS Circuit Design, Layout, and Simulation," 3rd Edition, John Wiley & Sons, Inc, Publication, 2010.
2. Sung-Mo Kang, Yusuf Leblebici: "CMOS Digital Integrated Circuits Analysis and Design," 2nd Edition, McGraw Hill, 2003.

Web/Digital resources:

1. <https://youtu.be/Gv5fESGW2Ms?list=PLNhFkFk6qEgLxC8XgE38cYNgI1wldYxXZ>
2. <https://youtu.be/IRpt1fCHd8Y?list=PLCmoXVvSEVHIEJi3SwdyJ4EICffuyqpkj>
3. <https://youtu.be/o9vEnzLL-1Y?list=PLojsqdbIzJGQtub91c4fF-TcCdzVYAInM>

SWAYAM/NPTEL: Nil

Self-Learning Exercises:

- 1) Analyze the characteristics and compute the read / write operation of SRAM cell.
- 2) Design and Develop the PLL for high frequency (5-GHz) applications.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES											PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PO1	PSO 1	PSO 2	PSO
CO1	3	3											2	2	
CO2	3	3											2	2	
CO3	3	3	3										2	2	
CO4	3	3	3	3									2	2	
CO5	3	3											2	2	

High – 3, Medium – 2, Low –1

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC641	Total Credits	3	Course Type	Professional Elective Course-II		
Course Title	Robotics and Computer Vision						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

Course prerequisite: Control Systems, Linear Algebra and Programming with MATLAB.

Course objective:

- 1.To develop conceptual and analytical skills for students in Robotics and Computer Vision,
2. To inculcate software and hardware skills to analyze, navigate and control robotics systems equipped with or without vision-based sensors.

Course Outcomes (COs): After completing this course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the foundations of Robotics and Computer vision.	L2
CO2	Analyze the kinematics, dynamics and navigating techniques for robots.	L4
CO3	Apply image processing and computer vision algorithms for robotics applications.	L3
CO4	Implement and demonstrate the working of robots for the given specification using modern tools.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	<p>Representing position & orientation: Pose in 2-dimensions, Pose in 3-dimensions, ortho-normal rotation matrices, homogeneous transformation matrices, Euler angles, roll-pitch-yaw angles, gimbal lock, quaternions</p> <p>Time & motion Trajectories: 1-dimensional, multi-dimensional, multi-segment, Interpolation of rotation, Smooth Cartesian motion, Time-varying coordinate frames, angular velocity, Inertial navigation solution</p>	8	0

2	<p>Mobile Robot Vehicles: Mobility, Bicycle and Car like models, moving to a point, line & pose, Modeling of Quad copter (Flying robots)</p> <p>Navigation: Reactive navigation, Braitenberg vehicles, Bug*automata, Distance transform, D*Road map methods: Voronoi, PRM, RRT</p> <p>Localization EKF- based dead reckoning Map based Creating a map Localization.</p>	8	0
3	<p>Kinematics: Forward kinematics, Inverse kinematics, Trajectories Assigning Denavit-Hartenberg parameters, Applications Velocity relationships Manipulator Jacobians, Resolve-rate motion control Force relationships, underactuated over actuated manipulators,</p> <p>Dynamics & Control: Independent Joint control, Rigid body equations of motion: gravity, inertia, Coriolis Forward dynamics, rigid body dynamics compensation.</p>	8	0
4	<p>Computer Vision Fundamentals: Light & color Spectral representation of light Color, color spaces, color gamut, color consistency, White balance Gamma correction,</p> <p>Camera model: Image formation Perspective imaging,</p> <p>Image processing: Acquiring images from files, camera and the web, Image histograms, Monadicoperation, Diadicoperations, Spatialoperations: convolution, template matching, rank filtering Morphology: image cleanup, skeletonization, hit-or-miss transform Shape changing: cropping, resizing, warping.</p>	8	0
5	<p>Image feature extraction: Region features: segmentation, thresholding, MSER, graph-based Line features: Hough transform point features.</p> <p>Visual Servoing: Position-based visual servoing (PBVS), Image feature motion due to camera motion, controlling feature motion — image-based visual servoing (IBVS), estimating depth.</p>	7	0

Text Books:

1. Peter Corke, "Robotics, Vision and Control: Fundamental Algorithms in MATLAB", Second Edition, Springer, 2017.
2. S.K. Saha, "Introduction to Robotics", Second Edition, McGraw Hill Education, 2017

Reference Books:

1. Saeed B. Niku, "Introduction to Robotics: Analysis, Control, Applications", Student Edition, Wiley, 2011
2. R.K. Mittal and I.J. Nagarath, "Robotics and Control", 6th Reprint, Tata McGraw-Hill Education, Delhi 2007.

Journals/Magazines:

1. IEEE Transactions on Robotics, IEEE, <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8860>
2. Robotics and Autonomous Systems, ScienceDirect <https://www.sciencedirect.com/journal/robotics-and-autonomous-systems>
3. International Journal of Computer vision, Springer. <https://www.springer.com/journal/11263>

SWAYAM/NPTEL:

1. <https://petercorke.com/>
2. <http://www.roboanalyzer.com/>
3. <https://nptel.ac.in/courses/107106090>
4. <https://www.youtube.com/channel/UCiK0J5wtnyX2jP-AiGbdhjjg>

Self-Learning Exercises:

1. Case Study projects
2. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3											3	3	
CO3	3	3											3	3	
CO4	3	3	3	3	3				3	3			3	3	3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC642	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Nanodielectrics: Challenges and Opportunities						
Teaching Learning Process	Contact Hours	Credits	Assessment in Weightage and marks				
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

Course prerequisite: Fundamental concepts of dielectric materials used in capacitors.

Course objective:

1. To familiarize on the characteristics, testing and measurement of insulation materials and equipment
2. To gain knowledge on the advanced computer simulation techniques.

Course Outcomes (COs): After completing the course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe the fundamentals of nano dielectrics in various applications.	L2
CO2	Apply the different methods to study the structural behavior of nanocomposites.	L4
CO3	Analyze the performance of nano composites.	L3
CO4	Demonstrate the skill sets using various tools for experimental/simulation of composite films towards research.	L5

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Dielectrics and nanodielectrics, structure, preparation, and characterization of nano dielectrics, attractiveness of polymer nano composites.	8	0
2	Preparation and structure: Methods of mixing aquasi – spherical nano fillers into a polymer, surface modification of nanoparticles and its effects. Changes in the movement and structure of atoms and molecules represented by the dielectric properties, Structure of polymer /nano filler interfaces.	8	0
3	Compatibility with other engineering performances: Electrical conductivity contrast between nanofillers and polymer matrix, electronic conduction effect on polymer/ metallic nanoparticles, effect on dielectric break down strength, need of high -k and low- k materials, thermal and mechanical	8	0

	characteristics.		
4	Computer simulation methods: Quantum mechanics with electronic states, molecular dynamics and Monte Carlo simulation with the collective motion of atoms and molecules, finite element method and statistical thermodynamics calculation with bulk materials, and phase- field method.	8	0
5	Epilogue: Nanodielectrics research challenges, environmental concerns and future prospects.	7	0

Text Books:

1. Tanaka, T., and Imai, T. (2017). Advanced nanodielectrics : fundamentals and applications. Pan Stanford Publishing.
2. Murty, B. S., Shankar, P., Raj, B., Rath, B. B., and Murday, J. (2013). Textbook of Nanoscience and Nanotechnology. Springer Science and Business Media.

Reference Books:

1. Kulkarni, S. K. (2019). Nanotechnology: Principles and Practices. Springer.

Journals/Magazines:

1. <https://www.springer.com/journal/12274>
2. <https://onlinelibrary.wiley.com/journal/21983844>
3. <https://ietresearch.onlinelibrary.wiley.com/journal/25143255>

Web/Digital resources:

1. <https://bajkulcollegeonlinestudy.in/StudyMaterialFinal/Chemistry/6th%20sem-DSE3Nano%20structure%20-%20Dr.%20Sunirban%20Das.pdf>

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/118102003>

Practice Based Learning:

No	Topics to be covered
1	Nanodielectrics in energy storage
2	Nanodielectrics in power sectors
3	Aging behavior of nanodielectrics

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	
CO1	3															
CO2	3	3														
CO3	3		3											3	3	
CO4	3	3	3	2	3				2					3	3	

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>		<i>ELECTRONICS AND COMMUNICATION ENGINEERING</i>					
<i>Course Code</i>	22EC643	<i>Total Credits</i>	3	<i>Course Type</i>	<i>Professional Elective course-II</i>		
<i>Course Title</i>	<i>Modern Wireless Communication Systems</i>						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		<i>CIE</i>	<i>SEE</i>	<i>Total</i>
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

Course prerequisite:

Basic concepts of Electronics.

Course objective:

1.To provide a comprehensive overview of existing wireless technologies.

Course Outcomes (COs): After completing this course, students will be able to:

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the functioning of wireless channels and modulation techniques.	L2
CO2	Demonstrate the multiple access techniques for Wireless Communication	L3
CO3	Analyze wireless communication system channel modelling and IP mobility framework	L3
CO4	Design multicarrier modulation schemes using simulation tools	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Wireless Channel Modelling: Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel - Capacity of Flat Fading Channel – Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver, Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels.	8	0

2	Multiple Antennas and Space Time Communications: Narrowband MIMO model– parallel decomposition of the MIMO channel– MIMO channel capacity– MIMO diversity gain: Beam forming– Space time modulation and coding–Frequency selective MIMO channels.	8	0
3	Multicarrier Modulation: Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub-channels – Mitigation of Sub-carrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset.	8	0
4	Wide band Code Division Multiple Access: CDMA system overview - air interface – physical and logical channels – speech coding, multiplexing and channel coding – spreading and modulation: frame structure, spreading codes- uplink-downlink – physical layer procedures: cell search and synchronization establishing a connection-power control-handover-overload control.	8	0
5	IP Mobility Framework: Challenges of IP Mobility -Address Management - Dynamic Host Configuration Protocol and Domain Name Server Interfaces – Security – Mobility-Based AAA Protocol - IP Mobility Architecture Framework - x Access Network - IPv6Challengesfor IP Mobility.	7	0

Text Books:

1. Andrea Gold smith, “Wireless Communications”, Cambridge University Press, 2005.
2. Andreas F. Molish, “Wireless Communications”, Wiley India, 2011.

Reference Books:

1. Savo G. Glisic, “Advanced Wireless Communications and Internet: Future Evolving Technologies”, 3rd Edition, JohnWiley, 2011
2. A. Paulraj, R. Nabar, D. Gore, “Introduction to Space-Time Wireless Communication”, 1st Edition, Cambridge University Press, 2008.
3. T. S. Rappaport, “Wireless Communications”, 2nd Edition, Pearson Education, 2008.

Web/Digital resources:

1. http://www.eecs.berkeley.edu/~dtse/Chapters_PDF/Fundamentals_Wireless_Communication_chapter5.pdf
2. <http://www.ece.mtu.edu/faculty/ztian/ee5530/sswireless.pdf>
3. http://webmail.aast.edu/~khedr/Courses/Graduate/Wireless%20Communications_F08/Lecture%20six%20OFDM.pdf
4. http://cctlab.snu.ac.kr/nrl/w_ch06land.pdf

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/117104115>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open Source Tool	Programming
2	Mini Project(Hardware)	Hardware Interfacing	Hardware Interfacing/ programming

Self-Learning Exercises:

1. Mini Projects
2. Simulation

Course Articulation:

22EC643	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2							2			2	2	
CO2	1		2							2			2	2	
CO3	1		2							2			2	2	
CO4	1		2							2			2	2	

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>		Electronics and Communication Engineering					
<i>Course Code</i>	22EC64 4	<i>Total Credits</i>	3	<i>Course Type</i>	Professional Elective Course		
<i>Course Title</i>	Digital Image Processing						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

Course prerequisite: Students should be familiar with basic mathematics and signal processing.

Course objective:

1. To enable the students to learn spatial, frequency domain image processing concepts, grayscale and colour image processing techniques.
2. To enable the students to analyze the different types of morphological and segmentation techniques.

COURSE OUTCOMES(COs): After the completion of the course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the theoretical concepts of digital image processing in the spatial and frequency domain	L2
CO2	Comprehend and apply various grayscale and color image processing techniques	L3
CO3	Demonstrate various image morphological Transform, segmentation and Compression techniques	L3
CO4	Analyze and demonstrate the real-world application of image processing techniques using modern tools	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Digital Image Fundamentals: Elements of visual perception, Image sensing and acquisition, Image sampling and quantization, spatial and intensity resolution, Image interpolation and resampling. Image Enhancement in Spatial Domain: Basic gray level transformations, histogram processing, histogram equalization, histogram matching, enhancement using histogram statistics, image subtraction, averaging, smoothing and sharpening using spatial filters and their combination.	8	0
2	Image Enhancement in Frequency Domain: Frequency domain filtering fundamentals, Correspondence between filtering in spatial and frequency domain, smoothing and sharpening using Butterworth and Gaussian Low pass and High pass filters, The Laplacian in the frequency domain, Unsharp masking, High boost filtering, High frequency emphasis filtering, Homomorphic filtering. Color image processing: Color models RGB, CMY, CMYK, HSI, Color transformations, Converting colors from RGB to HSI and HSI to RGB, Pseudo color image processing.	8	0
3	Basic Morphological Algorithms: Dilation and erosion, Opening and closing, The Hit or Miss transformation, Boundary extraction, Region filling, Extraction of connected components, Convex Hull, Thinning, Thickening and Pruning.	8	0
4	Wavelet Transforms: Matrix-based Transforms, Correlation, Fourier – Related Transforms, Walsh-Hadamard Transforms, Slant transform, Haar Transform, Wavelet Transforms. Image Segmentation: Point, line and edge detection (Robert, Canny and Prewitt techniques), Thresholding, Basic global thresholding, optimum global thresholding using Otsu's method.	8	0
5	Image Compression: Fundamentals, some basic compression methods- Huffman, Arithmetic and LZW coding techniques, Fractal image Compression, Digital image watermarking.	7	0

Text Books:

1. Khalid Sayood "Introduction to Data Compression", 4th Edition, Elsevier Inc, 2012.
2. David Solomon, Giovanni Motta "Handbook of Data Compression", 5th Edition, Springer, 2010.

Reference Books:

1. Yun Q. Shi, Huifang Sun "Image and Video Compression for Multimedia Engineering Fundamentals, Algorithms and Standards", CRC press, 2003.
2. [Jean-Loup Gailly Mark Nelson](#), "The Data Compression Book" BPB Publications ISBN-13 2010

Journals/Magazines:

1. https://www.researchgate.net/publication/314154399_A_study_of_image_processing_using_morphological_opening_and_closing_processes
2. <http://www.ijtrd.com/papers/IJTRD8373.pdf>
3. https://www.researchgate.net/publication/266737963_Discrete_Walsh-Hadamard_Transform_in_Signal_Processing
4. https://www.ijirst.org/DOC/1_irp608.pdf

Web/Digital resources :

1. <https://www.youtube.com/watch?v=5wRPin4oxCo>
2. <https://www.youtube.com/watch?v=rC16fhvXZOo>

SWAYAM/NPTEL :

1. <https://nptel.ac.in/courses/117105079>
2. <https://nptel.ac.in/courses/117105135>
3. <https://www.digimat.in/nptel/courses/video/117105135/L01.html>

Self-Learning Exercises:

1. Case Study projects

Course Articulation:

COURSE OUTCOME S ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3															
CO2	3	3											3	3		
CO3	3	3	3										3	3		
CO4	3	3	3	3	3				3	3			3	3		

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC646	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Operating systems						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60%	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

Course prerequisite: Basic concepts of computer organization.

Course objective:

1. To understand the services of operating system to users, processes, and I/O sub-systems.

Course Outcomes (COs): At the end of the course, the student will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe the principles of computer architecture, structure and functionalities of different Operating Systems.	L2
CO2	Explain various Kernel functionalities and resource allocation methods.	L2
CO3	Analyze different algorithms with their core functionalities to improve system performance.	L3
CO4	Analyze File system structures, File organization and security considering modern operating system concepts.	L3
CO5	Implement algorithms and analyze open source codes to understand, prepare document to give oral presentation.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction and Overview of Operating Systems: Computer system overview , Goals and Operation of an O.S, Evolution of OS Classes of operating systems, Structure of the supervisor, Operating system with monolithic structure, layered design, Virtual machine operating systems, Kernel-based operating systems, microkernel based OS.	8	0

2	Process Management: Process concept, Programmer view of processes, OS view of processes, Interacting processes, Threads. Fundamentals of scheduling, Long-term scheduling, Medium and short term scheduling, Real time scheduling, Case studies.	8	0
3	Memory Management: Memory allocation preliminaries, Contiguous and noncontiguous allocation to programs, Memory allocation for program controlled data, kernel memory allocation, Case studies. Virtual Memory: Virtual memory using paging, Demand paging, Page replacement, Page replacement policies, Memory allocation to programs, Page sharing.	8	0
4	File Management, Deadlock and File Security Techniques: File organization , File sharing , File system security. Deadlocks in resource allocation , deadlock detection & resolution , dead lock prevention , deadlock avoidance. Computer security concepts, Access control and intrusion detection, Case studies.	8	0
5	Device Drivers and Inter-process Communication: Devices and their characteristics, input output management, ,Disk scheduling algorithm and policies ,Establishing inter-process communication.	7	0

Text Books:

1. D.M.Dhamdhare, “Operating Systems – “A Concept based Approach”, TMH, 3rd Ed, 2006.
2. Willaim Stallings, “Operating System – Internals and Design Systems”, Pearson Education, 6th Ed,2009.

Reference Books:

1. Pramod chandra “An introduction to operating systems concepts and practice “, PHI, 3rd Ed ,2010
2. Silberschatz and Galvin, “Operating Systems Concepts”, John Wiley, 8th Edition, 2001.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc17_cs29/student/home
2. [http://www.uobabylon.edu.iq/download/M.S20132014/OperatingSystemConcepts,_8th_Edition\[A4\]](http://www.uobabylon.edu.iq/download/M.S20132014/OperatingSystemConcepts,_8th_Edition[A4])

Self-Learning Exercises: Case studies of algorithms to improve the core functions of operating system.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3	3										3		
CO3	3	3	3										3		
CO4	3	3	3										3		
CO5	3	3	3		3				3	3			3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC647	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Automotive Cyber Security						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

Course prerequisite: Basics of computer networks.

Course objective:

1. To understand the cyber security awareness and competencies in the automotive industry.
2. To learn all areas around automotive development being impacted by cyber security.
3. To implement appropriate cyber security measures.

Course Outcomes (COs): After completing the course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the security requirements in IT/computer and embedded systems.	L3
CO2	Apply the knowledge of security architecture, HW and SW solutions for security challenges in automotive domain.	L3
CO3	Analyze and model the security feature use cases.	L4
CO4	Demonstrate the threats and risks in security feature requirement using cases.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNI T No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to Cryptography and related Infrastructure; Motivation Security Basics: Current trends and Development, Safety and Security, Cryptography Concepts: Encoding, Encryption, Hash, Security services, Examples of Algorithm (AES 128, RSA)	8	0

2	Signature and Encryption , Symmetric and Asymmetric signatures. Public Key Infrastructure: Digital Certificate, Functions of PKI, Certifying Authority, Hierarchy of Certifying Authority Layered automotive security, CIA Triad.	8	0
3	Security Architecture: Software and Hardware Solutions - Introduction to Hardware Security Module (HSM), HSM and Software Crypto Libraries, Software and Hardware Encryption. Autosar Software Architecture overview, Introduction to Autosar Communication stack Crypto stack and Diagnostic Stack.	8	0
4	Automotive Security Features: Challenge- Response Protocol, Secure Access, Secure Flashing. Secure On-Board Communication, Secure Boot, Secure storage, Secure Logging.	8	0
5	Security Functional Testing- Overview; Security Features Validation: Penetration Testing-Overview, Methodology, Types of Penetration Testing. Threat and Risk Analysis in Security	7	0

Text Books:

1. Stallings, W. (2016). Cryptography and Network Security. Pearson.
2. Lemke, K., Paar, C., Wolf, M., andSpringerlink (Online Service. (2006). Embedded Security in Cars : Securing Current and Future Automotive IT Applications. Springer Berlin Heidelberg.

Reference Books:

1. Kleidermacher, D., andKleidermacher, M. (2012). Embedded systems security : Practical methods for safe and secure software and systems development. Newnes (An Imprint Of Butterworth-Heinemann Ltd.
2. Godbole, N. S. (2009). Information systems security : security management, metrics, frameworks and best practices. Wiley India.

Web/Digital resources:

1. https://link.springer.com/chapter/10.1007/978-981-16-2217-5_3

Self-Learning Exercises:

1. Project work on development of security feature prototype.
2. Application development on Linux or in any user friendly environment.
3. Analyze and present the case study topics provided by industry.



Course Articulation:

COURSE OUTCOME S↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOME S		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3	3										3	3	
CO3	3	3		3										3	
CO4	3	3	3	3	3				3	3				3	3

High – 3, Medium – 2, Low – 1

DEPARTMENT		Electronics and Communication Engineering					
Course Code	22EC648	Total Credits	3	Course Type	Professional Elective - V		
Course Title	Advance 5G						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Digital Communication, Mobile Communication systems.

COURSE OBJECTIVE: To provide good understanding of 5G Networks and its technologies.

COURSE OUTCOMES (COs): After the completing of this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the spectrum of 5G and its use cases	L2
CO2	Describe 5G architecture, its components and protocol stack.	L2
CO3	Illustrate in depth knowledge on functionality of Radio resource control, signaling and call management in NR.	L4
CO4	Analyze use of MIMO in 5G and its various beamforming techniques.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	<p>Introduction: Evolution of cellular Communication (1G to 5G), introduction to 3GPP specification, mm Wave and cm Wave, List of 3GPP, Road Map to 5G.</p> <p>LTE Basics and LTE-advanced: Introduction to LTE, LTE Basic and LTE Advanced.</p> <p>5G Fundamentals Use cases: Use cases of 5G, eMBB, mMTC, URLLC, V2X, Network Architecture, Reference Point System Architecture, Service Based System Architecture, Network Functions, Network Slicing</p>	7	0
2	<p>5G Base Station: Base Station Architecture, Virtualized RAN, Cloud RAN and O-RAN, CU-DU Split Base Station and CP-UP, Standalone Architecture (SA), Non-Standalone Architecture (NSA). Antenna Architecture basics, Base Station Classes.</p> <p>5G Interfaces: Xn interface, F1/ E1/ NG / X2 interfaces. Protocol Stack: User Plane and Control Plane.</p>	8	0

3	<p>5G Physical Layer: Waveforms, coding, numerology, frame structure and control channels.</p> <p>Radio Resource Control (RRC): RRC States (RRC Idle, RRC Connected and RRC Inactive).</p> <p>5G Signaling and Call Management in NR: Signaling Radio Bearers, PDU Sessions, QoS. Call management (Registration management, Connection Management and Access Control).</p>	8	0
4	<p>Introduction to MIMO and Beam Forming: MIMO, Analog, digital and hybrid beam-forming.</p> <p>5G Beam-forming Antenna: Active Antenna, Passive Antenna, polarizations, Antenna arrays, phased arrays, Power Splitter fundamentals, Antenna Basics – Dipole.</p> <p>5G Beam-forming L1 Concepts: SS/PBCH based Beam-forming, Codebook based Beam-forming, SRS based Beam-forming, Eigen-mode Beam-forming.</p>	8	0
5	<p>5G Beam-forming principles: Beam-forming Principle, DL MU-MIMO, SRS based Downlink MU-MIMO, Definition of basic sets of SSB, Azimuthal angle.</p> <p>5G Beam-forming Functionality: Static Beam-forming, Dynamic Beam-forming – Beam Steering and Switching, Digital Beam-forming vs. Analog Beam-forming, Pilot Signal, Spatial Multiplexing, Spatial Multiplexing vs Beam-forming, creating a Beam, Narrow Beams and Beam Steering, Beam Forming Evolution</p> <p>Massive, SU and MU MIMO: Massive MIMO Antennas, MIMO in a Handset, Multiple Panel Antenna, Massive MIMO vs SU-MIMO vs. MU-MIMO.</p>	8	0

References:

1. **Erik Dahlman, Stefan Parkvall, Johan,** “5G NR: The Next Generation Wireless Access Technology”, 1st Edition, Elsevier, 2016.
2. **Afif Osseiran, Jose F. Monserrat, Patrick Marsch,** “ 5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2nd Edition, 2011.
3. **Harri Holma. Antti Toskala, Takehiro Nakamura-**5G Technology:3GPP New Radio

Web/Digital resources:

1. <https://nptel.ac.in/courses/108105134>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	5G Waveform Generation, MIMO, Massive MIMO, Spatial Multiplexing, Beamforming and Hybrid Beamforming etc..	MATLAB	Design and analysis

Mapping - Course Outcomes with Program outcomes & Program Specific outcomes:

Course Outcomes	Program Outcomes												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3											3		
CO3	3	3	3	3	3								3	3	3
CO4	3	3	3	3	3								3	3	3

1---Low association, 2--- Moderate association, 3---High association

VI SEMESTER OPEN ELECTIVES

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC651	Total Credits	3	Course Type	Open Elective Course - 2		
Course Title	Nanoscience and technology						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

Course prerequisite: Basic concepts and mechanics of materials.

Course objective:

1. To learn various forms of nanomaterials for special applications.
2. To understand various nanostructure characterization techniques.
3. To study the principles, process steps and system components of the various lithographic techniques.

Course Outcomes (COs): After completing the course, students will be able to:

CO's	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe the fundamentals of nanoscience and nanotechnology.	L2
CO2	Relate the knowledge of nanostructures and nanomaterials to science and technology.	L2
CO3	Identify the deposition and characterization techniques to thin film structures.	L3
CO4	Demonstrate the skill sets in simulating various applications of nanoscience and nanotechnology	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorials
1	Introduction to nanoscience and nanotechnology , current technologies, beginning, implications, nano and world societies, societal aspects, nano-economics, the rise of nanotoxicology, policy debates and public engagement.	8	0

2	Introduction, One, Two and Three-dimensional Nanoparticles, General Strategies for the Synthesis of One-, Two- and Three-dimensional Nanostructures, Properties of Anisotropic Nanoparticles, Applications of Anisotropic Nanomaterials, One-Dimensional Nanostructures-Nanorods and Nanowires	8	0
3	Introduction, Synthetic Methods: Common Issues of Concern, Variety in Nanomaterials, Microemulsion-based Methods for Nanomaterials, Solvothermal Synthesis, Electron Microscopies, Optical Microscopies for Nanoscience and Technology, X-ray Diffraction, Small Angle Neutron/X-ray Scattering (SANS/SAXS), Cyclic Voltammetry, Impedance Analysis, Raman Scattering.	8	0
4	Silicon MOS Transistor from Micro to Nano-Introduction, Downscaling and Moore's Law, Challenges for Nano-MOSFETs, Emergence of new Materials, Novel Device Structures, Innovations in Process Technology, Dendritic nanostructures, macromolecules and dendrimers, top-down and bottomup process, molecular transport, mechanism and advanced applications.	8	0
5	The Nanotechnology Business-Nanotechnology Statistics: Current Situation, Types of Nanotechnology, Safety of Nanoproducts, Ultraprecision Engineering, Aerospace and Automotive Industries, Architecture and Construction, Catalysis, Environment, Lubricants, Metrology—Instrumentation, Minerals and Metal Extraction, Textiles, Silicon Microelectronics, Data Storage Technologies, Display Technologies, The Future of Nanotechnology.	7	0

Text Books:

1. Pradeep.T(2012), "A textbook of Nanoscience and Nanotechnology", Tata McGraw – Hill education private ltd.
2. Jeremy J. Ramsden(2009), "Applied NanotechnologyMicro and Nano technology Series", 1st Edition Elsevier.

Reference Books:

1. Jeremy J. Ramsden(2014)"Applied Nanotechnology: The Conversion of Research Results toProducts", Elsevier
2. B.S. Murthy, P Shankar, Baldev Raj, B BRath, and James Murday,(2012), "Textbook of Nanoscience and Nanotechnology", Universities Press.

Web/Digital resources:

1. <https://www.elsevier.com/books/applied-nanotechnology/ramsdn/978-0-8155-2023-8>

PRACTICE BASED LEARNING

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Journal articles based on NST	Open-source software tools	Team work, Communication skills

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3													3	
CO2	3	3												3	
CO3	3	3												3	3
CO4	3	3	3	3	3				2	2				3	3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC652	Total Credits	3	Course Type	Open Elective Course - 2		
Course Title	Automotive Electronics						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60%	100%
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

Course prerequisite: Sensors, Actuators, communication protocols.

Course objective:

1. To understand the concepts of Automotive electronics used in vehicles, including engine management, ignition, radio, carputers, telematics, in-car entertainment systems, and others.
2. To understand the related elements for control of relevant electrical systems are also found on hybrid vehicles and electric cars.

COURSEOUTCOMES(COs):

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the working of Motronic engine management and safety systems.	L2
CO2	Illustrate the flow of data and control signals in automotive networking	L2
CO3	Analyze the importance of sensors and actuators and explore their applications in automobiles.	L3
CO4	Take part in a group/individual activity and complete the assigned task by demonstrating skills related to implementation, documentation and presentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Electrical and electronic systems in the vehicle: Overview, Motronic-engine management system, electronic diesel control, Lighting technology, electronic stability program, Adaptive cruise control, Occupant-protection systems.	8	0
2	Networking and bus systems: Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, coupling of networks, Examples of networked vehicles. Introduction to VANET: Basic Principles and challenges, past and ongoing VANET activities.	8	0
3	Automotive sensors: Basics and overview, automotive applications, Sensor market, Features of vehicle sensors, Sensor classification, Selection of sensor technologies.	7	0

4	<p>Sensor measuring principles: Sensors for the measurement of position, speed, rpm, acceleration, pressure, force, and torque, Flow meters, temperature sensors,</p> <p>Sensor types: Engine speed sensors, Hall phase sensors, Sensors for transmission control & wheel speed, Yaw-rate sensors, Pressure sensors, Temperature sensors, Accelerator-pedal sensors, Steering angle sensors, Position sensors, Acceleration sensors, Rain/light sensors.</p>	8	0
5	<p>Actuators: Electromechanical & fluid mechanical actuators, Electrical machines</p> <p>Hybrid drives: Drive concepts, operating strategies for electric hybrid vehicles, Recuperative brake system, Electrical energy accumulators.</p>	8	0

Text Books:

1. Robert Bosch GmbH, “Bosch Automotive Electrics and Automotive Electronics”, 5th Edition, Springer Vieweg, 2014.
2. William B. Ribbens, “Understanding Automotive Electronics: An Engineering Perspective”, 8th Edition, Elsevier, 2017

Reference Books:

1. K. Babu, “Automotive Electrical and Electronics”, Khanna Publishers, 1st Edition, 2018.
2. John F. Kershaw, Ed.D. and James D. Halderman, “Automotive Electrical and Electronic Systems”, 5th Edition, Pearson Prentice Hall, 2007.
3. Barry Hollembeak, “Automotive Electricity and Electronics”, Cengage Learning, 6th Edition, 2014.
4. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols”, Prentice Hall, 2004.

Journals/Magazines:

1. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=10209>
2. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6979>
3. <https://www.sciencedirect.com/journal/vehicular-communications>

Web/Digital resources:

1. <https://www.youtube.com/playlist?list=PLCBA3EF828DFE7B0E>
2. <https://www.youtube.com/watch?v=STDlCdZnIsw&list=PLE06CAA834360BB39>

SWAYAM/NPTEL:

1. <https://www.udemy.com/course/basics-of-automotive-electronics/>
2. <https://nptel.ac.in/courses/107106088>
3. <https://nptel.ac.in/courses/108103009>



Practice Based Learning

No.	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1.	Automotive simulation	Any simulation tool for automotive domain.	Programming

Self-Learning Exercises:

1. Mini Project – Long Term Event will be conducted.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES											Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3												2		
CO2	3	2											2		
CO3	3	2											2		
CO4	3	3	3		3				2	2			3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC653	Total Credits	3	Course Type	Open Elective Course - 2		
Course Title	Smart Agricultural Technology						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

Course prerequisite: Basic concepts of Electronics, communication and Agriculture techniques in India.

Course objective:

1. To understand smart farming for improving agricultural management system.
2. To develop smart devices using transducers, sensors, actuators and motors for real time applications.

Course outcomes (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the Soil science, Plant anatomy and its health monitoring.	L2
CO2	Illustrate the suitability of sensors and actuators for modern agricultural purpose.	L3
CO3	Analyze the embedded electronics technology used for agricultural purpose.	L3
CO4	Develop prototype of smart technique used in agriculture – in group/individual and give effective presentation with documentation.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Soil Science: Nature and origin of soil; soil minerals, classification and composition, soil reaction, soil properties including structure, PH, surface tension and soil nutrient.	8	0
2	Sensors: Classification and characteristics, Smart sensors, Colorimetry based detection, MEMS Electrochemical Sensors, Dielectric Soil Moisture Sensors, ISFET, Weather sensors, Proximity Sensors, Signal conditioning and converters.	8	0
3	Actuators: Actuators for tool automation: A.C.-D.C. Motors, Stepper motor, Solenoid actuators, Piezoelectric motors, Electric	8	0

	drives, Hydraulic and Pneumatic actuator		
4	Telemetry: Wireless communication modules and topology, Zig- bee, Bluetooth, LORA, Zero power devices, Energy Harvesting Technology.	8	0
5	Technologies for farming: Water quality monitoring, micro- irrigation system, solar pump and lighting system, Fencing, Android based automation, Agricultural Robots, Standards for agriculture.	7	0

Text Books:

1. Brady, Nyle C, "The nature and properties of Soils" Eurasia Publishing House Pvt Ltd, 1998.
2. Ernest O. Doebelin, "Measurement Systems; Application and Design", McGraw Hill, 1984

Reference Books:

1. Aqeel-ur- Rehman, "Smart Agriculture an Approach Towards Better Agriculture Management", OMICS International, 2015.
2. Ville Kaajakari, "Practical MEMS: Design of microsystems, accelerometers, gyroscopes, RF MEMS, optical MEMS, and microfluidic systems", Small Gear Publishing, 2009.
3. Patranabis. D, "Principles of Industrial Instrumentation and control", Tata McGraw Hill, 1995.
4. Bolton W, "Mechatronics: A Multidisciplinary Approach", Pearson Education Asia, 2004.
5. Buresch, Mathew, "Photo-voltaic energy systems: Design and Installation", McGraw-Hill Book Company, 1983

Journals/Magazines:

1. Science Direct - Smart Agricultural Technology
2. ELSEVIER - Smart Agricultural Technology

Web/Digital resources:

1. <https://youtu.be/60YD5jsSlmo>
2. <https://youtu.be/LS3XGUZZLuI>
3. https://youtu.be/nsnpEmr1q_k
4. <https://youtu.be/WhAfZhFxHTs>
5. <https://www.youtube.com/watch?v=0WR4BeFcLks>

SWAYAM/NPTEL:

1. https://onlinecourses.swayam2.ac.in/arp19_ap94/preview
2. https://onlinecourses.nptel.ac.in/noc22_bt25/preview
3. <https://archive.nptel.ac.in/courses/126/105/126105009/>

PRACTICE BASED LEARNING

No	Topics to be covered	Tools and Techniques	Expected Skill/ Ability
1	Mini projects / Case study	Open-source software, hardware interface with suitable boards.	Programming , product development.

Self-Learning Exercises:

2. Case Study projects / Paper Presentation from reputed journals.

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	
CO2	3	3											3	3	
CO3	3	3	3										3	3	
CO4	3	3	3		3				3	3			3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC 654	Total Credits	3:0:0	Course Type	Open Elective Course - 2		
Course Title	Low power VLSI						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

Course prerequisite: Basic concepts of Electronics, CMOS VLSI.

Course objective: To learn how to increase the battery life of portable devices, leakage and dynamic power reduction is emerging as a primary goal of the VLSI circuit design.

Course Outcomes (COs): After completing this course, students will be able to:

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the need for low power VLSI chips.	L2
CO2	Analyze the low voltage CMOS Circuits at Architecture & Systems level.	L2
CO3	Analyze the performance of low power VLSI circuits.	L2
CO4	Explain the working of low power digital library cells.	L2
CO5	Demonstrate the working of low power VLSI Architecture & Systems using EDA tool.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits, Emerging Low power approaches. Device & Technology Impact on Low Power: short circuit and leakage in CMOS, Dynamic dissipation in CMOS.	8	0
2	Low-Voltage CMOS Circuits: Design style, Leakage current in Deep sub-micron transistors, device design issues, minimizing short channel effect, Low voltage design techniques using reverse Vgs, steep sub threshold swing and multiple threshold voltages, Testing with elevated intrinsic leakage, multiple supply voltages.	8	0

3	Low Power Circuits: Transistor and gate sizing, network restructuring and Reorganization, Special Flip Flops & Latches design.	7	0
4	Low power digital cells library. Logic level- Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.	8	0
5	Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components. Adiabatic Computation, Pass Transistor Logic Synthesis	8	0

Text Books:

1. Gary K. Yeap, “Practical Low Power Digital VLSI Design”, KAP, 2002.
2. Kaushik Roy, and Sharat Prasad, “Low-Power CMOS VLSI Circuit Design”, Wiley, 2000.

Reference Books:

1. Rabaey, and Pedram, “Low Power Design Methodologies”, Kluwer Academic, 1997.

Journals/Magazines: Use APA format.

Web/Digital resources:

1. https://www.youtube.com/watch?v=ruClwamT-R0&list=PLTEh-62_zAfHmJE-pcjgREKiKyPSgjkxj
2. https://www.youtube.com/watch?v=K2kL7pMnL_0&list=PLVDb88QIgXkeeUo6I2oudLvc76GbLGrTi

Self-Learning Exercises:

1. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3											2	2		
CO2	3	3											2	2		
CO3	3	3											2	2		
CO4	3	3											2	2		
CO5	3	3	3	3	3								2	2		

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC655	<i>Total Credits</i>	3	<i>Course Type</i>	Open Elective Course - 2		
<i>Course Title</i>	Artificial Intelligence and Deep Learning						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

Course prerequisite: Student should be familiar with basic concepts of Linear Algebra.

Course objective:

1. To make the students understand about the algorithms, methods, theoretical and practical approaches in the field of artificial intelligence and deep learning.

Course Outcomes (COs): After completing this course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the basic principles and algorithms of Artificial Intelligence.	L2
CO2	Analyze multi-layer perceptron with various structuring and tuning of hyper parameters.	L4
CO3	Analyze the working of various CNN architectures.	L4
CO4	Analyze, Implement and demonstrate the Artificial Intelligence and Deep learning algorithms for real-world applications.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to AI: Intelligent Agents, Agents and environment, Rationality, the nature of environment, the structure of agents, Goal based agents, Utility based agents, Learning agents.	8	0
2	Problem Solving and Search Techniques: Problem space & search, defining the problem as state space search, Searching for Solutions, Uninformed Search Strategies, Breadth First search, Depth First Search, Iterative deepening depth first search,	8	0

	Informed Search Strategies, Heuristic functions.		
3	Deep learning and Neural Networks: Perceptron, Multi-layer perceptron, Activation functions, feed forward process, error function, optimization algorithms and back propagation, classification using MLP.	8	0
4	Structuring DL projects and hyper parameter tuning: Defining performance metrics, designing baseline model and data preparation, evaluation of model, tuning hyper parameters, optimization, regularization and batch normalization.	8	0
5	Convolutional neural network: Architecture and Components of CNN, Image classification using CNN, Over fitting and dropout layer, LeNet-5, AlexNet.	7	0

Text Books:

1. Stuart Russel, Peter Norvig, “Artificial Intelligence: A Modern Approach,” 3rd Edition, Pearson Education, 2010 (Twelfth Impression 2018).
2. Josh Patterson and Adam Gibson, “Deep Learning, A practitioner’s approach,” O’Reilly Media Inc., 1st Edition, 2017.
3. Mohammed Elgandy, “Deep Learning for Vision Systems,” Manning Publication, 2020.

Reference Books:

1. Elaine Rich, Kevin Knight, Shivashankar B Nair, “Artificial Intelligence,” Tata MCGraw Hill 3rd edition. 2013 (24th Reprint 2018).
2. Luca Pietro, Giovanni Antiga, Thomas Viehmann, Eli Stevens, “Deep Learning with PyTorch,” Manning Publications, July 2020.
3. Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning,” The MIT Press, November 2016.

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/106105215>
2. https://onlinecourses.nptel.ac.in/noc22_cs56/preview

Self-Learning Exercises:

1. Mini Projects



Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3											3	2	
CO3	3	3											3	2	
CO4	3	3	3	3	3				3	3			3	3	2

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC661	<i>Total Credits</i>	3	<i>Course Type</i>	Open Elective Course		
<i>Course Title</i>	Bioelectronics and Biosensors						
<i>Teaching Learning Process</i>		<i>Cont act Hours</i>	<i>Cre dits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightag e</i>	40	60	100
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40	60	100
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20	25	45

Course prerequisite: Students should be familiar with basic concepts of signals and Electronics.

Course objective:

1. Extend principles of engineering to the development of biosensors and bioelectronic devices.

Course Outcomes (COs): At the end of the course, the student will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the working principle of Bioelectronics and Biosensors	L2
CO2	Compare different sensors and actuators in biomedical instrumentation system	L2
CO3	Analyze and Identify the different fabrication methods for sensor development	L4
CO4	Demonstrate the use of sensors and transducers for real time applications	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Bioelectronics Introduction, Potential advantages & Developments towards a bimolecular computer, development of molecular arrays as memory stores; molecular wires and switches; mechanisms of unit assembly.	8	0

2	Biosensors Introduction, principles, classification, various components of biosensors, Bio catalysis-based biosensors, Bio affinity based biosensors & Microorganisms based biosensors, Biologically active material and analytes. Types of membranes used in biosensor constructions.	8	0
3	Applications of Biosensors Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food Low cost - biosensor for industrial processes for online monitoring; biosensors for environmental monitoring. Application of enzymes in analysis; design of enzyme electrodes and their application as biosensors in industry, healthcare, food and environment.	8	0
4	Bio-Mems: Introduction to bio-MEMS. Materials for bio-MEMS. BioMEMS fabrication: bulk/surface micromachining, LIGA. Soft fabrication and polymers (soft-lithography, micromolding, micro-stereolithography, thick-film deposition, SAMs. Microfluidic principles. Microfluidic devices: microchannels, microvalves, micropumps, micro-needles, microreservoirs, micro-reactors. MEMS biosensors. Microactuators and micro drug delivery system. Micro total analysis system (μ TAS), lab-on-a-chip. Microarrays: polymerase chain reactor (PCR), DNA chip, functional genomics, bioinformatics. BioMEMS for tissue engineering. Packaging, power, data and RF safety of bioMEMS	8	0
5	Nano MEMS: Introduction to Nano-MEMS. Materials for Nano -MEMS. Nano MEMS fabrication, applications of Nano MEMS, Packaging, power, data and RF safety of NanoMEMS	7	0

Text Books:

1. Brian R Eggins - Biosensors an Introduction , First edition, John Wiley & Sons Publishers, 1996.
2. Loic J Blum, Pierre R Coulet - Biosensors Principles and Applications, First edition, Marcel Dekker, Inc, 1991
3. Donald G. Buerk - Biosensors Theory and Applications, First Edition Technomic Publishing. Co, Inc, 1993.
4. Marc J. Madou, From MEMS to Bio-MEMS and Bio-NEMS: Manufacturing Techniques and Applications, CRC Press, 1st edition, Jun.16, 2010, ISBN: 142005516X.

Reference Books:

1. Elizabeth A Hall - Biosensors, First Edition, Open University, Milton Keynes, 1990.
2. Graham Ramsay - Commercial Biosensors, First edition, John Wiley & Sons, Inc. 1998.
3. Tran Minh Canh - Sensor Physics & Technology - Biosensors , First Edition, Champan & Hall, 1993.
4. Steven S. Saliterman, Fundamentals of BioMEMS and Medical Microdevices, SPIE Publications, Jan. 19, 2006, ISBN: 0819459771.



Web Resources:

1. <https://nptel.ac.in/courses/108/108/108108147/>
2. <https://www.coursera.org/lecture/interface-with-arduino/lecture-2-1-actuators-uNCa4>

Self-Learning Exercises: Future Trends in Neuro sensors, Biosensors, Nano-technology, Soft Computing techniques in instrumentation.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3										3		
CO2	3	3	3										3		
CO3	3	3	3										3		
CO4	3	3	3		3				3	3			3	2	

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC662	<i>Total Credits</i>	3	<i>Course Type</i>	Open Elective Course		
<i>Course Title</i>	Optimization Techniques for Engineers						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

Course Prerequisite: Basic concepts of algebra and matrix operations

Course objective:

1. To learn operation research models using optimization techniques.
2. To formulate problems using appropriate optimization techniques.
3. To provide optimized solutions to real world problems through quantitative analysis/simulation.

Course Outcomes (COs): After completing the course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe the concepts of optimization techniques and their classifications.	L3
CO2	Apply the knowledge of various methods and models for optimizing the given problem.	L3
CO3	Analyze and solve different optimization models and techniques.	L4
CO4	Demonstrate the skill sets to simulate/ use analysis tools to solve real world problems.	L5

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Development and Classification of optimization problems: Definition, characteristics and phases, types of operation research models, applications, linear programming, problem formulation, graphical solution, simplex method, artificial variables techniques, two-phase method, big-M method.	8	0
2	Network optimization models: Transportation and assignment models, Finding initial basic feasible solution by north-west corner rule, least cost method and Vogel's approximation method, testing for optimality of balanced transportation problems. Shortest Route, Minimal Spanning Tree, Maximum	8	0

	Flow Models.		
3	CPM and PERT: Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT) Networks. Drawing of networks, Removal of redundancy, Network computations, Free slack, Total slack, Crashing, Resource allocation.	8	0
4	Integer and Dynamic Programming: Branch and bound algorithm, Dynamic Programming, introduction, Terminology, Bellman's Principle of optimality, Applications of dynamic programming, shortest path problem, linear programming problem.	8	0
5	Game theory and queuing models: Introduction – Terminology, Solution of games with saddle points and without saddle points, 2×2 games, dominance principle, m X 2 & 2 X n games and Graphical method. Waiting Lines: Introduction, Terminology, Single Channel, Poisson arrivals and exponential service times with infinite population and finite population models, Multichannel, Poisson arrivals and exponential service times with infinite population.	7	0

Text Books:

1. Hillier, F. S., & Lieberman, G. J. (2021). Introduction to operations research. Mcgraw-Hill.
2. R Panneerselvam. (2010). Operations research. Phi Learning.

Reference Books:

1. Taha, H. A. (2017). Operations research an introduction. Pearson.
2. Sharma. (2009). Operations Research: Theory and Applications. Macmillan.

Web/Digital resources:

1. <https://nptel.ac.in/courses/112106134/>
2. <https://link.springer.com/book/10.1007/978-0-387-78977-4>
3. <https://nptel.ac.in/courses/112101298>

Self-Learning Exercises:

Case studies and applying optimization techniques for the engineering and business related problems and obtain the solution.

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3	3										3	3	
CO3	3	3	3											3	
CO4	3	3	3	3	3				3	3				3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC663	Total Credits	3	Course Type	Open Elective Course		
Course Title	Professional Communication and Technical Report Writing						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Knowledge of basic communication skills.

COURSE OBJECTIVE:

1. To learn vocabulary, language and writing skills relevant to engineering as a profession.
2. To analyze, interpret and effectively summarize textual content.
3. To create reports using LaTeX and make effective technical presentations.

Course Outcomes (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe/develop vocabulary, language and writing skills relevant to engineering as a profession.	L2
CO2	Analyze, interpret and effectively summarize textual content.	L4
CO3	Create reports using LaTeX and effective technical presentations.	L4
CO4	Demonstrate the skill sets on a given technical/non-technical topic in a group and arrive at generalizations /consensus.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: communication-meaning, importance, dimensions and channels, barriers of communication, effective communication, essentials of good communication, types verbal (oral and written) and nonverbal. Technical Written Communication: Nature, origin and development of technical written communication, features. Difference between technical writing and general writing.	8	0

2	Technology-based communication: Effective email messages, slide presentations, editing skills using software. Modern day research and study skills: search engines, repositories, forums such as GitHub, Stack Exchange, OSS communities (MOOC, SWAYAM, NPTEL), and Quora; Plagiarism	8	0
3	Oral Presentation: Voice modulation, tone, describing a process, Presentation Skills: Oral presentation and public speaking skills, business presentations, improving presentation skills. Debate and Group Discussions (GD): introduction, differences between GD and debate; participating, understanding, and brain storming the GD topic, questioning and clarifying, GD strategies, activities to improve GD skills.	8	0
4	Technical Writing: differences between technical and formal writing style. letter Writing (formal, informal and semi-formal), job applications, minute preparation, curriculum vitae(CV) preparation (differences between Bio-Data, CV and Resume), and reports. Basics of report/technical paper writing, guidelines: Referencing Style (IEEE styleguide), structure of a report; types of reports, references, bibliography. Differences between technical presentations and seminars.	8	0
5	Introduction to LaTeX: Standard practice of learning LaTeX and writing technical report using LaTeX commands, related exercises. Case studies on report writing, presentation and seminars.	7	0

Text Books:

1. Goodheart-Willcox, (2017) “ProfessionalCommunication”,G-Wpublisher
2. Raman.MandSharma,S (2011)
“TechnicalCommunicationPrinciplesandPractice,OxfordUniversityPress,NewDelhi.

Reference Books:

1. Butterfield,Jeff (2013) “SoftSkillsforeveryone”,2ndedition,CengageLearningNewDelhi.
2. Sherman,TheodoreA. et al, (2017)“ModernTechnicalWriting”,1stedition,PrenticeHall,NewJersey.
3. Annauniversityauthor (2010),“EnglishforEngineersandTechnologists”(Combinededition,Vol.1and 2), OrientBlackswan.
4. MeenakshiRamanandSangeethaSharma
(2011)“TechnicalCommunication:PrinciplesandPractice”,2ndEdition, Oxford UniversityPress.

Journals/Magazines:

1. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=47>
2. <https://journals.sagepub.com/home/bcq>



SWAYAM/NPTEL:

1. <https://www.pdfdrive.com/professional-communication-technical-writing-e43179325.html>
2. <https://nptel.ac.in/courses/102104061>
3. <https://nptel.ac.in/courses/109104031>

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1										3					
CO2										3					
CO3								2	3						
CO4						1		2	3					1	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC664	Total Credits	3	Course Type	Open Elective Course-III		
Course Title	Verilog HDL						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 Marks	25 marks	45 Marks

Course prerequisite: Digital Electronics

Course objective:

1. To understand the basic language features of Verilog HDL and the role of HDL in digital logic design.
2. To learn the behavioral modeling of combinational and simple sequential circuits.
3. To understand the behavioral modeling of algorithmic state machines.
4. To study the synthesis of combinational and sequential descriptions.

Course Outcomes (COs): After completing this course, students will be able to:

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Demonstrate knowledge on HDL design flow, behavioral and switch modeling levels of abstraction.	L2
CO2	Design combinational and sequential logic circuits using behavioral modeling and write test bench Verilog code	L2
CO3	Demonstrate by identifying the suitable abstraction level for a given digital design and write the programs more effectively using Verilog tasks, functions and directives.	L2
CO4	Analyze the process of synthesizing the combinational and sequential descriptions	L2
CO5	Demonstrate knowledge on HDL design flow and verification of design flow	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog HDL? Trends in HDLs. Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block.	8	0
2	Basic Concepts: Lexical conventions, data types, system tasks, compiler directives. Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing.	8	0
3	Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types.	8	0
4	Behavioral Modeling: Structured procedures, initial and always, blocking and non-blocking statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks. Tasks and Functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions.	8	0
5	Useful Modeling Techniques: Procedural continuous assignments, overriding parameters, conditional compilation and execution, useful system tasks. Logic Synthesis with Verilog: Logic Synthesis, Impact of logic synthesis, Verilog HDL Synthesis, Synthesis design flow, Verification of Gate-Level Netlist.	7	0

Text Books:

1. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", 2nd Edition Pearson Education, 2012

Reference Books:

1. Donald E. Thomas, Philip R Moorby, *The Verilog Hardware Description Language*, Fifth edition Springer Science+Business 2015.
2. Michael D. Ciletti, *Advanced Digital Design with the Verilog HDL* Second edition, Pearson (Prentice Hall), 2015.
3. Padmanabhan, Tripura Sundari, *Design through Verilog HDL*, Wiley, 2016.

Web Resources:

1. <https://www.pdfdrive.com/professional-communication-technical-writing-e43179325.html>
2. <https://nptel.ac.in/courses/102104061>
3. <https://nptel.ac.in/courses/109104031>

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/102104061>
2. <https://nptel.ac.in/courses/109104031>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any Open Source Tool	Programming

Self-Learning Exercises:

1. Case Study projects
2. Mini Projects

Course Articulation:

22EC664OE↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3	2										3		
CO4	3	3											3		
CO5	3	3	2										3		

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>		Electronics and Communication Engineering					
<i>Course Code</i>	22EC 665	<i>Total Credits</i>	3	<i>Course Type</i>	Open Elective Course-III		
<i>Course Title</i>	Power Electronics						
<i>Teaching Learning Process</i>		<i>Cont act Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

Course prerequisite: Student should be familiar with basic concepts of electronics.

Course Objective:

1. To familiarize with the switching devices and its applications in various systems for power control.
2. To analyze and design different power converter circuits.

Course Outcomes (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the various power semiconductor devices.	L2
CO2	Design different firing and protection circuits for power semiconductor devices.	L3
CO3	Analyze the performance of controlled rectifiers, DC – DC converters and inverters.	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Power Semiconductor Devices: Introduction to Power Electronics- Power Diodes- Types, rating and switching characteristics. Current controlled devices- BJTs and Thyristors – Construction, operation, switching characteristics, rating and types. Voltage controlled devices: Power MOSFETs and IGBTs – construction, operation, switching characteristics, rating and types. Principles of series and parallel operation of power switching devices. Different types of Power Electronic circuits.	8	0

2	Firing and Protection Circuits: Firing circuits for power electronic devices, Gate driver circuits for SCR, MOSFET and IGBT and base driving for power BJT, Over voltage, over current and gate protections, Necessity of isolation, pulse transformer, opto-coupler , Design of snubbers.	8	0
3	Controlled Rectifiers: Introduction, Performance of Single phase fully controlled and semi controlled converters with R and RL Loads for continuous and discontinuous current modes. AC Voltage Controllers: - Introduction, On-Off and Phase control, Single –phase Bidirectional controllers with resistive and inductive loads.	8	0
4	DC – DC Converters or Choppers: Introduction, principle of operation, analysis of Buck, Boost, and Buck-boost converters, operation with R and RL loads, and their control strategies, performance parameters and classification.	8	0
5	Inverters: Introduction, principle of operation, performance parameters, and control strategies of Single phase Full and Half Bridge inverters with R and RL Loads, Introduction to Three phase, Current source inverters, Power Supplies: UPS, SMPS.	7	0

Text books:

1. Muhammad H. Rashid: “Power Electronics – Circuits, Devices and Applications”, 3rd edition, Pearson Education/ PHI, 2011.
2. R.S. Ananda Murthy, V. Nattarasu: “Power Electronics”, 2nd Edition, Sanguine Technical Publishers, India, 2005.

Reference books:

1. Daniel W. Hart: “Power Electronics”, 1st Edition, McGraw Hill, 2011.
2. L. UMANAND: “Power Electronics Essentials and applications”, 3rd Edition, John Wiley and sons, Inc, 2009.
3. V.R Moorthi: “Power Electronic Devices, Circuits & Industrial Applications”, 1st Edition, Oxford University Press, 2005.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3											2	2		
CO2	3	3	3										2	2		
CO3	3	3											2	2		

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC67L	<i>Total Credits</i>	1.5	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	CMOS VLSI Lab						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	0	0		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	39	1.5	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	1.5	<i>Minimum Marks</i>	20 marks	25 marks	45* Marks

Pre-requisite: Student should complete the course on CMOS VLSI

Course Objective:

1. Apply the concepts of basic combinational logic circuits, sequential circuit elements.
2. To develop familiarity and confidence with designing, building and testing digital circuits, including the use of CAD tools

Course Outcomes: After completing this course, students should be able to:

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Design and validate CMOS VLSI logic circuits using CAD tool.	L3
CO2	Simulate combinational and sequential circuits using CAD tool.	L4

Course Contents / Syllabus:

Expt. No.	Experiment Name	No. of Hours
1	CMOS Inverter circuit.	3
2	CMOS NOR and NAND gates.	3
3	CMOS XOR, XNOR, OR, NOR gates.	3
4	Multiplexer and Demultiplexer.	3
5	Common Source amplifier circuit.	3
6	Common drain circuit.	3
7	CMOS Comparator circuit.	3
8	Flip Flops: SR, D, JK and T.	3
9	4-Bit Binary Counter.	3
10	BCD Counter.	3

11	6T SRAM Cell.	3
12	3T DRAM.	3
13	Lab Test	3

Text Books:

1. R. Jacob Baker: “CMOS Circuit Design, Layout, and Simulation,” 3rd Edition, John Wiley & Sons, Inc, Publication, 2010.
2. Sung-Mo Kang, Yusuf Leblebici: “CMOS Digital Integrated Circuits Analysis and Design,” 2nd Edition, McGraw Hill, 2003.

Reference Books:

1. John f walkerly, “Digital design principles and practices”, 3rd ed., phi/pearson education, 2005.

Web Resources:

1. https://www.youtube.com/watch?v=u0WgSMa1hrc&list=PLK2eyR1C9gjr7j-YoL_-JwJmjU6lNZGTO

Mapping - Course Outcomes with Program outcomes & Program Specific outcomes

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3	3		3								3			
CO2			3	3	3						3		3	3		

0---No association, 1---Low association, 2--- Moderate association, 3---High association



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC68L	<i>Total Credits</i>	1.5	<i>Course Type</i>	Professional Core Course		
<i>Course Title</i>	Networking - Lab						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	0	0		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	39	1.5	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	1.5	<i>Minimum Marks</i>	20 marks	25 marks	45* Marks

COURSE PREREQUISITE: Computer Networks.

COURSE OBJECTIVE:

1. Enable students to choose suitable tools to model network and understand the protocols at various OSI reference levels.
2. Design suitable network and simulate using Network simulator tool.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Analyze Various Routing protocols and addressing schemes by creating different network configurations.	L4
CO2	Examine different network configurations for various IoT domain applications	L2
CO3	Prepare documentation as proof of the conduction of the experiment by following the highest ethics and standards.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool. Using CISCO packet Tracer, perform the following experiments <ol style="list-style-type: none"> Configure a basic Network topology. HTTP, DNS, Ping and Trace. Investigate Unicast, Broadcast and Multicast Traffic. 	3
2	Using CISCO Packet Tracer, Perform the following experiments. <ol style="list-style-type: none"> Subnetting – FLSM (Fixed Length Subnet Mask) Subnetting – VLSM (Variable Length Subnet Mask) 	3
3	Using CISCO Packet Tracer, Perform the following experiments <ol style="list-style-type: none"> Skills Integration challenge-planning subnets and configuring IP addresses. Observing the effects of collision in shared media environment. Static routing and default routing. 	3
4	Using CISCO Packet Tracer, Perform the following experiments <ol style="list-style-type: none"> Configure the given Network Topology Configure them by using RIP Routing Protocol. Study the different RIP Timer used in RIP 	3
5	Using CISCO Packet Tracer, Perform the following experiments <ol style="list-style-type: none"> Configure the given Network Topology Configure them by using OSPF Routing Protocol. Study the OSPF Process and its States. 	3
6	Using CISCO Packet Tracer, Perform the following experiments <ol style="list-style-type: none"> Configure the given Network Topology Network Address Translation (NAT) Access Control List (ACLs) 	3
7	a. Using CISCO Packet Tracer, Perform the following experiments <ol style="list-style-type: none"> Configure the given Network Topology and basic switching configuration. Configure VLAN and Inter-VLAN routing for a Network. b. Using Wireshark Tool, Perform the following exercises <ol style="list-style-type: none"> Packet Capture using Wireshark Viewing captured Traffic and analysis of packet 	3
8	<ol style="list-style-type: none"> Write a program for a HDLC frame to perform the following. <ol style="list-style-type: none"> Bit stuffing and destuffing. Character stuffing and destuffing. Write a program for Bellman ford's algorithm to find shortest path for a given network graph. 	3
9	<ol style="list-style-type: none"> Write a program for Dijkstra's algorithm to compute shortest path for 	3

	a given network graph. b. Write a program for the given data, use CRC-CCITT polynomial to obtain CRC code. Verify the program for WITH and WITHOUT error. Given DATA: “WELCOME TO SJCE”	
10	a. Write a program for minimum spanning tree using kruskal’s/Prim’s algorithm. b. Write a socket programming for Client-Server Model.	3
11	a. Familiarization with concept of IOT, Arduino/Raspberry Pi and perform necessary software installation. b. Study of Connectivity and configuration of Raspberry-Pi with basic peripherals, LEDS. Understanding GPIO and its use in program.	3
12	Configuration of Raspberry pi with SenseHat Device and use python library for reading and storing of sensor data from SenseHat	3
13	Laboratory Test	3

Text Books:

1. Todd Lammle, “CCNA Routing and switching complete study Guide”, SYBEX, 2nd Edition 2013.
2. Arshdeep Bahga “Internet of Things”, Universities press, 2015.

Reference Books:

1. Behrouz A Forouzan, “Data Communication and Networking”,4th Edition, Tata McGraw-Hill Education, 2010.
2. James F. Kurose, Keith W. Ross, “Computer networking- A Top-Down Approach”,6th Edition, Pearson education, 2013.

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3				3	3			3	3	
CO2	3	3	3	3	3				3	3			3	3	
CO3			2					2	3	2			2		

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC69P	Total Credits	1.5	Course Type	Professional core course		
Course Title	Design and Implementation Laboratory						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	0	0		CIE	SEE	Total
	Tutorial	0	0	Weightage	40%	60%	100%
	Practical	39	1.5	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	1.5	Minimum Marks	20 Marks	25 marks	45* Marks

COURSE PREREQUISITE:

To be enthusiastic to work in teams / groups, identifying new problems proposing solutions by exploring new tools

COURSE OBJECTIVE:

1. To generate new innovative interdisciplinary ideas
2. To design a method to realize the ideas.
3. To build a mathematical model and prototype
4. To carry out tests and Analysis
5. To prepare report and write articles

COURSE OUTCOMES (Cos)

After completion of the course students will be able to,

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Conduct literature survey to identify gaps in the existing methods and give an innovative solution	L2
CO2	Build a mathematical model, and develop prototype as proof of concepts	L3
CO3	Verify and validate results adhering to standards	L4
CO4	Work in group, prepare report, articles to communicate the design, implementation and results adhering to ethics.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

Week	List of Experiments/ Programs	No. of Hours
1	Literature survey	3
2	Literature survey	3
3	Synopsis preparation and presentation	3
4	Design of proposed system	3
5	Design and Intermediary results	3
6	Develop and Implement	3
7	MID RESULTS and Report	3
8	Develop and implement	3
9	Test verify and validate	3
10	Test verify and validate Mid results	3
11	Test and validate	3
12	Report and articles and Demo	3
13	Laboratory Test/Final Demo	3

Text Books:

1. Books on circuit and system design principals
2. HBR's 10 must read on Design Thinking, Penguin Random House, 2020

Reference Books:

1. Web resources: <https://www.amazon.in/HBRs-Must-Reads-Design-Thinking/dp/B086XHRG3K>
2. company websites and white papers

Journals/Magazines:

1. IEEE / Peer reviewed journals
2. Electronics Design Magazines

Web/Digital resources:

1. <https://github.com/>
2. <https://www.interaction-design.org/literature/topics/design-thinking>

Course Articulation Matrix:

COURSE OUTCOMES↓	Program outcomes												Program specific outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2									3		
CO2	3	3	3										3	3	
CO3	3	3	2		3								3	2	
CO4								2	3	3		3	3		3

High – 3, Medium – 2, Low – 1

Course Title	CONSTITUTION OF INDIA & PROFESSIONAL ETHICS			Course Type	Humanities, Social Sciences and Management Course			
Course Code	22HU512 / 22HU612	Credits	0	Class	V / VI Semester			
Course Structure	TLP	Credits	Contact Hours	Total Number of Classes / Semester	Assessment in Weightage and Marks			
	Theory	-	26	Theory	CIE		SEE	
	Practical	-	-	26	Weightage	100%	Weightage	-
	Tutorial	-	-		Max. Marks	50 Marks	Max. Marks	-
	Total	-	26		Min. Marks	25 Marks	Min. Marks	-

Course Objectives:

1. To provide basic information about Indian Constitution.
2. To identify individual role and ethical responsibility towards society.

Course Outcomes (COs):

1. Have general knowledge and legal literacy and thereby to take up competitive examinations.

CO-PO Mapping (Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2	1	3				

Course Content / Syllabus:

UNIT No.	Content	Lecture Hours
1	Introduction to the constitution of India, The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitutional Fundamental Rights & its limitations.	5
2	Directive principles of State Policy & Relevance of Directive principles of State Policy Fundamental Duties. Union Executives – President, Prime Minister, Parliament, Supreme Court of India.	5
3	State Executives – Governor, Chief Minister, State Legislature, High Court of State. Electoral Process of India, Amendment Procedures, 42 nd , 44 th , 74 th , 76 th , 86 th , and 91 st Amendments.	5
4	Social Provision for SC & ST Special Provision for Women, Children and Backward Classes, Emergency Provisions. Powers and Functions of Municipalities, Panchayats and Co-operative Societies.	5
5	Scope and Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility. Risk, Safety and liability of Engineers, Honesty, Integrity and Reliability in Engineers.	6

Evaluation Scheme:**Continuous Internal Evaluation – CIE**

Event	Event Type	Marks Allotted	Duration
CIE – 1	Written Test – 1	20	1 Hour
CIE – 2	Event	10	1 Hour
CIE – 3	Written Test – 2	20	1 Hour

Note:

14. The written test 1 & 2 (CIE – 1 & 3) both will be conducted for 20 marks each in 1 hour duration.
 15. The Event (CIE – 2) will be conducted for 20 marks and the marks scored will be reduced proportionately to 10 marks.
 16. The Event (CIE – 2) will be skill based assessment such as Seminars / Technical talks / Case study / hands-on activity / Mini projects / Sci-tech activity / Data analysis.
- A student must score on an average of 50% i.e., 25 marks out of 50 from all the events (CIE – 1, 2, 3) to pass.



VII SEMESTER

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC 710	Total Credits	4	Course Type	Professional Core Course		
Course Title	Innovation, Entrepreneurship and Management						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	52	4		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	52	4	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Current updates regarding entrepreneurs, business and technology start-ups in India and abroad.

COURSE OBJECTIVE:

1. The course explores the creation and management of start-up business.
2. Learn the common personality traits of a successful entrepreneur
3. Learn the techno economic feasibility of a project

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Identify institutional support for entrepreneurs starting new business, opportunity identification and product development.	L2
CO2	Analyze the importance of engineering/technology management in starting an organization.	L4
CO3	Develop Techno economic feasibility of a project and study importance of IPR and patents.	L3
CO4	List various successful entrepreneurial profiles, prepare a business plan, write report and critically evaluate.	L5

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

Unit No.	Course Content	Hours	
		Lecture	Tutorials
1.	Entrepreneurship: Concept, meaning, need and competencies/qualities/traits of an entrepreneur, technopreneurship. Innovation: Introduction, Motivating to innovate, introduce core ideas about how to think about innovation, including key theories about factors that affect innovation. An in-depth review of how companies structure to encourage and develop innovation. Product development and design.	11	0
2.	Role of financial institutions: Role of financial institutions in entrepreneurship development and support Institutes : District Industry Centers (DICs), State Financial Corporations, Small Industries Service Institutes (SISIs), Small Industries Development Bank of India (SIDBI), National Small Industries Corporation(NSIC) and other relevant institutions. Market Survey and Opportunity Identification: start-up industry, procedures for registration of industry. assessment of demand and supply in potential areas of growth, understanding business opportunity, considerations in product selection and development, data collection for setting up new ventures.	11	0
3.	Engineering Management: Introduction to Engineering Management: Engineering and Management, historical development of engineering management. Systems and scientific approach to management. Functions of management: planning and forecasting, decision making, organizing, motivating and leading technical people, controlling systems	10	0
4.	Technology management: Managing projects: Project planning and acquisition, organization and types, leadership and control. Case Studies	10	0
5.	Project Report Preparation: Preliminary report, Techno-economic feasibility report, Project viability. Case studies examples	10	0

Text Books:

1. Peter Duckers (1985), Innovation and Entrepreneurship Practice and Principles, Heinnemann.
2. Morse and Babcock (2009), Managing Engineering and Technology, 4th edition, PHI Learning Private Limited, New Delhi.
3. Poornimachirantimath (2012), Entrepreneurship and small business management, Pearson.

Reference Books:

1. Barringer, Duane (2009), Entrepreneurship Successfully Launching New Ventures, 4th edition, Prentice Hall.
2. Wehrich, Cannice, Koontz (2013), Management: A Global, Innovative and Entrepreneurial Perspective, McGraw Hill Education (India) Private Limited, New Delhi.
3. Ulrich, Eppinger, Goyal (2008), Product Design and Development, 4th edition, Tata McGraw Hill Education (India) Private Limited, New Delhi.
4. Vasant Desai (2012), The dynamics of Entrepreneurial Development and Management, Himalya Publishing House.
5. J. Tidd, J. Bessant and K. Pavitt (2005), Managing Innovation: Integrating Technical, Market and Organizational Change, Wiley.

Journals/Magazines:

1. <https://archive.nptel.ac.in/courses/110/106/110106141>

SWAYAM/NPTEL:

<https://nptel.ac.in/courses/110107094>

<https://www.digimat.in/nptel/courses/video/110107094/L01.html>

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			3					3						3
CO2	3			3					3						3
CO3	3			3		1		1	3						3
CO4	3			3					3	2		1			3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC721	Total Credits	3	Course Type	Professional Elective - III		
Course Title	Speech Processing using Deep Learning						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Students should be familiar with basic mathematics and signal processing.

COURSE OBJECTIVE:

1. To make students learn the fundamental concepts of speech processing, deep learning.
2. To study about feature extraction and classification techniques using deep learning algorithms.

COURSEOUTCOMES(COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the theoretical foundation of speech processing and deep learning.	L2
CO2	Analyze speech feature extraction and recognition techniques.	L4
CO3	Apply deep learning and CNN Architecture algorithms for Speech recognition.	L3
CO4	Analyze, Implement, demonstrate Neural network and machine learning algorithms for speech applications.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Phonetics: Speech Sounds and Phonetic Transcription, Articulatory Phonetics, Phonological Categories, and Pronunciation variation, Acoustic Phonetics, and Signals, Phonetic Resources, Advanced: Articulatory and Gestural Phonology, Text Normalization, Phonetic Analysis, Prosodic Analysis, Diphone Waveform Synthesis, Unit Selection Synthesis.	8	0
2	Automatic Speech Recognition: Speech Recognition Architecture, The Hidden Markov Model Applied to Speech, Feature Extraction: MFCC Vectors, Acoustic Likelihood Computation, Embedded Training, Evaluation: Word Error Rate.	8	0
3	Basics of Deep Learning: Introduction, Perceptron Algorithm Explained, Multilayer Perceptron, Deep Learning, Model Training, Unsupervised Deep Learning, Framework Considerations	8	0
4	Convolutional Neural Networks: Basic Building Blocks of CNN, Forward and Backpropagation in CNN, Text Inputs and CNNs, Classic CNN Architectures, Modern CNN Architectures, Applications of CNN in NLP, Fast Algorithms for Convolutions	8	0
5	Applications and User Interfaces: Application Architecture, Typical Applications, Computer Command and Control, Telephony Applications, Dictation, Accessibility, Handheld Devices, Automobile Applications, Speaker Recognition Speech Interface Design: General Principles, Handling Errors, Dialog Flow. Internationalization	7	0

Text Books:

1. Daniel Jurafsky, James H. Martin “Speech and Language Processing”, Pearson, Second Edition, 2017.
2. Uday Kamath, John Liu, James Whitaker “Deep Learning for NLP and Speech Recognition” Springer, 2019
3. Xuedong Huang, Alex Acerd, Hsiad-wuen Hon “Spoken Language Processing: A Guide to Theory, Algorithm and System Development” PH PTR, 2001.

Reference Books:

1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
2. Tom M. Mitchell “Machine Learning” McGraw Hill Education, 22nd reprint 2018.
3. Nilanjan Dey “Intelligent Speech Signal Processing”-Academic Press, 2019
4. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks” Apress, 2018.

Journals/Magazines:

3. IEEE Transactions on Neural Networks and Learning Systems, IEEE, <https://ieeexplore.ieee.org/xpl/aboutJournal.jsp?punumber=5962385>.
4. IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE, <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34>
5. IEEE / ACM Transactions on Audio, Speech, and Language Processing, IEEE, <https://signalprocessingsociety.org/publications-resources/ieeecom-transactions-audio-speech-and-language-processing/about-taslp>.
6. Speech Communication, Science Direct(Elsevier).
<https://www.sciencedirect.com/journal/speech-communication/about/aims-and-scope>.

SWAYAM/NPTEL:

1. <http://www.digimat.in/nptel/courses/video/117105145/L37.html>
2. <https://nptel.ac.in/courses/106106184>

Self-Learning Exercises:

3. Mini Projects

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PO1	PSO ₁	PSO ₂	PSO ₃
CO1	3												3		
CO2	3	3											3	2	
CO3	3	2											3	3	
CO4	3	3	3	3	3				3	3			3	3	3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC722	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Embedded Systems						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60%	100%
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Microprocessor & Microcontroller concepts and applications.

COURSE OBJECTIVE:

1. To equip the students with the basic concepts of embedded system, applications in which they are used.
2. To understand the concept of different components in embedded system and their interactions.

COURSE OUTCOMES (COs):

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the major components that constitute an embedded system.	L2
CO2	Analyze the basic structure of embedded systems.	L3
CO3	Apply contemporary techniques for Hardware-Software co-design of embedded systems for Real time applications using RTOS.	L3
CO4	Design real time embedded systems using the concepts of RTOS, simulate using modern software tools through group/individual projects and give effective oral presentation with documentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to Embedded Systems: Embedded systems, Processor Embedded into a system, Embedded Hardware Units and Devices in a system, Embedded Software in a system, Examples of Embedded Systems, Embedded SOC and use of VLSI Circuit Design Technology, Complex system Design and processors, Design Process in Embedded system, Formalization of System Design, Design Process and Design Examples.	8	0
2	Devices and Communication Buses for Device Network: I/O types and examples, Serial Communication Devices, Parallel Device Ports, Sophisticated Interfacing features in Device Ports, Wireless Devices, Timers and counting Devices, Networked Embedded Systems, Serial Bus	8	0

	Communication Protocols, Parallel Bus Device Protocols, Network Protocols, Wireless and Mobile system protocols.		
3	Device Drivers and Interrupt Service Mechanism: Programmed I/O Busy-wait approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt servicing mechanism, multiple interrupts, DMA, Device Driver Programming, EDLC.	8	0
4	Hardware Software Co-Design, Program Modeling, Embedded Firmware Design and Development: Fundamental Issues in Hardware Software Co-Design, Computational models in Embedded Design, Hardware Software tradeoffs, Embedded Firmware Design approaches, Embedded Firmware Development languages, Programming in Embedded C.	8	0
5	RTOS based Embedded System Design: OS basics, Types of Operating Systems, Tasks, process and Threads, Multiprocessing and Multi-tasking, Task Scheduling, Threads, Processes and Scheduling, Task Communication, Task Synchronization, Device Drivers, how to choose an RTOS?	7	0

Text Books:

1. Raj Kamal: “Embedded Systems - SoC, IoT, AI and Real-Time Systems”, 4th Edition, TMH, 2020.
2. Shibu K V: “Introduction to Embedded Systems”, 2nd Edition, TMH, 2017.

Reference Books:

1. James K Peckol: “Embedded Systems- A Contemporary Design Tool”, 1st edition, John Wiley, 2019.
2. Santanu Chattopadhyay, “Embedded System Design”, 2nd edition, PHI Learning, 2013

Journals/Magazines:

1. <https://www.springer.com/journal/10617>
2. <https://jes-urasipjournals.springeropen.com/>
3. <https://www.sciencepublishinggroup.com/journal/index?journalid=236>
4. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4563995>

Web/Digital resources:

1. <https://www.youtube.com/watch?v=JO4AEkOVF2M&list=PLrjkTql3jnm-lZMoUb1xMCp0HgxvJ7ocx>
2. <https://www.coursera.org/learn/introduction-embedded-systems>

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/108102045/>
2. <https://nptel.ac.in/courses/106105193/>
3. <https://nptel.ac.in/courses/106105159/>



Practice Based Learning

No.	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1.	Building An Embedded System	Raspberry Pi, Arduino Board	Hardware interface & Programming
2.	Simulation Of an Embedded System	Any open-source Simulator	Logical Thinking

Self-Learning Exercises:

1. Mini Project – Long Term Event will be conducted.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2	3	2											2		
CO3	3	2											2		
CO4	3	3	3		3				2	2			3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC723	Total Credits	3	Course Type	Professional Elective - III		
Course Title	Internet of Things						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basics concepts of electronics devices and Communication systems

COURSE OBJECTIVE:

1. To understand the application areas of IOT.
2. To realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks

COURSE OUTCOMES (COs): After the completing of this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the fundamentals of Internet of Things and its building blocks along with their characteristics	L2
CO2	Demonstrate interfacing of various sensors with Arduino/Raspberry Pi.	L2
CO3	Analyze the protocols and standards designed for IoT and its current research challenges.	L3
CO4	Simulate real time problems using modern software tools through group projects and give oral presentation with documentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	FUNDAMENTALS OF IoT: 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, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.	8	0
2	IoT PROTOCOLS: IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 1901.2a and Lora WAN, Zigbee, RFID and NFC. Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks (AODV & DSR), Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP, MQTT, AMQP and XMPP.	8	0
3	DESIGN AND DEVELOPMENT: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi.	8	0
4	DATA ANALYTICS AND SUPPORTING SERVICES: Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning-No SQL Databases, Hadoop Ecosystem, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, AWS for IoT, System Management with NETCONF-YANG.	8	0
5	CASE STUDIES/INDUSTRIAL APPLICATIONS: Cisco IoT system, IBM Watson IoT platform, Manufacturing, Converged Plant wide Ethernet Model (CPwE), Power Utility Industry, Grid Blocks Reference Model, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control	7	0

Text Books:

1. RajkumarBuyya, "Internet of Things: Principles and Paradigms", Elsevier Science, 2016.
2. ArshdeepBahga,"Internet of Things", Universities press,2015
3. Olivier Hersent,"The Internet of Things", Wiley student edition, Reprint, 2015.

Reference Books:

1. Raj Kamal,"Internet of Things - Architectures and Design principles",1st Edition, McGraw Hill Education,2017.
2. Jan Holler, "From Machine-to-Machine to the Internet of Things", Academic Press, 2014.

Web/Digital resources:

1. Introduction to internet of things- <https://archive.nptel.ac.in/courses/106/105/106105166/>
2. Design for internet of things, IISc Bangalore- <https://nptel.ac.in/courses/108108098> -

PRACTICE BASED LEARNING

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Design and develop a prototype for IoT Domain Specific application using Raspberry PI	Raspberry Pi/ Arduino, with appropriate sensors.	Design and Developing an Engineering solution

Self-Learning Exercises:

1. Case Study / Mini Projects

Design and develop a prototype for IoT Doman Specific Projects such as Home Automation, Intruder Detector, Smart Agriculture, Smart city, forest fire detection etc...

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3											3		
CO3	3	3											2		
CO4	3	3	3		3	2							3		3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC724	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Quantum Computing and Communication						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of quantum mechanics, linear algebra operator and matrices.

COURSE OBJECTIVE:

1. Understand fundamental differences between conventional computing and quantum computing
2. Learn basic quantum computing algorithms.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the representation of Qubit, Bloch sphere and Density matrix for quantum computing.	L2
CO2	Interpret the applications of entanglement in teleportation and super dense coding.	L3
CO3	Illustrate the application of quantum algorithm for quantum computing.	L3
CO4	Develop quantum circuits using simulation tool and ensure its reliability – in group / individual and give effective presentation with documentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Why Quantum Computing, Postulates of Quantum Mechanics, Qubit - The smallest unit and Bloch sphere representation, Multiple Qubit States and Quantum Gates and Quantum Circuits.	8	0
2	Quantum Teleportation, Super Dense Coding, Bloch Sphere and Density Matrix, Measurement Postulates.	8	0
3	Algorithms: Deutsch Algorithm, Deutsch-Josza & Bernstein-Vazirani Algorithms, Simon Problem, Grover's Search Algorithm, Shor's Factorization Algorithm.	8	0
4	Quantum Fourier Transform, Implementing QFT-3 qubits (and more), Quantum Error Corrections for different Qubits.	8	0
5	Shannon Entropy, Shannon's Noiseless Coding Theorem, EPR and Bell's Inequalities, Cryptography-RSA Algorithm, Quantum Cryptography.	7	0

Text Books:

1. Michael A. Nielsen & Isaac L. Chuang, "Quantum Computation and Quantum Information", 10th Edition Cambridge University Press – 2010.
2. Eleanor Rieffel and Wolfgang Polak, "QUANTUM COMPUTING - A Gentle Introduction", 2nd Edition, MIT Press Cambridge, 2011.
3. D. Bouwmeester, A. K. Ekert, and A. Zeilinger, eds. "The Physics of Quantum Information", Springer-2013

Reference Books:

1. P. Kok and B. W. Lovett, "Introduction to Optical Quantum Information Processing", 1st edition, Cambridge university press – 2010.
2. L. Mandel, and E. Wolf. "Optical Coherence and Quantum Optic"s, 1st edition, Cambridge University Press 1995

Journals/Magazines:

1. <https://learn-xpro.mit.edu/>
2. <https://www.quantamagazine.org/tag/quantum-computing>
3. Nature Magazine Journal - Rinton Press.

Web/Digital resources:

1. <https://youtu.be/xnmpWfQKPSE?list=PLo4DhXMUkdvU9rZvEQYLdly5dABHv1ZuD>
2. <https://www.youtube.com/playlist?list=PLuBwWyD3M82x9PfxeF70xb0E122mQAWH6>

SWAYAM/NPTEL:

1. <https://www.youtube.com/watch?v=Vzh5guYUyvM&list=PLq-Gm0yRYwThGmlypvSFQ-kT2rPaXKAZ5>
2. <https://www.youtube.com/playlist?list=PLo4DhXMUkdvU9rZvEQYLdly5dABHvIzuD>

PRACTICE BASED LEARNING

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Implementation of Quantum logic gates for single and multiple qubit gates	Open-source tool	Logical thinking

Self-Learning Exercises:**Case Study****Course Articulation:**

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	2												2	
CO3	3	3												3	
CO4	3	3	3		3									3	

High – 3, Medium – 2, Low – 1



DEPARTM ENT	Electronics and communication Engineering						
Course Code	22EC725	Total Credits	3	Course Type	Professional Core Course		
Course Title	Bio Medical Signal Processing						
Teaching Learning Process		Contact Hours	Credi ts	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basics of signals and systems

COURSE OBJECTIVE:

1. To learn the basic concepts and tools for modeling and analyzing biomedical signals, with specific focus on nonstationary and multivariate physiological time series.

COURSE OUTCOMES (COs): At the end of the course, the student will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Apply basic knowledge to study origins and characteristics of biomedical signal.	L2
CO2	Analyze the different sources of noise and artifacts of biological signals.	L3
CO3	Design model to study various events and waveform complexities of different biological signals.	L3
CO4	Implement an algorithm as a team-member to design and implement experiments using modern tools.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to Biomedical Signals: Classification of signals, the nature of biomedical signals, the action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis.	8	0
2	Neurological signal processing: The brain waves and its	8	0

	potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Linear prediction theory, The Autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination- The case of epileptic patients, overall performance.		
3	Data acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of sleep-wake transitions, Hypnogram model parameters, Event history analysis for modeling sleep.	8	0
4	Adaptive Interference/Noise Cancellation: A review of Wiener filtering problem, Principle of an Adaptive filter, The steepest-descent algorithm, the Windrow-Hoff least mean square adaptive algorithm, Adaptive noise canceller, Cancellation of 60Hz interference in ECG, canceling of maternal ECG in fetal ECG.	8	0
5	Cardio-logical Signal Processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG parameters and their estimation, The use of multi-scale analysis for parameter estimation of ECG waveforms, Arrhythmia analysis monitoring, long term continuous ECG recording.	7	0

Text Books:

1. D C Reddy: "Biomedical Signal Processing Principles and Techniques", 1st Edition, Tata McGraw Hill publications, 2005.
2. Rangaraj M. Rangayyan: "Biomedical Signal Analysis A case study approach" , 2nd Edition, John Wiley publications, 2002
3. Willis J Tompkins: "Biomedical Digital Signal Processing", Prentice Hall, 2000.

Reference Books:

1. Eugene N. Bruce: "Biomedical Signal Processing & Signal Modeling," Wiley publications, 2001.
2. Robert E. Kass, Uri Eden, Emery N. Brown *Analysis of Neural Data*. ISBN: 978-1-4614-9602-1, 2014.

Web/Digital resources:

1. ocw.mit.edu > Courses > Health Sciences and Technology MIT Open Course War
2. <http://ocw.mit.edu>
3. www.vub.ac.be/en/study/fiches/30340/biomedical-signals-and-images
4. www.crcpress.com > Biomedical Science > Biomedical Imaging.

Self-Learning Exercises:

1. Acquisition modes of biomedical signals
2. Correlation, FFT and Convolution to study biomedical signals.
3. Modern techniques to study biomedical signals.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3	3										3		
CO4	3	3	3		3				3	3			3	3	

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	<i>ELECTRONICS AND COMMUNICATION ENGINEERING</i>						
<i>Course Code</i>	<i>22EC72 6</i>	<i>Total Credits</i>	<i>3</i>	<i>Course Type</i>	<i>Professional Elective Course</i>		
<i>Course Title</i>	<i>Protocol Engineering</i>						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	<i>39</i>	<i>3</i>		<i>CIE</i>	<i>SEE</i>	<i>Total</i>
	<i>Tutorial</i>	<i>0</i>	<i>0</i>	<i>Weightage</i>	<i>40 %</i>	<i>60 %</i>	<i>100 %</i>
	<i>Practical</i>	<i>0</i>	<i>0</i>	<i>Maximum Marks</i>	<i>40 Marks</i>	<i>60 Marks</i>	<i>100 Marks</i>
	<i>Total</i>	<i>39</i>	<i>3</i>	<i>Minimum Marks</i>	<i>20 Marks</i>	<i>25 marks</i>	<i>45 Marks</i>

COURSE PREREQUISITE:

Fundamentals of Computer Networks

COURSE OBJECTIVE:

1. To understand fundamental terminologies of emerging communication protocol
2. To design communication protocol using Software Development Language to meet the given specifications

Course Outcomes (COs): After completing this course, students will be able to:

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe the fundamental terminologies, specifications, and operation of communication protocol.	L2
CO2	Design and simulate protocol using formal and informal approaches.	L3
CO3	Verify protocol testing and validate testing errors	L3
CO4	Demonstrate the knowledge of developing different communication protocols using Software Development Language.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial

1	Introduction: Introduction to communication protocols, software, subsystems development methods, protocol engineering process, reference models, services and interface protocols at various layers.	8	0
2	Protocol specifications: components of protocol, service specifications, entity specifications interface and interactions, examples (HDLC, ABP, RSVP etc).	8	0
3	SDL: Features, communication system using SDL, examples of SDL based protocol specifications, protocol verification, validation design errors, validation approaches, and examples.	8	0
4	Testing: Conformance testing, framework, conformance test architectures, test sequence generation methods, TTCN framework, examples.	8	0
5	Protocol testing: Types, performance testing, Interoperability testing, scalability testing. Protocol synthesis, protocol implementation requirements and methods.	7	0

Text Books:

1. A. Leon –Garcia, Indra Widjaja “Communication Networks”, Tata McGraw Hill.
2. W. Stallings “Data and Computer Communication”, 7th edition, PHI, New Delhi.
3. Pallapa Venkataram, Sunil Kumar S Manvi, B. Sathish Babu“ Communication Protocol Engineering”, PHI, Learning, 2014.

Reference Books:

1. Mohammed G. Gouda “Elements of Protocol Design”, Wiley Student Edition, 2004.
2. M.Steen Strub “Routing in Communication networks”, PH, New York.
3. Sivarammurthy, Manoj “Ad Hoc Wireless Networks: Architectures and Protocols”, Pearson Education, 2004.
4. Charles E. Perkins “Ad Hoc Networking”, Addison Wesley, 2008.

SWAYAM/NPTEL:

1. <https://archive.nptel.ac.in/courses/106/105/106105183/>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Software Development Language.	Programming

Self-Learning Exercises:

1. Mini Projects (Simulation)

Course Articulation:

22EC726↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2			2								2		
CO2	1	1			1	2							2		
CO3	2	2			2								2		
CO4	2					2			3				2		

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC731	Total Credits	3	Course Type	Professional Elective course		
Course Title	Nanoscience and Technology						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE

Basic concepts of material physics, chemistry and usage of relevant simulation tools.

COURSE OBJECTIVE:

1. To acquaint with the fundamental concepts of materials for nanoscience and technology.
2. To identify and analyze the engineering performance of the selected material.

COURSE OUTCOMES (COs)

CO'S	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe the fundamentals of materials towards nanoscience and technology.	L2
CO2	Identify the analytical techniques and interface science to materials.	L3
CO3	Analyze the engineering performance and properties of nanoparticles	L4
CO4	Demonstrate the skill sets using software tools for the simulation of composite films.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Generic methodologies for nanotechnology-classification and fabrication, classification of nanostructures, nanoscale architecture, electronic properties of atoms and solids, effects of nanometer length scale, top-down process, bottom-up process, templating methods, ordering of nanosystems.	8	0

2	Characterization techniques: Classification, scattering physics, SEM, TEM, AFM, bulk and surface diffraction techniques, electron spectroscopy for surface analysis, infrared spectroscopy and Raman spectroscopy.	8	0
3	Quantum wells, wires and dots: Preparation of quantum nanostructures, size effects, conduction electrons and dimensionality, Fermi gas and density of states, potential wells, partial confinement, properties dependent on density of states, applications: infrared detectors and quantum dot lasers.	8	0
4	Properties of nanoparticles: Face centered nanoparticles, metal nanoclusters, magic numbers, theoretical modeling of nanoparticles, geometric and electronic structure, reactivity, fluctuations. Carbon molecules, structure, clusters, discovery, crystal and structure of C ₆₀ , larger and smaller fullerenes, carbon nanotubes, fabrication, structure, electrical, vibrational and mechanical properties, applications.	8	0
5	Principles of interface science: Surface and interface energies, analysis of wet interfaces, modifying interfaces, adsorption and surfactancy, polymer adsorption, chemistry of grafting, physical properties of grafted polymer layers, nanostructured organic coatings by soft lithography, making thin organic films, spin-coating of polymers and colloids, making organic multilayers.	7	0

Text Books:

1. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan(2007), “Nanoscale science and technology”, John Wiley and Sons Pvt. Ltd.
2. Charles P Poole, Jr, Frank J Owens (2006), “Introduction to Nanotechnology”, John Wiley and Sons Pvt. Ltd.

Reference Books:

1. W. Gaddand, D. Brenner, S. Lysherski and G. J. Infrate (Eds)(2002),“Handbook of Nanoscience Engineering and Technology”, CRC Press.

Web/Digital resources:

1. <https://web.pdx.edu/~pmoeck/phy381/intro-nanotech.pdf>

SWAYAM/NPTEL:

1. https://onlinecourses.nptel.ac.in/noc19_mm21/preview
2. <https://nptel.ac.in/courses/118104008>

PRACTICE BASED LEARNING

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Articles based on nanoscience and technology	Open-source software tools	Teamwork, Communications skills

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3												3	
CO2	3	3												3	
CO3	3		3											3	3
CO4	3	3	3	3	3				2	2				3	3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC732	Total Credits	3	Course Type	Professional Elective Course – IV*		
Course Title	Statistical Signal Detection and Processing						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Students should be familiar with Digital Signal Processing and Linear Algebra.

COURSE OBJECTIVE:

1. This course will discuss methods for analysis of digital signals with noise. Students will be introduced the basics of Estimation Theory, Parametric, and Non-parametric spectrum estimation and filter models.

COURSE OUTCOMES (COs): After completing this course, students should be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain signal models using deterministic and stochastic methods.	L2
CO2	Apply signal models to various filter structures.	L3
CO3	Analyze applications for prediction and power spectrum estimation.	L4
CO4	Analyze, Implement and demonstrate adaptive signal processing algorithms using modern tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Overview of Random processes: Stationary processes, Gaussian processes, Ergodicity, white noise, power spectrum	8	0
2	Signal modeling: Pade approximation, Prony's method, Autocorrelation method, Covariance method, AR, MA and ARMA models.	8	0

3	Filter models: Levinson recursion, Lattice filter: FIR and IIR, Wiener filter: FIR and IIR filter.	8	0
4	Spectrum Estimation: Nonparametric methods, Periodogram, Bartlett's method, Welch's method, Blackman-Tukey approach, Maximum Entropy method, Parametric Methods, Frequency estimation.	8	0
5	Adaptive filtering: LMS and RLS algorithm, Linear Quadratic Gaussian filter.	7	0

Text Books:

1. Monson Hayes, "Statistical Digital Signal Processing and Modelling", WileyIndia2014
2. B. Widrow, S. Stearns, "Adaptive Signal Processing", Latest Edition, Pearson 2015.
3. D. G. Manolakis, V. K. Ingle and S. M. Kogon, "Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing," McGraw-Hill, New York, 2000.

Journals/Magazines:

1. IEEE Signal Processing Magazine, IEEE,
<https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=79>
2. IEEE Journal of selected Topics in signal Processing, IEEE,
<https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4200690>

SWAYAM/NPTEL:

1. NPTEL Video lecture by Prof S Mukhyopadhyay, IIT Kharagpur
2. <https://www.youtube.com/watch?v=Ru3FhYbjcFs&list=PL4FB9652402002C76>

Self-Learning Exercises:

1. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	2											3	2	
CO3	3	3											3	2	
CO4	3	3	3	3	3				3	3			3	3	2

High – 3, Medium – 2, Low – 1

<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC733	<i>Total Credits</i>	3	<i>Course Type</i>	Professional Elective Course		
<i>Course Title</i>	Cryptography and Network Security						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Computer Networks

COURSEOBJECTIVE:

1. To learn how to maintain the confidentiality, integrity and availability of a data.
2. To understand various protocols for network security to protect against the threats in the networks.

COURSEOUTCOMES(COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the security requirements in IT/computer and understand the importance of security system	L2
CO2	Analyze conventional key, public key cryptography, key management and distribution schemes	L4
CO3	Apply the knowledge of security architecture, intruders and intruder detection mechanisms	L3
CO4	Demonstrate the skill sets to simulate/use analysis tools to secure the information system	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Security goals, services, mechanisms and attacks, The OSI security architecture, Layers in the TCP/IP, A model for network security, Classical encryption techniques, Rooter machine, Steganography, Problems.	8	0
2	Symmetric key cryptography: Block cipher design principles, DES, AES. Public key cryptography: RSA, Diffie-Hellman key exchange, Elliptic curve, Elgamal, Rabin and Knapsack cryptosystems, Authentication algorithms	8	0
3	Security at the Application Layer: E-Mail architecture and security, E-Mail threats, PGP, Multipurpose internet mail extension, S/MIME functionality, S/MIME messages, S/MIME certificate processing, enhanced security services.	8	0
4	Security at Transport Layer: SSL architecture, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol and shake Protocol, SSL message formats. Security at Network Layer: IP Sec overview, Services provided by IP Sec, Applications of IPsec.	8	0
5	Intruders, Intrusion Detection, Password Management. Malicious software: Viruses and Related Threats, Virus Counter measures. Firewall Design Principles.	7	0

Text Books:

1. WILLIAM STALLINGS, “Cryptography and Network Security”, Pearson Education ,7th Edition, 2017.
2. BEHROUZ A. FOROUZAN, “Cryptography and Network Security”, TMH, 2nd Edition, 2011

Reference Books:

1. KAUFMAN, PERLMAN & SPECINER, “Network security -Private communication in a public world”, PHI, 2nd Edition 2005.
1. BISHOP MATT: “Introduction to Computer Security”, Dreamtech Press, 2013
2. WILLIAM STALLINGS: “Computer Security Principles”, TMH, 4th Edition, 2020

Web Resources:

1. <https://nptel.ac.in/syllabus/106105031/>
2. <https://nptel.ac.in/courses/106105162/>
3. <https://www.youtube.com/watch?v=p6w9RZ5PNho>

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3	3	3	3								3	3	
CO3	3	3	3	3	3										
CO4	3	3	3	3	3				3	3					3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC73 4	Total Credits	3	Course Type	Professional Elective - 734		
Course Title	Wavelet and compression techniques						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Linear algebra, Probability, Signal and Image Processing.

COURSEOBJECTIVE:

1. To make students learn the signal representation and analyze the continuous, discrete-time signals and coding techniques using wavelet transform.

COURSEOUTCOMES(COs): After completing this course, students should be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Apply the concept of Vectors, Basis Sets for Signal Representation.	L3
CO2	Analyze discrete and continuous time signals using Wavelets.	L4
CO3	Apply coding techniques, dictionary techniques and Quantization Techniques for images.	L3
CO4	Analyze, Implement and demonstrate the real-world application of wavelets and compression techniques using modern Tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Linear Algebra Review: Vector spaces and basis, inner products, diagonalization, shift invariant linear transform, convolution and DFT, signal as vector representation using Fourier basis.	8	0

2	Construction of discrete wavelets: Mother wavelets and scaling function, first state wavelet basis, iteration, Multi resolution analysis, Filter bank, Up-sampling, Down sampling, Quadrature mirror filters and conjugate filters, Haar, Daubechies orthogonal wavelets, Biorthogonal Wavelets	8	0
3	Coding Techniques: Huffman coding, Adaptive Huffman coding, Applications of Huffman coding algorithm to text and audio processing, Arithmetic coding, generating and deciphering the tag, Comparison of Huffman coding & Arithmetic coding, Adaptive arithmetic coding and applications	8	0
4	Scalar and Vector Quantization Techniques: Scalar quantization, Uniform & Adaptive quantizer, Vector Quantization, Advantages of VQ over SQ, LBG algorithm. Transform coding: DCT, Quantization and coding of transform coefficients.	8	0
5	Dictionary techniques: Static/Adaptive dictionary techniques, Applications to File compression- UNIX compress, GIF image compression, JPEG, JPEG-LS lossless image compression techniques. Mathematical preliminaries for Lossy Compression techniques: Distortion criteria, conditional entropy, differential entropy, Models: physical, probabilistic, linear system models.	7	0

Text Books:

1. Michael Frazier, “An Introduction to Wavelets through Linear Algebra”, Springer Edition.
a. 2013 Reprint.
2. Khalid Sayood: “Introduction to Data Compression”, 4th Edition, Elsevier Inc, 2012.

Reference Books:

1. Raghuvver M. Rao, Ajit Bopardikar, “Wavelet Transforms: Introduction to Theory and Applications”, Pearson Publication. 2014.
2. David Solomon, Giovanni Motta: "Handbook of Data Compression", 5th Edition, Springer, 2010.
3. K. P. Soman, K I Ramachandran, N G Resmi, “Insight into Wavelets: From Theory to Practice”, PHI Eastern Economy Edition, 2014.

Journals/Magazines:

1. International Journal of wavelets, Multiresolution and Information Processing, World Scientific, worldscientific.com/worldscinet/ijwmip
2. IEEE Signal Processing Magazine, IEEE, <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=79>
3. IEEE Journal of selected Topics in signal Processing, IEEE, <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4200690>

SWAYAM/NPTEL:

1. <https://www.youtube.com/watch?v=c4s5X-Bm2Wc&list=PLUYV0LEDKN9CQ-HT33K8ED6-f2tlxcN0Q>
2. <https://www.youtube.com/watch?v=c4s5X-Bm2Wc&list=PLUYV0LEDKN9CQ-HT33K8ED6-f2tlxcN0Q>
3. <https://nptel.ac.in/courses/108101093>
4. <https://nptel.ac.in/courses/117105135>

Self-Learning Exercises:

1. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	2	2	-
CO4	3	3	3	3	3	-	-	-	3	3	-	-	3	3	3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC735	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Advanced computer Networks						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Fundamentals of computer Networks.

COURSE OBJECTIVE:

1. To provides a comprehensive overview on advanced topics in network protocols and networked systems.
2. To study the Internet protocols and recent research results.
3. Examine network architectures, data networks, network virtualization, software-defined networking concepts and principles.

COURSE OUTCOMES (COs)

After the completion of the course student will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the effective communication mechanisms using techniques like connection establishment, queuing theory, recovery and various congestion control techniques.	L2
CO2	Conceptualize on data and control plane separation, Openflow, network programmability, virtualization, data center constructs and SDN Framework.	L3
CO3	Analyze paradigm shift in the functionality of network models, controllers and constructs	L4
CO4	Assess the strategies used for development of software defined operations and infrastructure.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream (TCP), End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery.	8	0
2	Congestion Control and Resource Allocation: Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System (DNS), Electronic Mail (SMTP, POP, IMAP, MIME), World Wide Web (HTTP), Network Management (SNMP).	8	0
3	SDN: Control plane, Data plane, moving information between planes, why can separation be important? Distributed control planes: IP and MPLS, Creating the IP underlay, Convergence time, Load balancing, High availability, Creating the MPLS overlay, Replication. Centralized control planes: Logical versus Literal, Route servers. OpenFlow: Wire protocol, Replication, FAWG, Config and Extensibility, Architecture, Hybrid approaches: Ships in the night, SDN Controllers: General concepts-VMware.	8	0
4	Network Programmability: Management interface, Application-Network divide: Command line interface, NETCONF & NETMOD, SNMP, Modern programmatic interfaces: Publish and Subscribe interfaces, XMPP, Modern orchestration: Openstack.	8	0
5	Network Function Virtualization: Virtualization and data plane I/O, Services engineered path, Service locations and chaining: Metadata, NFV at ETSI, Non-ETSI NFV Work: Middlebox studies. SDN solutions for the data center network, Building an SDN Framework: Open Daylight Controller/Framework.	7	0

Text Books:

1. Larry Peterson and Bruce S Davis, "Computer Networks: A System Approach", Elsevier, 5th Edition, 2014.
2. Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies", O'Reilly Media Publishers, 2013.

Reference Books:

1. Uyless Black, “Computer Networks, Protocols, Standards and Interfaces” Prentice Hall, 2nd edition 2021.
2. Paul Goransson, Chuck Black and Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann, 2nd Edition, 2016.
3. William Stallings, “Foundations of Modern Networking”, Pearson, 2016.
4. Jim Doherty, “SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization”, Addison Wesley, 2016.

Web/Digital resources:

<https://www.youtube.com/watch?v=f5ksLu5Xjnk&list=PLG9aCp4uE-s3Mmbn4q5J87OriIN3CuFDS>

SWAYAM/NPTEL:

https://onlinecourses.nptel.ac.in/noc23_cs35/preview

PRACTICE BASED LEARNING

SI No.	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Simulation	Any open-source tool	Programming

Self-Learning Exercises:

3. Case Study Projects
4. Mini Projects

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	
CO2		3	3										3	3	
CO3	3	3	3	3	3				2	2			3	3	
CO4	3		3	3	3				2	2			3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC736	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Deep Learning for Computer Vision						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of Linear Algebra.

COURSE OBJECTIVE:

1. To make students understand image formation and deep learning network models used in training, testing and validating the data.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain image formation fundamentals and multilayered neural network using various perceptron algorithms.	L2
CO2	Analyze different deep learning networks involved in structuring the model and tuning of hyper parameters for object detection techniques.	L4
CO3	Analyze various CNN and Advanced CNN Architectures.	L4
CO4	Analyze, Implement and demonstrate deep learning algorithms for real-world applications.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Image Formation: Pinhole perspective, weak perspective, cameras with lenses, Rigid Transformation and Homogeneous coordinates, Intrinsic and Extrinsic Parameters, Geometric Camera Calibration	8	0
2	Deep Learning and Neural Network: Perceptron, Multi-layer perceptron, Activation functions, feed forward process, error	8	0

	function, optimization algorithms and back propagation, classification using MLP.		
3	Convolutional neural network: Architecture and Components of CNN, Image classification using CNN, Over fitting and dropout layer, Convolution over colour images.	8	0
4	Structuring DL projects and hyper parameter tuning: Defining performance metrics, designing baseline model and data preparation, evaluation of model, tuning hyper parameters, optimization, regularization and batch normalization.	8	0
5	Advanced CNN Architecture and Object Detection: Description and comparison of LeNet-5, AlexNet, VGGNet, Inception, GoogleNet, R-CNN, SSD and YOLOs.	7	0

Text Books:

1. Josh Patterson and Adam Gibson, “Deep Learning, A practitioner’s approach,” O’Reilly Media Inc., 1st Edition, 2017.
2. Seth Weidman, “Deep Learning from Scratch, Building with Python from first principles,” O’Reilly Media Inc., ISBN: 9781492041412, September 2019.
3. Mohammed Elgandy, “Deep Learning for Vision Systems,” Manning Publication, 2020.
4. David A. Forsyth, Jean Ponce, “Computer Vision – A modern approach,” Pearson Education Inc., 2nd Edition, 2012.

Reference Books:

1. Luca Pietro, Giovanni Antiga, Thomas Viehmann, Eli Stevens, “Deep Learning with PyTorch,” Manning Publications, ISBN: 9781617295263, July 2020.
2. Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning,” The MIT Press, November 2016.

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/106106224>
2. <https://nptel.ac.in/courses/106105215>

Self-Learning Exercises:

1. Mini Projects

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO4	3	3	3	3	3	-	-	-	3	3	-	-	3	3	3

High – 3, Medium – 2, Low – 1



VII SEMESTER OPEN ELECTIVES

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC741	Total Credits	3	Course Type	Open Elective Course -04		
Course Title	Product Design and Development						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Knowledge of Allied Engineering Subjects that helps in Product Development

COURSE OBJECTIVE:

1. To conceptualize a product
2. To convert the concept into product
3. To Design and test the product
4. To analyze the product usage and its market acceptance
5. Product sustenance and future improvement

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explore the need of products, according to market requirement	L2
CO2	Investigate market requirements and arrive at decision about the product	L3
CO3	Develop Prototype, analyze and document the results	L4
CO4	Explain IPR and patent requirements to safe guard Innovation	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: A generic development process, development process and organizations, process flows, product development organizations	8	0
2	Product planning: planning process, Identifying customer needs, product specifications, Product architecture, concept generation concept selection, concept testing	8	0
3	Design: Industrial Design, Design for manufacturing, Prototyping, robust design	8	0
4	Development: Product development economics, Managing Projects	8	0
5	IPR: Patents and Intellectual property rights,	7	0

Text Books:

1. Karl T Ulrich, Steven D E, Anitha Goyal – “Product Design & Development”, McGrawHill Publishers, 4th edition 2011

Reference Books:

Journals/Magazines:

1. Electronics for you
2. Digit

Web/Digital resources:

websites of manufacturing companies, and Youtube video resource and popular product blogs

SWAYAM/NPTEL:

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Survey of successful products	Survey method	Recognizing Novelty in products
2	Technical specifications and standards	Reference documents	Knowledge

Self-Learning Exercises:

1. Case Study projects
2. Mini Projects
3. Any others

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														3
CO2	3			3	3										3
CO3	3	3	3			3								3	3
CO4	3														3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC742	Total Credits	3	Course Type	Open Elective Course		
Course Title	Hybrid Vehicles						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basics of Electrical and Electronics

COURSE OBJECTIVE:

1. To understand the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. To learn the various aspects of hybrid and electric drive train, types of electric machines and energy storage devices.

COURSE OUTCOMES (COs): After completing this course, students should be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Demonstrate the knowledge of architecture, technology, and fundamentals of electric and hybrid vehicles.	L2
CO2	Analyze various energy storage technologies and propulsion systems utilized in hybrid electric vehicles.	L4
CO3	Examine the working of different configurations of electric, hybrid vehicle, performance analysis and Energy Management strategies used in HEVs.	L4
CO4	Take part in a group/individual activity and complete the assigned task by demonstrating skills related to implementation, documentation and presentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	<p>Introduction to Electric Vehicle: History of Electric Vehicles, Development towards 21st Century, Types of Electric Vehicles in use today – Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Motion and Dynamic Equations of the Electric Vehicles: various forces acting on the Vehicle in static and dynamic conditions.</p> <p>Introduction to Hybrid Electric Vehicle: Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid Drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.</p>	8	0
2	<p>Electric Drive Trains: Basic concept of electric traction, introduction to various electric drive- train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit</p> <p>Hybrid vehicle architectures: Series hybrid vehicle architectures, Parallel hybrid vehicle architectures, Series-Parallel hybrid vehicle architectures –range extender and full hybrid systems, Parallel hybrid architectures, Plug-in hybrid architectures, commercially available electric and hybrid vehicles.</p>	8	0
3	<p>Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Battery Management System(BMS)/Energy Management System (EMS)</p>	8	0
4	<p>Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.</p>	8	0
5	<p>Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Introduction to various charging techniques and schematic of charging stations</p>	7	0

Text Books:

1. James Larminie, J. Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd. 2003.
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
3. WilliamB.Ribbens,“UnderstandingAutomotiveElectronics”,Butterworth,HeinemannWoburn, 5thEdition,1998.
4. SethiH.M,“AutomobileTechnology”,TataMcGraw-Hill-2003.

Reference Books:

1. Crouseand Anglin, “AutomotiveMechanism”, TataMcGraw-Hill,9thEdition.2003.
2. Newton, Steedsand Garet,“Motorvehicles”,ButterworthPublishers,1989.
3. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”,Springer, 2015.
4. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.

Web/Digital resources:

1. https://archive.nptel.ac.in/content/syllabus_pdf/108103009.pdf
2. <https://www.youtube.com/watch?v=V004WUdpHeA&list=PLCBKiW2ShR0B5Rs-ytbbp-uyiPAzqdZts>
3. <https://www.youtube.com/watch?v=BMrA-5EDakg&list=PLQnccOCAloDQXQ62BTGvsRQFBBisedbJT>
4. <https://www.youtube.com/watch?v=ErV51GVso1w&list=PL2ir4svMoaYj48N0VWoic25P9LaU2wlbA>
5. <https://www.youtube.com/watch?v=hcNqUZ1TiRM&list=PL2CubuFTe28NyTyCIUCMizxksWmmeY36x>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill /Ability
1	Hybrid Vehicle simulation	Any simulation tool for automotive domain.	Programming/ Simulation

Self-Learning Exercises:

1. **Case Study projects**
2. **Mini Projects**

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2			3								
CO2	2	3	2	2	2		3							2	
CO3	3	3	3	3	3		3							3	
CO4					3	2	2	2	3	3	3			2	3

High – 3, Medium – 2, Low – 1



DEPARTMENT NT	Electronics and Communication Engineering						
Course Code	22EC74 3	Total Credits	3	Course Type	Open Elective Course - 4		
Course Title	Deep Learning for NLP						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic mathematics, Signal Processing.

COURSE OBJECTIVE:

1. Learn the concepts on natural language processing and deep learning.
2. To analyze CNN and Deep learning algorithms for different applications.

COURSE OUTCOMES (COs): After completing this course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS	L2
CO2	Explain the theoretical foundations, algorithms, and methodologies of Neural Network	L2
CO3	Analyze CNN and Deep Learning architecture and Algorithms.	L4
CO4	Analyze, Implement and demonstrate Deep Learning algorithms for real-world applications.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Fundamentals: What is Natural Language Processing, Origin of NLP, Language and Knowledge, The challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications, Language Modelling: Various Grammar-based Language Models, Statistical Language Model.	8	0

2	Word Level Analysis: Regular Expressions, Finite State Automata, Morphological parsing, Spelling Error Detection and correction, words and word classes, part of speech tagging, Syntactic Analysis: Context-free Grammar, Constituency, Parsing, Probabilistic parsing, Architecture of NLG Systems, Generation Tasks, and Representations, Application of NLG.	8	0
3	Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches, Direct Machine Translation, Rule-based machine translation, corpus-based machine translation, Semantic or Knowledge-based MT System, Translation involving Indian Languages	8	0
4	Basics of Deep Learning: Introduction, Perceptron Algorithm Explained, Multilayer Perceptron, Deep Learning, Model Training, Unsupervised Deep Learning, Framework Considerations	8	0
5	Convolutional Neural Networks: Basic Building Blocks of CNN, Forward and Backpropagation in CNN, Text Inputs and CNNs, Classic CNN Architectures, Modern CNN Architectures, Applications of CNN in NLP, Fast Algorithms for Convolutions	7	0

Text Books:

4. Tanveer Siddiqui, U S Tiwary, "Natural Language Processing & Information Retrieval", Oxford Higher Education, Sixth impression, 2018.
5. Uday Kamath, John Liu, James Whitaker, "Deep Learning for NLP and Speech Recognition", Springer, 2019

Reference Books:

3. Nitin Indurkha, Fred J. Damerau, Handbook of Natural Language Processing, Second Edition, CRC Press, 2010.
4. James Allen, Natural Language Understanding, Pearson Publication 8th Edition, 2012.
5. Chris Manning, Hinrich Schütze, Foundations of Statistical Natural Language Processing, 2nd edition, MIT Press Cambridge, MA, 2003.
6. Umberto Michelucci, Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks, Apress, 2018.

Journals/Magazines:

7. IEEE Transactions on Neural Networks and Learning Systems, IEEE.
<https://ieeexplore.ieee.org/xpl/aboutJournal.jsp?punumber=5962385>.
8. IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE.
<https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34>
9. IEEE Computational Intelligence Magazine, IEEE.
<https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=10207>
10. Natural Language Processing Journal, Elsevier,
<https://www.journals.elsevier.com/natural-language-processing-journal>

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/106106184>
2. <https://nptel.ac.in/courses/106105158>
3. <https://nptel.ac.in/courses/106106211>

Self-Learning Exercises:

4. CaseStudyprojects
5. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	2	2
CO4	3	3	3	3	3	-	-	-	3	3	-	-	3	3	3

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC744	<i>Total Credits</i>	3	<i>Course Type</i>	Open Elective Course		
<i>Course Title</i>	Application Specific Integrated Circuits						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of Electronics and VLSI.

COURSE OBJECTIVE:

1. To learn of basic design approaches of Application Specific Integrated Circuits (ASIC)
2. To get familiar with practical knowledge of doing tapeout.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the concepts of ASIC design methodology of CMOS Logic circuits.	L2
CO2	Analyze the different hierarchical design entry for ASIC Library.	L3
CO3	Examine the back-end design of ASIC circuit with necessary performance parameters.	L3
CO4	Design, Demonstrate and validate the CMOS VLSI circuits using EDA tool with presentation and documentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to ASICs: Full custom, Semi-custom and Programmable ASICs, ASIC Design flow, ASIC cell libraries. CMOS Logic: Data path Logic Cells: Data Path Elements, Adders: Carry skip, Carry bypass, Carry save, Carry select, Conditional sum, Multiplier (Booth encoding), Data path Operators, I/O cells, Cell Compilers.	8	0
2	ASIC Library Design: Logical effort: Predicting Delay, Logical area and logical efficiency, Logical paths, Multi stage cells, Optimum delay and number of stages, library cell design.	8	0
3	Low-level design entry: Schematic entry: Hierarchical design, The cell library, Names, Schematic Icons & Symbols, Nets, Schematic Entry for ASICs, Connections, vectored instances & buses, Edit in place, attributes, Net-list screener. ASIC Construction: Physical Design, CAD Tools System partitioning, Estimating ASIC size and Partitioning.	8	0
4	Floor planning and placement: Goals and objectives, Measurement of delay in Floor planning, Floor planning tools, Channel definition, I/O and Power planning and Clock planning. Placement: Goals and Objectives, Min-cut Placement algorithm, Iterative Placement Improvement, Time driven placement methods, Physical Design Flow.	8	0
5	Routing: Global Routing: Goals and objectives, Global Routing Methods, Global routing between blocks, Back-annotation. Detailed Routing	7	0

Text Books:

1. Michael John Sebastian Smith, "Application - Specific Integrated Circuits" AddisonWesley Professional; 2005.
2. Rakesh Chadha, Bhasker J., "An ASIC Low Power Primer", Springer, ISBN: 978-1-4614-4270-7.

Reference Books:

1. Neil H.E. Weste, David Harris, and Ayan Banerjee, "CMOS VLSI Design: A Circuits and Systems Perspective", 3rd edition, Addison Wesley/ Pearson education, 2011.
1. Vikram Arkalgud Chandrasetty, "VLSI Design: A Practical Guide for FPGA and ASIC Implementations", Springer, 2011, ISBN: 978-1-4614-1119-2.

Journals/Magazines:

1. Technion Research Group - ASIC² Research Group
2. IEEE - Transactions on Parallel and Distributed Systems (TPDS)
3. Solid-State Circuits Magazine

Web/Digital resources:

1. https://youtu.be/qee-ahSeKiU?list=PLfGJEQLQIDBN0VsXQ68_FEYyqcym8CTDN

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/108106158>
2. <https://nptel.ac.in/courses/117108040>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill /Ability
1	Design and simulation of standard cell	Electric / Cadence	Simulation skill
2	Simulation with validation of CMOS VLSI Circuits.	Electric / Cadence	Design methodology in VLSI Circuits.

Self-Learning Exercises:

6. Case Study projects - Paper Presentation and implementation of the same from reputed journals

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2	3	3	3										3	3	
CO3	3	3	3										3	3	
CO4	3	3	3		3				2	2			3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC745	Total Credits	3	Course Type	Open Elective Course		
Course Title	Embedded Systems						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic electronics, digital electronics, knowledge of microcontrollers and C programming.

COURSE OBJECTIVE:

- To enable the students to understand embedded-system programming and apply that knowledge to design and develop embedded solutions.

COURSE OUTCOMES (COs): After studying this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the basic structure and major components that constitute an embedded system.	L2
CO2	Explain contemporary techniques for Hardware-Software co-design of embedded systems	L2
CO3	Illustrate Real time applications using RTOS.	L3
CO4	Design real time embedded systems using the concepts of RTOS, simulate using modern software tools through group projects and give effective oral presentation with documentation.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	<p>Introduction to Embedded Systems: Embedded Systems and general-purpose computer systems, history, classifications, applications and purpose of embedded systems</p> <p>Core of embedded systems: microprocessors and microcontrollers, RISC and CISC controllers, Big endian and Little-endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, embedded firmware, other system components.</p>	8	0

2	Characteristics and quality attributes of embedded systems: Characteristics, operational and non-operational quality attributes. Embedded Systems – Application and Domain Specific: Application specific – washing machine, domain specific - automotive. Embedded Hardware: Memory map, i/o map, interrupt map, processor family, external peripherals, memory – RAM, ROM, types of RAM and ROM, memory testing, CRC, Flash memory. Peripherals: Control and Status Registers, Device Driver, Timer Driver - Watchdog Timers.	8	0
3	Devices and Communication Buses for Device Network: I/O types and examples, Serial Communication Devices, Parallel Device Ports, Sophisticated Interfacing features in Device Ports, Wireless Devices, Timers and counting Devices, Networked Embedded Systems, Serial Bus Communication Protocols, Parallel Bus Device Protocols, Network Protocols, Wireless and Mobile system protocols.	8	0
4	Hardware Software Co-Design, Program Modeling, Embedded Firmware Design and Development: Fundamental Issues in Hardware Software Co-Design, Computational models in Embedded Design, Hardware Software tradeoffs, Embedded Firmware Design approaches, Embedded Firmware Development languages, Programming in Embedded C.	8	0
5	RTOS based Embedded System Design: OS basics, Types of Operating Systems, Tasks, process and Threads, Multiprocessing and Multi-tasking, Task Scheduling, Threads, Processes and Scheduling, Task Communication, Task Synchronization, Device Drivers, how to choose an RTOS.	7	0

Text Books:

1. RajKamal: “Embedded Systems -SoC, IoT, AI and Real-Time Systems”, 4th Edition, TMH, 2020.
2. Shibu K V: “Introduction to Embedded Systems”, 2nd Edition, TMH, 2017.

Reference Books:

1. James K Peckol: “Embedded Systems -A Contemporary Design Tool”, 1st edition, John Wiley, 2019.
2. Santanu Chattopadhyay, “Embedded System Design”, 2nd edition, PHI Learning, 2013

Web/Digital resources:

1. <https://nptel.ac.in/courses/108102045/>
2. <https://nptel.ac.in/courses/106105193/>
3. <https://nptel.ac.in/courses/106105159/>
4. <https://www.youtube.com/watch?v=JO4AEkOVF2M&list=PLrjkTql3jnm-IZMoUb1xMCP0HgXvJ7ocx>
5. <https://www.coursera.org/learn/introduction-embedded-systems>

Self-Learning Exercises:

1. Case Study projects
2. Mini Projects

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3											3		
CO3	3	3	2										3	3	
CO4	3	3	2		2				2	2			3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC751	Total Credits	3	Course Type	Open Elective Course		
Course Title	Analog and Mixed Mode VLSI						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of Electronics and CMOS VLSI circuits

COURSE OBJECTIVE:

1. The course aims to teach design techniques for analog amplifiers, current mirrors oscillators and PLL.
2. The objective of the course is to design and to implement the product level design blocks for VLSI applications

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the Second order effect on single stage analog amplifier circuits.	L3
CO2	Analyze the biasing techniques to design single stage and differential amplifier.	L3
CO3	Analyze the feedback concept and able to design the feedback circuits for a given application.	L3
CO4	Design, Demonstrate and validate the analog circuits using EDA tool, document and give an effective presentation.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Basic MOS Device Physics: General considerations, MOS I/V Characteristics, second order effects, MOS device models. Single stage Amplifier: CS stage with resistance load, current source load, triode load, CS stage with source degeneration, source follower, common-gate stage, cascade stage.	8	0
2	IC biasing -current sources, Current mirrors and current-steering circuits, Cascade and Wilson current mirror, Multiple-Transistor IC amplifiers, Cascade configuration, Folded cascade and self cascade structure	8	0
3	Differential Amplifiers: Basic difference pair, common mode response, Differential pair with MOS loads, Gilbert cell. Active loaded differential amplifier, Frequency response.	8	0
4	General feedback structure - Negative feedback, Four basic topologies, Loop gain, Stability, Effect of feedback on amplifier poles, Single pole response, Two pole response, Frequency compensation, Compensation Techniques,	8	0
5	Oscillators and Phase Locked Loops: Ring Oscillators, LC Oscillators, VCO, Mathematical Model of VCO. Simple PLL, Charge pump PLL, Non-ideal effects in PLL, Delay locked loops and applications	7	0

Text Books:

1. Behzad Razavi: "Design of Analog CMOS Integrated Circuits," McGraw – Hill international Edition, Electrical Engineering Series, 2001.
2. Phillip E. Allen, Douglas R. Holberg: "CMOS Analog Circuit Design," 2nd Edition, Oxford University Press, 2002.

Reference Books:

1. R. Jacob Baker. "CMOS: MIXED-SIGNAL CIRCUIT DESIGN," IEEE Press Series on microelectronics systems, A John Wiley & Sons, Inc., Publication 2008.
2. Neil H. E. Weste, "CMOS VLSI Design: A Circuits and Systems Perspective". Publishing House of Electronics Industry. 2011

Journals/Magazines:

1. AMC – Digital Library - <https://dl.acm.org/journals>
2. IEEE - Solid-State Circuits Magazine.
3. IEEE - Transactions of Circuits and Systems II (TCAS-II)

Web/Digital resources:

1. <https://youtu.be/Q3WYZF5wzgU?list=PLbMVogVj5nJQB44z6h0XO2644Vbv7OM8> - Lecture series on Electronics - CMOS Analog VLSI Design

SWAYAM/NPTEL:

1. https://youtu.be/DfSG8FzFGfo?list=PLUtfVcb-iqn9PmsLh_tkzhlNfIFdk_NsI – Lecture Series on Analog Circuits and Systems through SPICE Simulation – NPTEL

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Design and simulation of single stage amplifiers	Electric / Cadence	Simulation skill
2	Simulation with validation of analog CMOS VLSI Circuits.	Electric / Cadence	Design methodology in VLSI Circuits.

Self-Learning Exercises:

7. Case Study projects - Paper Presentation and implementation of the same from reputed journals

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2	3	3	3										3	3	
CO3	3	3	3										3	3	
CO4	3	3	3		3								3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC752	Total Credits	3	Course Type	Open Elective - 05		
Course Title	Wireless Sensor Networks						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of Electronics, sensor and Communication.

COURSEOBJECTIVE:

1. To understand the fundamentals of wireless sensor networks and its application to the real time scenarios.
2. To study the various protocols at various layers and its differences with traditional protocols.

COURSEOUTCOMES(COs): After the completing of this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Understand the fundamental about the architecture of wireless sensor networks.	L1
CO2	Demonstrate the working of flow control and Error control MAC protocols of WSN.	L2
CO3	Explain the principles of data transmission, routing protocols and its challenges.	L3
CO4	Analyze the challenges and design issues of transport layer services and security.	L4
CO5	Work effectively in a group, and make use of simulation/ analysis tools to complete a given task.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus

Unit No.	Course Content	No. of Hours	
		Lecture	Tutorial
1	<p>Overview of Wireless Sensor Networks: Key definitions of sensor networks, Advantages of sensor Networks, Unique constraints and challenges, Applications, Enabling Technologies for Wireless Sensor Networks.</p> <p>ARCHITECTURES: Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design problem of WSN, Gateway Concepts. Networking technologies- Physical Layer and Transceiver Design Considerations.</p>	8	0
2	<p>MAC Protocols for Wireless Sensor Networks: Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention – Based Protocols, Contention – Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, IEEE 802.15.4 Mac Protocol. Link Layer Protocols - Error Control, Framing and Link Management.</p>	8	0
3	<p>Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols, Proactive Routing.</p>	8	0
4	<p>Transport Layer and QoS: Challenges of transport layer protocol in wireless environments- TCPs challenges and design issues in ad hoc networks-Transport protocols for ad hoc networks-Transport control protocols for WSNs-Issues and challenges in providing QoS in ad hoc networks-Network layer QoS solutions QoS Model-QoS in wireless sensor networks-Congestion control in network processing.</p>	8	0
5	<p>Security in WSNs: Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad Hoc Wireless Networks.</p> <p>APPLICATIONS of WSNs: Ultra-wide band radio communication, Wireless fidelity systems, Home automation, smart metering Applications.</p>	7	0

SLE: Examples of Some Sensors Nodes, Sensor-MAC protocol Case study, Geographical Routing, Performance analysis of Transport layer Protocols & Congestion, Network Management for WSN.

Text Books:

1. Holger Karl & Andreas Willig, -“Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 2005.
2. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, and Applications”, John Wiley, 2007.

Reference Books:

1. Walteneus Dargie and Christian poellabauer, “*Fundamentals of Wireless Sensor Networks*”, Wiley, 2010.
2. C. Siva Ram Murthy and B.S.Manoj, “*Ad Hoc Wireless Networks: Architectures and Protocols*”, PHI, 2004.

Web Resources:

1. <https://nptel.ac.in/courses/106105160/>
2. <http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02>
3. <https://pdfs.semanticscholar.org/e87f/5253451603be6ef1b5d56700ed8048a33d61.pdf>
4. <http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf>

Mapping - Course Outcomes with Program outcomes & Program Specific outcomes

EC320	Program outcomes												Program specific outcomes		
	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	PSO 3
CO1	3														
CO2	3	3												3	
CO3		3												3	
CO4		3	3											3	3
CO5		3			3				3						3

1---Low association, 2--- Moderate association, 3---High association



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC753	Total Credits	3	Course Type	Open Elective Course-V		
Course Title	Mobile Computing						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 Marks	25 marks	45 Marks

COURSE PREREQUISITE: Basics of Mobile Communication

COURSE OBJECTIVE:

1. To make the student understand the concept of mobile computing paradigm, its novel applications and limitations.
2. To understand the issues and solutions of various layers of mobile networks, namely MAC layer, Network Layer & Transport Layer
3. To understand the data delivery models in mobile environments.
4. To understand the platforms and protocols used in mobile environment

COURSE OUTCOMES (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the evolution of wireless and mobile communication networks with respect to their technical features and applications	L2
CO2	Analyze the fundamental concepts of mobile computing and identify the challenges related to mobile operating systems.	L3
CO3	Evaluate the different inter-networking challenges and Wireless Application Protocol (WAP) for Internet access	L3
CO4	Simulate real time computing problems using modern software tools through group projects and give oral presentation with documentation.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial

1	Wireless and Mobile Network Architecture: Principle of Cellular Communication, Overview 1G, 2G, 2.5G and 3G and 4G technologies. GSM Architecture and Mobility management handoff management, Network signaling.	8	0
2	Mobile Computing fundamental challenges, Mobile Devices –PDA and mobile OS, Palm OS, Win CE, Symbian, Android and iOS.	8	0
3	Mobile IP and IP v 6 and its application in mobile computing, Cellular Digital Packet Data (CDPD), VOIP, GPRS Services, Wireless Local Loop (WLL) system.	8	0
4	Wireless Application Protocol (WAP): The Wireless Application Protocol application environment, wireless application protocol client software, hardware and websites, wireless application protocol gateways, implementing enterprise wireless application protocol.	8	0
5	Wireless Mark-up Language: An Introduction to Wireless Technologies, Markup Languages, An Introduction to XML, Fundamentals of WML., Writing and Formatting Text, navigating between Cards and Decks, Displaying Images, Tables, Using Variables, Acquiring User Input.	7	0

Text Books:

1. Raj Kamal: “Mobile Computing”, Second Edition, Oxford University Press,2013
2. Ashoke K Talukder, Hasan Ahmed and Roopa R Yavagal: “Mobile Computing”, Second Edition, Tata McGraw Hill, 2010.

Reference Books:

1. Yi Bing Lin and Imrich Chlamtac: “Wireless and Mobile Networks Architecture”,Third Edition, John Wiley,2008
2. Uwe Hansmann, Lothar Merk, Mertin S Nickloue and Thomas Stober: “Principles of Mobile Computing” Second Edition, Springer International Edition, Springer Professional Computing, 2003.

Journals/Magazines:

1. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7756>
2. <https://www.springer.com/journal/779>
3. <https://dblp.org/db/journals/sigmobile/sigmobile4.html>

Web/Digital resources:

1. <https://www.youtube.com/watch?v=5MoIg51WLXA>
2. <https://www.youtube.com/watch?v=Rjluns-AEnc>
3. <https://www.youtube.com/watch?v=oxTUC5I22LU&list=PLE6yE0jB6BTMJXIXw4PS1kOqqZ9ty7eoG>
4. <https://www.youtube.com/watch?v=uIPtLr8R1-U&list=PLE6yE0jB6BTOY6Z1DKEkQ8yZ8fFPUiCD8>

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/106106147>
2. https://onlinecourses.swayam2.ac.in/nou21_ge41/preview

Practice Based Learning:

No.	Topics to be covered	Tools and Techniques	Expected Skill /Ability
1.	Building an android application	Android studio, MIT app inventor	Programming

Self-Learning Exercises:

1. Mini Project – Long Term Event will be conducted.

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											2		
CO2	3	3											2		
CO3	3	3											2		
CO4	3	3	2		2				2	2			2	2	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC75 4	Total Credits	3	Course Type	Open Elective Course-V		
Course Title	Robotics and Computer Vision						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Control Systems, Linear Algebra and Programming with MATLAB.

COURSE OBJECTIVE:

1. To develop conceptual and analytical skills for students in Robotics and Computer Vision.
2. To inculcate software and hardware skills to analyze, navigate and control robotics systems equipped with or without vision-based sensors.

COURSEOUTCOMES(COs): After completing this course, students should be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain mathematically, the position and orientation information of the object in an environment.	L2
CO2	Analyze the kinematics and dynamics concepts required to manipulate and control robot.	L4
CO3	Apply the techniques to estimate the location of robot and navigate.	L3
CO4	Analyze, Implement and Demonstrate the working of robots for the given specification using modern tools.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Representing position & orientation: Pose in 2-dimensions, Pose in 3-dimensions, orthonormal rotation matrices, homogeneous transformation matrices, Euler angles, roll-pitch-yaw angles, gimbal lock, quaternions Time & motion Trajectories: 1-dimensional, multi-dimensional, multi-segment, Interpolation of rotation, Smooth Cartesian motion, Time- varying coordinate frames, angular velocity, Inertial navigation solution	8	0

2	Sensors and Actuators in Robotics: Gyroscope, Accelerometer, Contact and Proximity Sensor, Position and Velocity sensors, Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective Transformations. Electric, Hydraulic and Pneumatic actuators; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators	8	0
3	Kinematics: Forward kinematics, Inverse kinematics, Trajectories Assigning Denavit - Hartenberg parameters, Applications Velocity relationships Manipulator Jacobians, Resolve-rate motion control Force relationships, under and over actuated manipulators	8	0
4	Mobile Robot Vehicles: Mobility, Bicycle and Car like models, moving to a point, line & pose, Modeling of Quadcopter (Flying robots) Navigation: Reactive navigation, Braitenberg vehicles, Bug* automata, Distance transform, D*Roadmap algorithm, Extended Kalman filter	8	0
5	Dynamics: Lagrange's method of modelling of dynamics, Applying for Robotics links and joints, Independent Joint control, Rigid body equations of motion: gravity, inertia, Coriolis Forward dynamics	7	0

Text Books:

1. Peter Corke, "Robotics, Vision and Control: Fundamental Algorithms In MATLAB", Second Edition, Springer, 2017
2. S. K. Saha, "Introduction to Robotics", 2nd Edition, McGraw Hill Education, 2017

Reference Books:

1. Saeed B Niku, "Introduction to Robotics: Analysis, Control, Applications", Student Edition, Wiley, 2011
2. R. K. Mittal and I. J. Nagarath: "Robotics and Control", 6th Reprint, Tata Mcgraw-Hill Education, Delhi 2007.

SWAYAM/NPTEL:

1. <https://petercorke.com/>
2. <http://www.roboanalyzer.com/>
3. <https://nptel.ac.in/courses/107106090>
4. <https://www.youtube.com/channel/UCiK0J5wtnyX2jP-AiGbhdhcg>



Journals/Magazines:

1. IEEE Transactions on Robotics, IEEE,
 - a. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8860>
2. Robotics and Autonomous Systems <https://www.sciencedirect.com/journal/robotics-and-autonomous-systems>
3. International Journal of Computer vision <https://www.springer.com/journal/11263>

Self-Learning Exercises:

1. Case Study projects
2. Mini Projects

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		2
CO2	3	3											3	2	2
CO3	3	3											3	2	3
CO4	3	3	3	3	3				3	3			3	3	3

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC755	Total Credits	3	Course Type	Open Elective Course		
Course Title	Industrial Automation						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of electronics and physics.

COURSE OBJECTIVE:

1. To understand the concepts of automation in industry.
2. To learn control technologies in automation.
3. To understand the role of Programmable logic controllers in industry.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the principles of automation in industries.	L2
CO2	Outline the technology involved in material handling and automated Storage systems.	L2
CO3	Analyze various control techniques for process automation.	L3
CO4	Develop ladder diagrams for process-controlled applications	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	UNIT1: Introduction Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break-Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in process.	8	0

2	UNIT2: Material handling and Identification Technologies The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Automated Storage Systems: Storage System Performance, Automated Storage/Retrieval Systems, Work-in-process Storage, Product identification system: Barcode, RFID	8	0
3	UNIT3: Control Technologies in Automation Computer Based Industrial Control: Introduction & Automatic Process Control, Building Blocks of Automation System: LAN, Analog & Digital I/O Modules, SCADA System, HMI & RTU.	8	0
4	UNIT4: Automated Inspection and Testing Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor and Actuators for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods.	7	0
5	UNIT5: Programmable Logic Controllers (PLCs) Introduction, Micro PLC, programming a PLC, Logic Functions, Input & Output Modules, PLC Processors, PLC Instructions, Documenting a PLC System, Timer & Counter Instructions, Comparison & Data Handling Instructions, Sequencing Instructions, Mask Data Representation, Typical PLC Programming Exercises for Industrial Applications.	8	0

Text Books:

1. M.P. Grover, “Automation, Production Systems and Computer Integrated Manufacturing”, Fourth Edition, Pearson Education.
2. Webb John, “Principles and Applications of PLC” –Mcmillan 1992

Reference Books:

1. Krishna Kant, “Computer Based Industrial Control” ,EEE-PHI.
2. Tiess Chiu Chang & Richard A. Wusk, “An Introduction to Automated Process Planning Systems”
3. Amber G.H & P.S. Amber, “Anatomy of Automation” ,Prentice Hall.

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	PLC programming using ladder diagram	Any open-source tool	Programming
2	Mini project	Hardware	Interfacing

Self-Learning Exercises:

1. Case Study projects
2. Mini Projects

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3											3		
CO4	3	3			2				2	2			3		

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC756	<i>Total Credits</i>	3	<i>Course Type</i>	Open Elective Course		
<i>Course Title</i>	Fundamentals of Telecommunication systems						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basics of Electronics

COURSEOBJECTIVE:

- To understand the basics of telecommunication networks and digital transmission of data.
- To study about the evolution of switching systems and the digital switching.
- To study about the telecommunication traffic and its measurements.
- To learn the technologies associated with the data switching operations.
- To understand the use of software for the switching and its maintenance.

COURSEOUTCOMES(COs)

After the completion of the course student will be able to

Cos	Course Outcomes	Highest Level of Cognitive Domain
CO1	Understand the fundamental of telecommunication systems, access networks and their hierarchy	L2
CO2	Derive mathematical model for telecommunication system and to carry out performance analysis of DSS.	L2
CO3	Analyze digital switching system software architecture.	L3
CO4	Demonstrate skill sets related to software tools in the analysis and simulation of Digital switching system	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Developments of telecommunications: Network structure, Network services, terminology, Regulation, Standards. Introduction to telecommunications transmission, Power levels, Four wire circuits, Digital transmission, FDM, TDM,PDH and SDH, Transmission performance.	8	0
2	Evolution of Switching Systems: Introduction, Message switching, Circuit switching, Functions of switching systems, Distribution systems. Digital Switching Systems: Fundamentals: Purpose of analysis, Basic central office linkages, switching system hierarchy, Evolution of digital switching systems, Stored program control switching systems, Digital switching system fundamentals, Building blocks of a digital switching system, PCM, digital transmission systems, Basic call processing.	8	0
3	Telecommunications Traffic: Introduction, Unit of traffic, Congestion, Traffic measurement, Mathematical model, Lost call systems, Queuing systems. Switching Systems: Introduction, Single stage networks, Gradings, Link Systems, GOS of Linked systems.	8	0
4	Time Division Switching: Introduction, space and time switching, Time switching networks, Synchronization. Access networks: Local loop, ADSL, XDSL, WILL, Wi-Fi, Wi-Max, FTTH, HFC. Introduction to Stored program control switches.	7	0
5	Switching System Software: Introduction, Scope, Basic software architecture, Operating systems, Database Management, Concept of generic program, Software architecture for level 1 control, Software architecture for level 2 control, Software architecture for level 3 control, Network and operational aspects., Common channel signaling.	8	0

Text Books:

1. J E Flood," Telecommunication and Switching, Traffic and Networks", Pearson Education, Reprint 2002
2. Syed R. Ali, "Digital Switching Systems – Reliability and analysis", Tata McGraw-Hill, 2002.

Reference Books:

1. John C Bellamy: Digital Telephony, 3rd Edition, Wiley India, 2000
2. F J Redmill and A R Valdar: SPC digital telephone exchanges, Peter Perigrinus Ltd IEE telecom series 21, ISBN 0 86341 301 3

SWAYAM/NPTEL:

<https://nptel.ac.in/courses/117104104>

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill / Ability
1	Simulations	Any open source tool	Programming

Self-Learning Exercises:

1. Mini Projects (Simulation)

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2	2	3											3	3	
CO3	2												3		
CO4			3		3				3	3				3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC76P	Total Credits	2	Course Type	Project work Course		
Course Title	Project Work Phase - 1						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	0	0		CIE	SEE	Total
	Tutorial	0	0	Weightage	100 %	---	100 %
	Practical	39	2	Maximum Marks	50 Marks	---	50 Marks
	Total	39	2	Minimum Marks	25 marks	---	25 Marks

COURSE PREREQUISITE:

Knowledge of analog circuits, digital circuits, communication principles and processors.

COURSE OBJECTIVE:

- To generate interdisciplinary idea leading to product.
- To generate methodology to realize the idea.
- To perform feasibility analysis, budgetary analysis and schedule the execution of problem.
- To prepare a report.

COURSE OUTCOMES (COs): After Completion of the course, the students will be able to :

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Identify and formulate a problem through adequate literature survey, taking into consideration societal, environmental and sustainability issues.	L2
CO2	Plan and schedule the execution of the problem by carrying out necessary design, anticipating bottlenecks and conforming to feasibility and budgetary aspects.	L3
CO3	Submit a synopsis and an effective presentation.	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3				3	3	3	3	3			3	3	3
CO2	3	3	2	2	2	3	3	3	3	3	2	2	3	3	3
CO3									3	3					

High – 3, Medium – 2, Low – 1

DEPARTMENT		ELECTRONICS AND COMMUNICATION ENGINEERING				
Course Code	22EC73X	Total Credits	2	Course Type	Professional Elective Course	
Course Title		SWAYAM COURSE (Replacement for Professional Elective IV)				
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks		
	Lecture	0	0		CIE	Total
	Tutorial	0	0	Weightage	100 %	100 %
	Practical	26	2	Maximum Marks	50 Marks	50 Marks
	Total	26	2	Minimum Marks	25 marks	25 Marks

COURSE PREREQUISITE:

Knowledge of electronics and communication

COURSE OBJECTIVE:

1. To identify and compare technical and practical issues related to the area of course specialization.
2. To prepare a well-organized report employing elements of technical writing and critical thinking and develop competence in presenting.

COURSE OUTCOMES (COs)

COs	Course Outcomes	Highest Level of Cognitive Domain
CO1	Extend the topic of interest to develop a thought process for technical presentation.	L2
CO2	Outline a detailed literature survey and build a document with respect to technical publications.	L2
CO3	Analyse and comprehend the proof-of-concept and related data.	L4
CO4	Evaluate the presentation and improve soft skills.	L5

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create
Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3							3	3				2		
CO2	3	3						3	3				2		
CO3	3			3				3	3				2		
CO4	3							3	3	3			2		

High – 3, Medium – 2, Low – 1

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC77P	Total Credits	1	Course Type	PWC / Technical Seminar / Internship in Industry		
Course Title	Industrial training /Internship / Technical Seminar						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	0	0		CIE	SEE	Total
	Tutorial	0	0	Weightage	100 %	---	100 %
	Practical	26	1	Maximum Marks	50 Marks	---	50 Marks
	Total	26	1	Minimum Marks	25 marks	---	25 Marks

COURSE PREREQUISITE:

Domain Knowledge in the professional courses.

Hands-on expertise

Undertaken study projects.

COURSE OBJECTIVE:

1. Explore career alternatives prior to graduation.
2. Integrate theory and practice.
3. Assess interests and abilities in their field of study.
4. Learn to appreciate work and its function in the economy.
5. Develop work habits and attitudes necessary for job success.
6. Develop communication, interpersonal and other critical skills in the job interview process.

COURSE OUTCOMES (COs): After completion of the course, the students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Apply skill sets in the projects in industries during his or her industrial training.	L3
CO2	Describe use of advanced tools and techniques encountered during industrial training and visit.	L2
CO3	Build the knowledge by interacting with industrial personnel, follow engineering practices and discipline prescribed in industry.	L4
CO4	Develop awareness about general workplace behaviour and build interpersonal and team skills.	L3
CO5	Create professional work reports and presentations	L2

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Articulation:

COs↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	2	-	3	3	3	2	-	2			
CO2	2	2	-	-	2	-	3	3	3	2	-	2			
CO3	2	2	-	-	2	-	3	3	3	2	-	2			
CO4	2	2	-	-	2	-	3	3	3	2	-	2			
CO5	2	2	-	-	2	-	3	3	3	2	-	2			

High – 3, Medium – 2, Low – 1



VIII SEMESTER

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC811	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Automotive Electronics						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60%	100%
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Sensors, Actuators, communication protocols.

COURSE OBJECTIVE:

1. To understand the concepts of electronics used in Automobiles.
2. To understand the sensors, actuators and controllers used in automobiles.

COURSE OUTCOMES(COs):

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the working of Motronic engine management and safety systems.	L2
CO2	Illustrate the flow of data and control signals in automotive networking	L2
CO3	Analyze the importance of sensors and actuators and explore their applications in automobiles.	L3
CO4	Take part in a group/individual activity and complete the assigned task by demonstrating skills related to implementation, documentation and presentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Electrical and electronic systems in the vehicle: Overview, Motronic-engine management system, electronic diesel control, Lighting technology, electronic stability program, Adaptive cruise control, Occupant-protection systems.	8	0
2	Networking and bus systems: Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, coupling of networks, Examples of networked vehicles. Introduction to VANET: Basic Principles and challenges, past and ongoing VANET activities. VANET Topology Based Routing Protocols	8	0
3	Automotive sensors: Basics and overview, automotive applications, Sensor market, Features of vehicle sensors, Sensor classification, Selection of sensor	7	0

	technologies.		
4	Sensor measuring principles: Sensors for the measurement of position, speed, rpm, acceleration, pressure, force, and torque, Flow meters, temperature sensors, Sensor types: Engine speed sensors, Hall phase sensors, Sensors for transmission control & wheel speed, Yaw-rate sensors, Pressure sensors, Temperature sensors, Accelerator-pedal sensors, Steering angle sensors, Position sensors, Axle sensors, Piezoelectric knock sensors, Acceleration sensors, Force & torque sensors, Rain/light sensors.	8	0
5	Actuators: Electromechanical & fluid mechanical actuators, Electrical machines Hybrid drives: Drive concepts, operating strategies for electric hybrid vehicles, Recuperative brake system, Electrical energy accumulators.	8	0

Text Books:

1. Robert Bosch GmbH, “Bosch Automotive Electrics and Automotive Electronics”, 5th Edition, Springer Vieweg, 2014.
2. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols”, Prentice Hall, 2004.

Reference Books:

1. I.K. Babu, “Automotive Electrical and Electronics”, Khanna Publishers, 1st Edition, 2018.
2. John F. Kershaw, Ed.D. and James D. Halderman, “Automotive Electrical and Electronic Systems”, 5th Edition, Pearson Prentice Hall, 2007.
3. William B. Ribbens, “Understanding Automotive Electronics: An Engineering Perspective”, 8th Edition, Elsevier, 2017
4. Barry Hollembeak, “Automotive Electricity and Electronics”, Cengage Learning, 6th Edition, 2014.

Journals/Magazines:

1. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=10209>
2. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6979>
3. <https://www.sciencedirect.com/journal/vehicular-communications>

Web/Digital resources:

1. <https://www.youtube.com/playlist?list=PLCBA3EF828DFE7B0E>
2. <https://www.youtube.com/watch?v=STDICdZnIsw&list=PLE06CAA834360BB39>

SWAYAM/NPTEL:

1. <https://www.udemy.com/course/basics-of-automotive-electronics/>
2. <https://nptel.ac.in/courses/107106088>
3. <https://nptel.ac.in/courses/108103009>



Practice Based Learning:

No.	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1.	Automotive simulation	Any simulation tool for automotive domain.	Programming

Self-Learning Exercises:

1. Mini Project

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES									Program Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3												2		
CO2	3	2											2		
CO3	3	2											2		
CO4	3	3	3		3			3	2	2			3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC812	Total Credits	3	Course Type	Professional Elective - V		
Course Title	Cloud Computing						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Fundamentals of Computer Networks.

COURSE OBJECTIVE: Enable student to provide easy, scalable access to computing resources and IT services.

COURSE OUTCOMES (COs): After the completing of this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the fundamental knowledge on principles of cloud computing and its related concepts.	L2
CO2	Illustrate the virtualization technologies with the architectural models of cloud computing.	L2
CO3	Apply suitable applications to leverage the strength of cloud computing.	L3
CO4	Demonstrate different features of cloud platforms used in Industry.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Cloud Computing Overview: The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Architecture, Characteristics and Benefits, Challenges in the cloud, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies, Amazon Web Services (AWS), Google App Engine, Microsoft Azure, Hadoop, Force com and Salesforce.com.	8	0

2	Virtualization: Introduction, Characteristics of virtualized environments, Increased security, Managed execution, Portability, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples- Xen par virtualization, VMware: full virtualization, Microsoft Hyper-V. Cloud Computing Architecture: Introduction, Reference model Architecture, Infrastructure- and hardware-as-a-service, Platform as a service, Software as a service, Deployment Model- Public clouds, Private clouds, Hybrid clouds, Community clouds, Open challenges.	8	0
3	Cloud Management: Service Level Agreement, Cloud Economics, Managing Data, Introduction to Map Reduce, Open Stack, Resource Management.	8	0
4	Cloud Platforms in Industry: Amazon web services: Compute services, Storage services, Communication services, Additional services. Google Cloud, App Engine: Architecture and core concepts, Application life cycle, Cost model Observations Microsoft Azure: Azure core concepts, SQL Azure, Windows Azure platform appliance, Observations	8	0
5	Advanced Topic in Cloud Computing: Green cloud computing, Introduction to Docker Container, Sensor Cloud Computing, IoT Cloud, Fog Computing, Mobile Cloud Computing	7	0

Text Books:

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, “Cloud Computing: Principles and Paradigms”, Wiley, 2011.
2. Gautam Shroff, “Enterprise Cloud Computing - Technology, Architecture, Applications”, Cambridge University Press, 2010.
3. Barrie Sosinsky, “Cloud Computing Bible”, Wiley-India, 2010.

Reference Books:

1. Buyya, Rajkumar, James Broberg, and Andrzej M. Goscinski, “Cloud computing: Principles and paradigms”, John Wiley & Sons, 2010.
2. Dan C. Marinescu, “Cloud Computing Theory and Practice”, Morgan Kaufmann, Elsevier 2013.

Web/Digital resources:

1. <https://nptel.ac.in/courses/106105167>



PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Hosting a application using different Service Model such as IaaS, PaaS and SaaS offered by AWS, Google and Azure	AWS /GCP/Azure	Can host an application on cloud using different service model.
2	Demonstrating some application project which is built and used through cloud	AWS /GCP/Azure	Can able to understand the develop and hosting an application on Cloud.

Self-Learning Exercises:

1. Mini Projects

- a. Deploying a Static and Dynamic Websites using AWS Core Services such as EC2 Instance and S3 Service.
- b. Deploying an application on Cloud.

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3													3
CO2		3	3												3
CO3		3	3											3	3
CO4			3	3	3									3	3

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>		Electronics and Communication Engineering					
<i>Course Code</i>	22EC813	<i>Total Credits</i>	3	<i>Course Type</i>	Professional Elective Course		
<i>Course Title</i>	<i>Digital Compression Techniques</i>						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60 %	100 %
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Student should be familiar with basic concepts of information theory and coding, matrix representation of audio signals and images

COURSE OBJECTIVE:

1. To facilitate students with basic concepts and techniques of data compression
2. To apply fundamental space optimization techniques, algorithms for the compression of text, audio, image and video files.

COURSEOUTCOMES(COs): After the completion of the course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the fundamental concepts of information theory for lossless and lossy compression with mathematical models and coding techniques.	L2
CO2	Apply coding techniques like Huffman, adaptive Huffman and Arithmetic coding, static and dynamic dictionary techniques for lossless compression.	L3
CO3	Analyse various transform coding and sub-band coding for lossy compression.	L4
CO4	Develop, analyze and demonstrate compression techniques/algorithms for multimedia applications with collaborative learning.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to data compression: Lossless compression, Lossy compression, Modeling and coding, Brief review of information theory, Mathematical preliminaries for lossless compression, Minimum description length principle, physical, probabilistic, Markov models. Mathematical preliminaries for Lossy Compression techniques, Models: physical, probabilistic, linear system models. Distortion criteria, conditional entropy, differential entropy,	8	0

2	Coding Techniques: Huffman coding, Construction of Huffman Tree, Adaptive Huffman coding, Applications of Huffman coding algorithm to text and audio processing, Arithmetic coding, Generating and deciphering the tag, Comparison of Huffman coding & Arithmetic coding, Adaptive arithmetic coding	8	0
3	Dictionary techniques: Static/Adaptive dictionary techniques like LZ77/78 compression, LZW algorithm Applications to: File compression- UNIX compress, GIF image compression, JPEG, JPEG-LS lossless image compression techniques.	8	0
4	Lossy compression Techniques: Scalar quantization, Uniform & Adaptive quantizer, Vector Quantization, Advantages of VQ over SQ, LBG algorithm. Transform coding: Quantization and coding of transform coefficients, DCT DFT and KLT	8	0
5	Sub-band Coding: Sub-band coding, analysis and synthesis filters, decimation, interpolation. Wavelets: Multi-resolution analysis and scaling function, implementation using filters, image compression using wavelets, Haar wavelet, lossy encoding using EZW and SPHIT, JPEG 2000.	7	0

Text Books:

1. Khalid Sayood "Introduction to Data Compression", 4th Edition, Elsevier Inc, 2012.
2. David Solomon, Giovanni Motta "Handbook of Data Compression", 5th Edition, Springer, 2010.

Reference Books:

1. Yun Q. Shi, Huifang Sun "Image and Video Compression for Multimedia Engineering Fundamentals, Algorithms and Standards", CRC press, 2003.
2. Jean-Loup Gailly Mark Nelson, "The Data Compression Book" BPB Publications ISBN-13 2010

Journals/Magazines:

1. <https://ietresearch.onlinelibrary.wiley.com/doi/10.1049/iet-ipr.2018.6052>
2. <https://web.stanford.edu/class/ee398a/handouts/papers/Shapiro%20-%20EZT.pdf>
3. <https://www.ijert.org/enhanced-spiht-algorithm-for-image-compression>
4. <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5566019>
5. <https://www.jetir.org/view?paper=JETIRDS06190>
6. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3558422

Web/Digital resources :

1. <https://www.youtube.com/watch?v=5wRPin4oxCo>
2. <https://www.youtube.com/watch?v=rC16fhvXZOo>

SWAYAM/NPTEL :

1. <https://youtu.be/rC16fhvXZOo>
2. <https://youtu.be/5wRPin4oxCo?t=9>
3. https://youtu.be/c7s8DSiF_9Q



Self-Learning Exercises:

2. Case Study projects
3. Mini Projects

Course Articulation:

COURSE OUTCOME S ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3												3	
CO2	3	3												3	
CO3	3	3	3										3	3	
CO4	3	3	3	3	3				3	3			3	3	

High – 3, Medium – 2, Low – 1



<i>DEPARTMENT</i>	Electronics and Communication Engineering						
<i>Course Code</i>	22EC814	<i>Total Credits</i>	3	<i>Course Type</i>	Professional Elective Course		
<i>Course Title</i>	Advanced Embedded Systems						
<i>Teaching Learning Process</i>		<i>Contact Hours</i>	<i>Credits</i>	<i>Assessment in Weightage and marks</i>			
	<i>Lecture</i>	39	3		CIE	SEE	Total
	<i>Tutorial</i>	0	0	<i>Weightage</i>	40 %	60%	100%
	<i>Practical</i>	0	0	<i>Maximum Marks</i>	40 Marks	60 Marks	100 Marks
	<i>Total</i>	39	3	<i>Minimum Marks</i>	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Basics of Sensors, Actuators, Programming, and Components of embedded systems.

COURSE OBJECTIVE:

1. To look closely into the Hardware and Software points of view and describe the tools and methodologies needed for embedded system design.
2. To provide RTOS concepts for coding the embedded system software routines.

COURSE OUTCOMES (COs):

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Classify embedded systems and identify the skills required for embedded system design.	L2
CO2	Analyze the hardware, software structures and evaluate them for embedded systems applications.	L3
CO3	Identify the necessity of RTOS in embedded system design and different types of commercial RTOS for embedded applications.	L3
CO4	Apply rapid prototypes designing using open-source Arduino and raspberry pi boards through group / individual project and give effective oral presentation with documentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Embedded System, Applications and Characteristics of Embedded Systems, Overview of Processor and Hardware Units in Embedded System, Embedded Software into A System, Embedded System Design, Embedded System Architecture, System on Chip, Network on Chip.	8	0
2	Embedded Hardware Design and Development, Sensors, A/D – D/A Converters and Actuators, Interfacing Techniques, Network Embedded Systems, Interfacing SRAM, DRAM and Flash Memory, Internet Enabled Systems – Network Protocols.	8	0

3	Internet Connectivity and IoT Computing, EDGE Computing Architecture and Application Areas, IoT Communication Module Protocols, Rapid Prototype Designing Using Open-Source Boards, EDGE AI and Cloud AI, Embedded AI Applications.	8	0
4	RTOS: Some Important Concepts, Types of Real Time Tasks and Their Characteristics, Task Scheduling, Commercial RTOS And Time Services, Features Of RTOS, Device Drivers, Interrupts and Servicing Mechanism, Interrupt Latency and Deadline, Direct Memory Access, Device Driver Programming.	8	0
5	Programming Model Concepts, UML 2.0 Modelling, State Charts, General C Language Characteristics, Hardware/Software Co-Design, Hardware/Software Partitioning, Testing Embedded Systems, Design for Testability and Self-Test.	7	0

Text Books:

1. Raj Kamal: “Embedded Systems - SoC, IoT, AI and Real-Time Systems”, 4th Edition, TMH, 2020.
2. Shibu K V: “Introduction to Embedded Systems”, 2nd Edition, TMH, 2017.

Reference Books:

1. James K Peckol: “Embedded Systems- A Contemporary Tool”, 2nd edition, John Wiley, May, 2019.
2. Elecia White, “Making Embedded Systems: Design Patterns for Great Software”, O’Reilly Media; 1st edition, December 6, 2011.

Journals/Magazines:

1. <https://www.springer.com/journal/10617>
2. <https://jes-urasipjournals.springeropen.com/>
3. <https://www.sciencepublishinggroup.com/journal/index?journalid=236>
4. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4563995>

Web/Digital resources:

1. <https://www.youtube.com/watch?v=JO4AEkOVF2M&list=PLrjkTql3jnm-lZMoUb1xMCp0HgxvJ7ocx>
2. <https://www.coursera.org/learn/introduction-embedded-systems>
3. <https://www.udemy.com/topic/embedded-systems/>
4. <https://www.coursera.org/courses?query=embedded%20systems>
5. <https://www.classcentral.com/tag/embedded-systems>
6. <https://www.edx.org/learn/embedded-systems>
7. <https://www.online.colostate.edu/certificates/embedded-systems-certificate/>
8. <https://www.udacity.com/course/embedded-systems--ud169>

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/108102045/>
2. <https://nptel.ac.in/courses/106105193/>
3. <https://nptel.ac.in/courses/106105159/>

Practice Based Learning:

No.	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1.	Building an Embedded System with RTOS	Raspberry Pi, Arduino Board and any advanced hardware board.	Hardware interface and Programming
2.	Simulation Of an Embedded System with RTOS	Any open-source Simulator	Logical Thinking

Self-Learning Exercises:

1. Mini Project – Long Term Event will be conducted.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 ₀	PO1 ₁	PO1 ₂	PSO ₁	PSO ₂	PSO ₃	
CO1	3															
CO2	3	2											2			
CO3	3	2											2			
CO4	3	3	3		3				2	2			3	2		

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC815	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Operations Research						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basic concepts of algebra and matrix operations

COURSE OBJECTIVE:

1. Familiarization of operation research models using optimization techniques.
2. Problem formulation using optimization techniques for different models.
3. Solve engineering and business problems using operation research models.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Describe the different models of linear programming techniques.	L2
CO2	Apply various methods and models for optimization.	L3
CO3	Analyze and solve different models and techniques for real world applications.	L4
CO4	Demonstrate the skill sets to simulate/use analysis tools to solve engineering and business problems.	L5

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Linear models: The phase of an Operation Research study, introduction to Linear Programming assumptions, graphical method, simplex algorithm, duality formulation, dual simplex, bit-integer programming (BIP), upper bound and interior point algorithms.	8	0
2	Transportation and network optimization models: Transportation and assignment Models, Traveling Salesman Problem, Networks Models, Shortest Route, Minimal Spanning Tree, Maximum Flow Models, Project Network, Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT) Networks.	8	0
3	Inventory models: Economic Order Quantity Models, Quantity Discount Models, Stochastic Inventory Models, Multi Product Models, Inventory Control Models in real time applications and practice.	8	0
4	Queuing models: Introduction to Queuing Systems and Structures, Notation Parameter, Single Server and Multi Server Models, Poisson Input, Exponential Service, Constant Rate Service, Infinite Population, Problems and applications.	8	0
5	Decision models: Game Theory, Solving simple game problems, Two Person Zero Sum Games, Graphical Solution, Algebraic Solution, Linear Programming Solution. Replacement Models, Models Based on Service and Economic Life, Single or Multi Variable Search Technique and Simple Problems.	7	0

Text Books:

1. Hillier, F. S., & Lieberman, G. J. Introduction to operations research. Mcgraw-Hill. 2021.
2. R Panneer selvam. Operations research. Phi Learning. 2010.

Reference Books:

1. Taha, H. A. (2017). Operations research an introduction. Pearson.

Web/Digital resources:

1. <https://nptel.ac.in/courses/112106134/>
2. <https://youtu.be/IRpt1fCHd8Y?list=PLCmoXVuSEVHIEJi3SwdyJ4EICffuyqpk>
3. <https://youtu.be/o9vEnzLL-lY?list=PLojsqdbIzJGQtub91c4fF-TcCdzVYAInM>

Self-Learning Exercises:

Parametric algorithm, Critical Path Scheduling technique. Case study on inventory model, Simulation and Dynamic Programming.

Course Articulation:

COURSE OUTCOME S↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOME S		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3	3	
CO2	3	3	3										3	3	
CO3	3	3	3	3										3	
CO4	3	3	3	3	3				3	3					

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC821	Total Credits	3:0:0	Course Type	Professional Elective Course		
Course Title	Low power VLSI						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100%
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basics of Electronics, CMOS VLSI Circuit.

COURSE OBJECTIVE:

1. Learn to enhance the battery life, reduce leakage and dynamic power consumption of portable devices.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the need of Low power circuit design.	L2
CO2	Analyze the performance of Low power Architecture & Systems.	L2
CO3	Design the low power-low voltage logic circuits for the given specifications.	L3
CO4	Analyze the performance of low power circuits.	L2
CO5	Demonstrate the working of Low power Architecture & Systems using EDA tool.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Need for low-power VLSI chips, Sources of power dissipation, designing for low-power, Physics of power dissipation in CMOS circuits, low-power design limits.	8	0
2	Synthesis for Low power: Low-Power - Gate-Level Design, Architecture-Level Design, Algorithmic-Level Power Reduction, RTL Techniques for Optimizing Power.	8	0
3	Design and Test of Low - voltage CMOS circuits: Circuit design style, Leakage currents in deep submicron transistors, Deep submicron device design issues Key to minimizing SCE, Low-voltage current design techniques, Testing deep submicron ICs with elevated intrinsic leakage, Multiple supply voltages.	8	0
4	Low Power Circuits: Logic Families, Low-Power and Standard Cell Libraries, Logic Styles for Specific Applications - Library Cells for Self-Timed Design, Library Cells for Cryptographic Applications, SEU-Tolerant Logic Single-Clock Latches and Flip-Flops, High-Throughput CMOS Circuit Techniques, Fast and Efficient CMOS Functional Circuits, the Future of Dynamic Logic.	8	0
5	Software Design for Low Power: Sources of software power dissipation, Software power estimation. Software power optimizations, Automated low-power code generation, co-design for low-power, Recent advances in low power design.	7	0

Text Books:

1. Kaushik Roy, Sharat Prasad, “Low-Power CMOS VLSI Circuit Design” Wiley, 2000.
2. Gary K. Yeap, “Practical Low Power Digital VLSI Design”, KAP, 2002

Reference Books:

1. **Christian Piguet:**“Low power CMOS circuits – Technology, logic design and CAD tools”, 1st Edition, CRC Press, Taylor& Francis Group 2006.
2. Rabaey, Pedram, “Low Power Design Methodologies” Kluwer Academic, 2010.



Web/Digital resources:

1. https://www.youtube.com/watch?v=ruClwamT-R0&list=PLTEh-62_zAfHmJE-pcjgREKiKyPSgjkxj
2. https://www.youtube.com/watch?v=K2kL7pMnL_0&list=PLVDb88QIgXkeeUo6I2oudLvc76GbLGrTi

SWAYAM/NPTEL:

1. <https://www.youtube.com/watch?v=ruClwamT-R0&list=PLB3F0FC99B5D89571>
2. https://www.youtube.com/watch?v=K2kL7pMnL_0&list=PLVDb88QIgXkeeUo6I2oudLvc76GbLGrTi

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	3	3												2		
CO3	3	3	3											2		
CO4	3	3												2		
CO5	3	3	3	2	2					2			3	2		

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC822	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Mobile Computing						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60%	100%
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Basics of Mobile Communication, Programming skill.

COURSE OBJECTIVE:

1. To define mobile technologies in terms of hardware, software, and communications.
2. To utilize mobile computing nomenclature to describe and analyze existing mobile computing frameworks and architectures.

COURSE OUTCOMES (COs):

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Summarize the evolution of mobile computing technology and operating systems used in mobile devices.	L2
CO2	Analyze the different inter-networking challenges and evaluate the solutions in wireless mobile data networks with respect to mobile IP Network Layers.	L3
CO3	Develop creative skills in designing WAP pages using wireless mark-up language and application frameworks.	L3
CO4	Simulate real time computing problems and develop a mobile application using modern software tools through group/individual project and give oral presentation with documentation.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Principle of Cellular Communication, Overview 1G, 2G, 2.5G, 3G,4G and 5G technologies. Mobile Computing fundamentals. Mobile Devices and mobile OS - Palm OS, Win CE, Symbian, Android and iOS. Security issues in mobile computing.	8	0
2	Data perspective: CDPD, GSM Architecture and data services, CDMA, 3G, 4G,5G, VoIP, Wireless Local Loop (WLL) system, Wireless Telephony	8	0
3	Mobile IP and IP v 6 and its application in mobile computing. Wireless Application Protocol (WAP): The Wireless Application Protocol application environment, wireless application protocol client software, hardware and	8	0

	websites, wireless application protocol gateways, implementing enterprise wireless application protocol.		
4	An Introduction to WML and XML, key XML technologies for mobile computing, Writing and Formatting Text, navigating between Cards and Decks, Displaying Images, Tables, Using Variables, Acquiring User Input. UML and XForms.	8	0
5	Introduction to mobile development process. Architecture, design and technology selection for mobile application. Mobile application development hurdles. Testing mobile applications.	7	0

Text Books:

1. Raj Kamal: “Mobile Computing”, Second Edition, Oxford University Press,2013
2. Ashoke K Talukder, Hasan Ahmed and Roopa R Yavagal: “Mobile Computing”, Second Edition, Tata McGraw Hill, 2010.

Reference Books:

1. Yi Bing Lin and Imrich Chlamtac: “Wireless and Mobile Networks Architecture”,Third Edition, John Wiley,2008
2. Uwe Hansmann, Lothar Merk, Mertin S Nicklouse and Thomas Stober: “Principles of Mobile Computing” Second Edition, Springer International Edition, Springer Professional Computing, 2003.

Journals/Magazines:

4. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7756>
5. <https://www.springer.com/journal/779>
6. <https://dblp.org/db/journals/sigmobile/sigmobile4.html>

Web/Digital resources:

1. <https://www.youtube.com/watch?v=5MoIg5IWLXA>
2. <https://www.youtube.com/watch?v=Rjluns-AEnc>
3. <https://www.youtube.com/watch?v=oxTUC5I22LU&list=PLE6yE0jB6BTMJXIXw4PS1kOqqZ9ty7eoG>
4. <https://www.youtube.com/watch?v=uIPtLr8R1-U&list=PLE6yE0jB6BTOY6Z1DKEkQ8yZ8fFPUiCD8>

SWAYAM/NPTEL:

3. <https://nptel.ac.in/courses/106106147>
4. https://onlinecourses.swayam2.ac.in/nou21_ge41/preview

Practice Based Learning:

No.	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1.	Building an android application	Android studio, MIT app inventor	Programming

Self-Learning Exercises:

1. Mini Project – Long Term Event will be conducted.

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	3	3													
CO3	3	3													
CO4	3	3	3		3				2	2			3	3	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC823	Total Credits	3	Course Type	Professional Elective - VI		
Course Title	Assistive Technology						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: Basics concepts of electronics devices and systems

COURSE OBJECTIVE:

1. Explore the types and uses of assistive technology,
2. Compare technologies related to vision, hearing, communication, mobility, and cognitive disabilities.
3. To evaluate the needs of people with disabilities and the community resources, and systems available to increase their independence.

COURSE OUTCOMES(COs): After completing this course, students will be able to

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Understand principles and complexities of assistive technology design and engineering.	L2
CO2	Explain the challenges and realities of people with disabilities and become equipped as an advocate.	L2
CO3	Analyze the design experience that includes working with users of assistive technology to identify challenges, prototype solutions, perform user testing, and communicate results.	L4
CO4	Provide an opportunity for students to interact with users of assistive technology in the local community along with health care professionals, coaches, and project partners	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create



Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction: Assistive and adaptive rehabilitation devices for people with disabilities. Use case: Assistive technology for improving the quality of life, for people with acquired brain injury, for the with communication disorder and with visual impairment & behavioral problem.	8	0
2	Assistive devices: Mobility aids such as wheel chair, tri cycle, walkers, prosthetic device. Hearing aids such as behind the ear (BTE), In the ear (ITE) and in the canal (ITC) for people with hearing disabilities. Case study on application of Low-Cost Devices as Teaching Materials for Children with Different Disabilities. Imaging Systems in Assistive Technology.	8	0
3	Technology for Assistive devices: Mechanical Engg Support, Electrical and electronics Engg supports and programming support. Aging, Disability, and Assistive Internet of Things Assistive IoT: Enhancing Human Experiences, Deployment Scenarios and Challenges.	8	0
4	Industries Supports: Ethical Issues in Assistive Technology, Delivering Assistive Technology Services to the Client, Technologies That Aid Transportation, Robotic Assistive Technologies That Aid Manipulation, Sensory Aids for Persons With Visual Impairments, Assistive Technologies for Cognitive Augmentation.	8	0
5	Case studies: Assistive Technology Based on a Psychological Model of Elderly People, Touch Screens for the Older User, Intelligent HTML to Voice XML Conversion Agent for Text Disabilities, Assistive Technology for People with Communication Disorder. A Multi-Disciplinary Approach to Ambient Assisted Living.	7	0

Text Books:

1. Giulio E. Lancioni, Nirbhay N. Singh, “Assistive Technologies for People with Diverse Abilities”, Springer, 2014.
2. Fernando A. AuatCheein, “ASSISTIVE TECHNOLOGIES”, Intech, 2012.
3. Seyed Shahrestani, “Internet of Things and Smart Environments”, springer,2017.
4. Albert M. Cook, Janice M. Polgar and Pedro “Assistive Technologies, Principles & Practice”, Elsevier, 5th Edition, 2020.

Reference Books:

1. Carsten Rocker, Martina Ziefle, “E-Health, Assistive Technologies and Applications for Assisted Living”, Medical Information Science Reference, 2011.

Web/Digital resources:

1. Text book 4 link: <https://doi.org/10.1016/C2016-0-02627-X>

Course Articulation:

COURSE OUTCOMES ↓	PROGRAM OUTCOMES												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3												3	
CO3	3	3	3												3
CO4	3	3	3	3	3								3	3	3

1---Low association, 2--- Moderate association, 3---High association



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC824	Total Credits	3	Course Type	Professional Elective - VI		
Course Title	Advanced Vehicular Network						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE: The students are expected to have some basic knowledge about wireless communications, computer networks and mobile networks.

COURSE OBJECTIVE:

1. Students will be introduced with the emerging technologies, standards and applications in vehicular communication systems.
2. The students will study the design considerations and challenges of vehicle to infrastructure and vehicle to vehicle communications. Theories such as routing protocols, forwarding strategies will also be introduced in the course.

COURSE OUTCOMES(COs)

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Explain the challenges in designing MAC and Routing protocols for wireless ad-hoc networks with fundamental concepts of vehicular ad-hoc Networks.	L2
CO2	Analyze the various vehicular communication technologies used in VANET.	L4
CO3	Analyze the message forwarding strategies, Challenges and applications in VANET.	L4
CO4	Analyze, Implement and demonstrate the real time problems using modern tools through group projects.	L4

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Introduction to VANET: Introduction of ad-hoc networks, Key definitions of ad- hoc networks Ad Hoc Network features, Classification, Advantages of ad- hoc/sensor networks - Unique constraints and challenges Driving Applications, Vehicular Ad Hoc Network (VANET), VANET Scenarios, Differences between VANET and MANET, need of VANET, Components of VANET, Characteristics of VANET.	8	0
2	MEDIA ACCESS CONTROL (MAC) PROTOCOLS: Media Access Control (MAC) Protocols Introduction - Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks – Classifications of MAC Protocol. MACAW – FAMA – BTMA – DPRMA – Real-Time MAC protocol – Multichannel Protocols – Power Aware MAC. ROUTING PROTOCOLS: Issues in Designing a Routing Protocol for Ad HocWireless Networks – Classifications of Routing Protocols -Table-driven protocols – DSDV – WRP – CGSR – On-Demand protocols – DSR – AODV – TORA – LAR – ABR – Zone Routing Protocol – Power Aware Routing protocols.	8	0
3	Communication in VANET: Types of Communication in VANET, Introduction todedicated short range communication, IEEE 1609.0(WAVE Architecture), IEEE1609.1(Network Resources Management), IEEE 1609.2 (Security Services), IEEE802.11P(Physical layer), IEEE 802.11P(MAC Layer) and IEEE 1609.3(NetworkingServices)	8	0
4	Message forwarding strategies in VANET and Challenges in VANET:Introduction, types of messages in VANET, Message forwarding strategies,Message packet format, need of priority-based message forwarding, proposedpriority assigning mechanism and analysis of priority-based message delivery,Volatility, Critical time latency of message delivery, Drastic increment in vehiclesand roads, Diverse networking standards, High mobility of Nodes, Networksecurity, Efficient Message forwarding and Mitigation techniques to addressVANET security.	8	0
5	Scope and Application of VANET: Scope of VANET, Road traffic management services, commercial application services, road safety services, Application of VANET: Road safety, real timing traffic monitoring, cooperative message exchange, priority-based messaging, collision avoidance messages, lane guidance, emergency notifications, E-toll collections prediction services.	7	0

Text Books:

1. Sonali P.Botkar, Sachin P.Godse, Parikshit N.Mahalle and Gitanjali R.Shinde, “VANET: Challenges and Opportunities”, First edition, CRC Press, Taylor and Francis group, 2021.
2. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols”, Prentice Hall, 2004.

Reference Books:

1. Hannes Hartenstein and Kenneth P Laberteaux, “VANET: Vehicular Applications and Inter-Networking Technologies”, First edition, A John Wiley and Sons, Ltd, Publication, 2010.
2. Claudia Campolo, Antonella Molinaro and Riccardo Scopigno, “Vehicular ad hoc Networks: Standards, Solutions, and Research”, Springer International Publishing Switzerland, 2015.

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Routing Protocols	NS-2/NS-3	
2	Scope and application of VANET	NS-2/NS-3	

Self-Learning Exercises:

1. Mini Projects

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3	3										3		
CO4	3	3	3	3	3				3	3			3	3	

High – 3, Medium – 2, Low – 1

DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC825	Total Credits	3	Course Type	Professional Elective Course		
Course Title	Optical Networks and Sensors						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	39	3		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60 %	100 %
	Practical	0	0	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	3	Minimum Marks	20 marks	25 marks	45 Marks

COURSE PREREQUISITE:

Basics of Optical Fiber Communication and Computer Networks.

COURSE OBJECTIVE:

1. To understand the working of optical network architecture.
2. To gain familiarization of optical network design models.

COURSE OUTCOMES (COs): After completing this course, students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Illustrate the working of different optical network architecture.	L2
CO2	Analyze the working principle of network design for various models.	L4
CO3	Design optical communication networks using the knowledge of control and management.	L3
CO4	Demonstrate the knowledge of protocols for optical network management using various tools.	L5

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Content / Syllabus:

UNIT No.	Content	Hours	
		Lecture	Tutorial
1	Evolution of optical networks architecture: Introduction, Optical networks architecture, Long-haul optical networks, Regional / metro optical networks, Optical access networks, All-optical networks—the wave of the future	8	0

2	Photonic Packet Switching: Optical Time Division Multiplexing, Tunable Delays, Optical Phase Lock Loop, Buffering, Burst Switching	8	0
3	WDM Network Design: LTD and RWA Problems, Dimensioning Wavelength- Routing Networks, Statistical Dimensioning Models, Maximum Load Dimensioning Models	8	0
4	Design aspects of optical communication networks: Introduction, Optical networking and wave length – division multiplexing, Control and management of WDM networks, Need for a design tool, Design architecture, Applications of ARTHUR	8	0
5	Emerging optical network management: Third-generation network management goals, Generic framing procedure, Optical transport network, generalized multi-protocol label switching, Protocols for bandwidth management in third-generation networks, Protocols for light path establishment and management.	7	0

Text Books:

1. Ramaswami, R., Kumar Sivarajan, and Sasaki, G. (2009). Optical Networks: A practical perspective. Morgan Kaufmann.
2. Ilyas, M., and Mouftah, H. T. (2019). The Handbook of Optical Communication Networks. CRC Press.

Reference Books:

1. Partha Pratim Sahu. (2020). Advances in Optical Networks and Components. CRC Press.
2. Milorad Cvijetic, and Djordjevic, I. (2013). Advanced optical communication systems and networks. Boston: Artech House, Cop.

Journals/Magazines:

1. <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7361>
2. <https://opg.optica.org/jocn/home.cfm>
3. <https://link.springer.com/journal/11078/volumes-and-issues>
4. <https://www.photonicsociety.org/publications/journal-of-optical-communications-and-networking>

Web/Digital resources:

1. <https://www.coursera.org/lecture/computer-networking/fiber-connections-DG82X>.

SWAYAM/NPTEL:

1. <https://nptel.ac.in/courses/117104127>.

PRACTICE BASED LEARNING:

No	Topics to be covered	Tools and Techniques	Expected Skill/Ability
1	Optical Communication systems	Scilab/Octave/ Optilux/ Any open source tool	Design/ Simulation

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3	3										3		
CO3	3	3	3											2	
CO4	3	3	3	2	3				3	2			3	2	

High – 3, Medium – 2, Low – 1



DEPARTMENT	Electronics and Communication Engineering						
Course Code	22EC83P	Total Credits		Course Type	Project work Course		
Course Title	Project work Phase - 2						
Teaching Learning Process		Contact Hours	Credits	Assessment in Weightage and marks			
	Lecture	0	0		CIE	SEE	Total
	Tutorial	0	0	Weightage	40 %	60%	100 %
	Practical	39	10	Maximum Marks	40 Marks	60 Marks	100 Marks
	Total	39	10	Minimum Marks	20 marks	25 Marks	45 Marks

COURSE PREREQUISITE:

Knowledge of analog circuits, digital circuits, communication principles and processors.

COURSE OBJECTIVE:

1. To function effectively in a team for the implementation of the idea using available resources within stipulated time.
2. To demonstrate the working of the project.
3. To prepare comprehensive document and give an effective presentation.

COURSE OUTCOMES (COs): After completion of the course, the students will be able to:

CO#	Course Outcomes	Highest Level of Cognitive Domain
CO1	Function effectively in a team contributing constructively for implementation and successful completion of the project with an efficient management of time and resource.	L6
CO2	Fabricate/implement the project adopting necessary tools and techniques adhering to ethical issues and carry out a performance evaluation based on prevailing trends.	L6
CO3	Demonstrate the working of the project and lifelong learning attitude by validating the results of the work to meet futuristic trends, sustainability aspects and publication requirements.	L4
CO4	Prepare a comprehensive document and give an effective presentation making use of modern tools, adhering to standard practices and ethics.	L3

L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 - Create

Course Articulation:

COURSE OUTCOMES↓	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3				2				3	3	3
CO2	3	3	3		3			3		2	2		3	3	3
CO3							2				2			3	3
CO4					3			3	2	2				3	3

High – 3, Medium – 2, Low – 1



