ESTD. 1939

KARNATAK LAW SOCIETY'S
GOGTE INSTITUTE OF TECHNOLOGY
"JNANA GANGA" UDYAMBAG, BELAGAVI-590008,
KARNATAKA, INDIA.
Approved by AICTE & UGC
Permanently Affiliated and Autonomous Institution Under
Visvesvaraya Technological University, Belagavi
www.git.edu

ESTD. 1979

2018-19 Scheme

Department: Electronics and Communication Engineering

Programme: B.E. (Electronics and Communication Engineering)

3rd to 8th Semester Scheme of Teaching and Examination

5th and 6th Semester Syllabus

INSTITUTION VISION

Gogte Institute of Technology shall stand out as an institution of excellence in technical education and in training individuals for outstanding caliber, character coupled with creativity and entrepreneurial skills.

MISSION

To train the students to become Quality Engineers with High Standards of Professionalism and Ethics who have Positive Attitude, a Perfect blend of Techno-Managerial Skills and Problem-solving ability with an analytical and innovative mindset.

QUALITY POLICY

- Imparting value-added technical education with state-of-the-art technology in a congenial, disciplined and a research-oriented environment.
- Fostering cultural, ethical, moral and social values in the human resources of the institution.
- Reinforcing our bonds with the Parents, Industry, Alumni, and to seek their suggestions for innovating and excelling in every sphere of quality education.

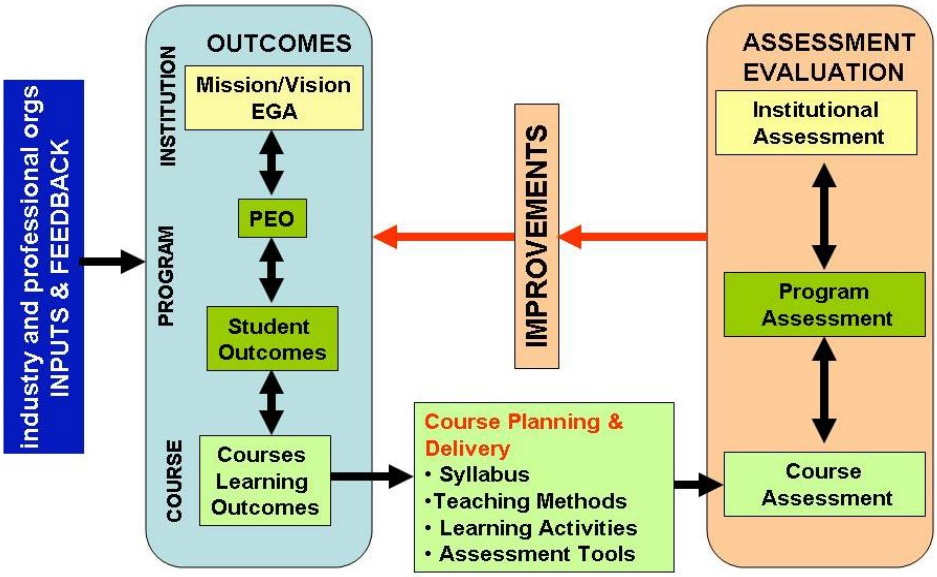
DEPARTMENT VISION

The Electronics & Communication Engineering department shall impart quality technical education and entrepreneurship skills to develop creative individuals to face changing global scenario.

MISSION

To augment the national talent pool, with Electronics and Communication Engineers having all-encompassing technical knowledge, principled practices and nationalistic outlook.

OUTCOME BASED EDUCATION (OBE)



PROGRAM OUTCOMES (POs):

National Board of Accreditation (NBA) has framed the Program Outcomes (PO) based on twelve Graduate Attributes (GA). These POs are generic to engineering education and applies to all branches of Engineering.

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

2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.

3. Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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

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

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

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

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

1. **The graduates will acquire core competence in basic science and Electronics and Communication Engineering fundamentals necessary to formulate, analyze, and solve engineering problems and to pursue advanced study or research.**
2. **The graduates will engage in the activities that demonstrate desire for ongoing personal and professional growth and self-confidence to adapt to rapid and major changes.**
3. **The graduates will maintain high professionalism and ethical standards, effective oral and written communication skills, work as part of teams on multidisciplinary projects under diverse professional environments, and relate engineering issues to the society, global economy and to emerging technologies.**

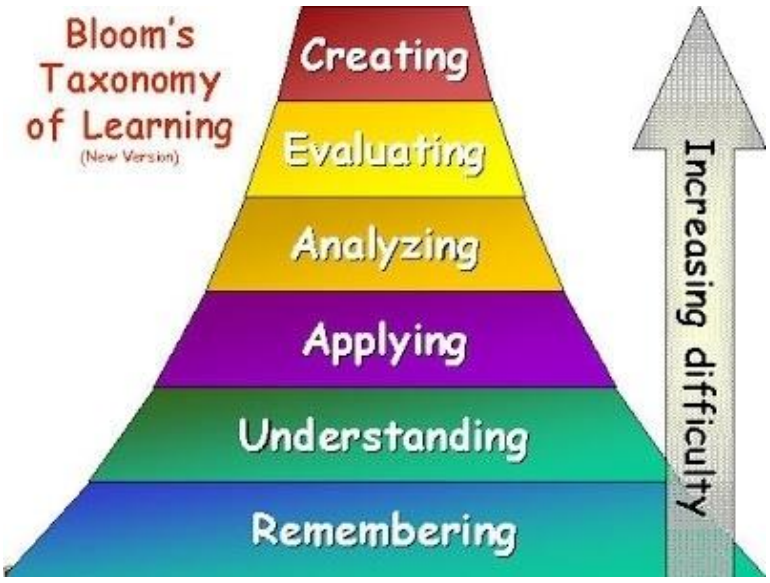
PROGRAM SPECIFIC OUTCOMES (PSOs):

1. **Understanding and applying the mathematical and scientific concepts, for analysis and design of basic Electronics and Communication systems.**
2. **Developing critical thinking abilities coupled with competence in use of computational tools for professional growth; complimented with communication skills and leadership attributes.**
3. **Identifying societal needs and sensitizing individuals towards finding innovative solutions to contemporary issues with multidisciplinary outlook.**

BLOOM'S TAXONOMY OF LEARNING OBJECTIVES

Bloom's Taxonomy in its various forms represents the process of learning. It was developed in 1956 by Benjamin Bloom and modified during the 1990's by a new group of cognitive psychologists, led by Lorin Anderson (a former student of Bloom's) to make it relevant to the 21st century. The **revised taxonomy** given below emphasizes what a learner "Can Do".

Lower order thinking skills (LOTS)		
L1	Remembering	Retrieve relevant knowledge from memory.
L2	Understanding	Construct meaning from instructional material, including oral, written, and graphic communication.
L3	Applying	Carry out or use a procedure in a given situation – using learned knowledge.
Higher order thinking skills (HOTS)		
L4	Analyzing	Break down knowledge into its components and determine the relationships of the components to one another and then how they relate to an overall structure or task.
L5	Evaluating	Make judgments based on criteria and standards, using previously learned knowledge.
L6	Creating	Combining or reorganizing elements to form a coherent or functional whole or into a new pattern, structure or idea.



Scheme of Teaching and Examination- 3rd to 8th Semester B.E.

As per the guidelines of UGC CBCS the courses can be classified into:

i. **Core Courses (PC):** This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirements of a program in a said discipline of study. These courses will have 4 credits per course.

ii. **Foundation Courses:** The Foundation Courses are of two kinds:

   a. Compulsory Foundation (FC): These courses are the courses based upon the content that leads to Knowledge enhancement. These courses provide opportunities to improve technological knowledge before entering industry as well as preparing students for higher degrees in technological subjects. They are mandatory for all disciplines. These courses will have 4 credits per course.

The courses are: **Basic Science Courses (BS), Engineering Science Courses (ES).**

   b. **Foundation Electives (FE):** These are value-based courses aimed at man making education. These courses will have 3 credits per course. The course is related to **Humanities and Social Science Courses.**

iii. **Elective Courses:** This is course, which can be chosen from the pool of papers. It may be supportive to the discipline/ providing extended scope/enabling an exposure to some other discipline / domain / nurturing student proficiency skills. These courses will have 3 credits per course.

An elective may be **Discipline Centric (PE)** or may be chosen from an unrelated discipline. It may be called an **Open Elective (OE).**

Mandatory Non-Credit Courses (MNC): These courses are mandatory for students joining B.E./B.Tech. Program and students have to successfully complete these courses before the completion of degree.

Semester wise distribution of credits for B.E program

Total credits for B.E Program: 175 credits

		Regular batch		Dip. Lateral entry	
	Semester	**Credits per Sem**	**Total credits**	**Credits per Sem**	**Total credits**
1st year	1	20	40	----	----
	2	20		----	
2nd year	3	24	48	24	48
	4	24		24	
3rd year	5	24	48	24	48
	6	24		24	
4th year	7	23	39	23	39
	8	16		16	
	Total	**175**	**175**	**135**	**135**

Scheme of Teaching and Examination- 3rd to 8th Semester B.E.

Third Semester (Regular)									
S. No.	**Course Code**	**Course Title**		**Contact Hours**	**Total Contact Hours/week**	**Total credits**	**Marks**		
				L – T – P			**CIE**	**SEE**	**Total**
1.	18MATEC31	Statistical-Numerical – Fourier Techniques	BS	4 – 0 – 0	4	4	50	50	100
2.	18EC32	Analog Electronics	PC1	4 – 0 – 0	4	4	50	50	100
3.	18EC33	Digital Electronics	PC2	4 – 0 – 0	4	4	50	50	100
4.	18EC34	Signals and Systems	PC3	3 – 2 – 0	5	4	50	50	100
5.	18EC35	Network Analysis	PC4	4 – 0 – 0	4	4	50	50	100
6.	18ECL36	Analog Electronics Lab	L1	0 – 0 – 3	3	1.5	25	25	50
7.	18ECL37	Digital Electronics Lab	L2	0 – 0 – 3	3	1.5	25	25	50
8.	18ECL38	Network Analysis Lab	L3	0 – 0 – 2	2	1	25	25	50
9.	18EC39	Environmental Studies	HS	MNC		MNC	25	-	25
		Total			**29**	**24**	**350**	**325**	**675**

Third Semester (Diploma)									
S. No.	**Course Code**	**Course Title**		**Contact Hours**	**Total Contact Hours/week**	**Total credits**	**Marks**		
				L – T – P			**CIE**	**SEE**	**Total**
1.	18DMATEC31	Calculus, Fourier Analysis and Linear Algebra	BS	4 – 0 – 0	4	4	50	50	100
2.	18EC32	Analog Electronics	PC1	4 – 0 – 0	4	4	50	50	100
3.	18EC33	Digital Electronics	PC2	4 – 0 – 0	4	4	50	50	100
4.	18EC34	Signals and Systems	PC3	3 – 2 – 0	5	4	50	50	100
5.	18EC35	Network Analysis	PC4	4 – 0 – 0	4	4	50	50	100
6.	18ECL36	Analog Electronics Lab	L1	0 – 0 – 3	3	1.5	25	25	50
7.	18ECL37	Digital Electronics Lab	L2	0 – 0 – 3	3	1.5	25	25	50
8.	18ECL38	Network Analysis Lab	L3	0 – 0 – 2	2	1	25	25	50
9.	18EC39	Environmental Studies	HS	MNC		MNC	25	-	25
		Total			**29**	**24**	**350**	**325**	**675**

Forth Semester (Regular)									
S. No.	**Course Code**	**Course Title**		**Contact Hours**	**Total Contact Hours/week**	**Total credits**	**Marks**		
				L – T – P			**CIE**	**SEE**	**Total**
1.	18MATEC41	Partial Differential Equations, Sampling Techniques and Transforms	BS	4 – 0 – 0	4	4	50	50	100
2.	18EC42	Microcontrollers	PC1	4 – 0 – 0	4	4	50	50	100
3.	18EC43	Control Systems	PC2	4 – 0 – 0	4	4	50	50	100
4.	18EC44	DSP & Algorithms	PC3	3 – 2 – 0	5	4	50	50	100
5.	18EC45	Communication Theory and Techniques	PC4	4 – 0 – 0	4	4	50	50	100
6.	18ECL46	Microcontrollers Lab	L1	0 – 0 – 2	2	1	25	25	50
7.	18ECL47	Communication Lab	L2	0 – 0 – 2	2	1	25	25	50
8.	18ECL48	Control System Lab	L3	0 – 0 – 2	2	1	25	25	50
9.	18ECB49/ 18ECS49	Balake Kannada/ Sanskrutika Kannada	HS	0 – 2 – 0	2	1	25	25	50
		Total			**30**	**24**	**350**	**350**	**700**

 # MNC: Mandatory Non-credit course. Pass in this course is mandatory for the award of degree.

Fourth Semester (Diploma)									
S. No.	**Course Code**	**Course Title**		**Contact Hours**	**Total Contact Hours/week**	**Total credits**	**Marks**		
				L – T – P			**CIE**	**SEE**	**Total**
1.	18DMATEC41	Vector Calculus, Laplace Transforms and Probability	BS	4 – 0 – 0	4	4	50	50	100
2.	18EC42	Microcontrollers	PC1	4 – 0 – 0	4	4	50	50	100
3.	18EC43	Control Systems	PC2	4 – 0 – 0	4	4	50	50	100
4.	18EC44	DSP & Algorithms	PC3	3 – 2 – 0	5	4	50	50	100
5.	18EC45	Communication Theory and Techniques	PC4	4 – 0 – 0	4	4	50	50	100
6.	18ECL46	Microcontrollers Lab	L1	0 – 0 – 2	2	1	25	25	50
7.	18ECL47	Communication Lab	L2	0 – 0 – 2	2	1	25	25	50
8.	18ECL48	Control System Lab	L3	0 – 0 – 2	2	1	25	25	50
9.	18ECB49/ 18ECS49	Balake Kannada/ Sanskrutika Kannada	HS	0 – 2 – 0	2	1	25	25	50
		Total			**30**	**24**	**350**	**350**	**700**

Fifth Semester (Regular)									
S. No.	**Course Code**	**Course Title**		**Contact Hours**	**Total Contact Hours/week**	**Total credits**	**Marks**		
				L – T – P			**CIE**	**SEE**	**Total**
1.	18EC51	Operating System**	PC1	3 – 2 – 0	5	4	50	50	100
2.	18EC52	CMOS VLSI Design	PC2	4 – 0 – 0	4	4	50	50	100
3.	18EC53	Information Theory and Digital Communication	PC3	4 – 0 – 0	4	4	50	50	100
4.	18EC54	Engineering Electromagnetics	PC4	3 – 2 – 0	5	4	50	50	100
5.	18EC55X	Professional Elective-I	PE	3 – 0 – 0	3	3	50	50	100
6.	**18EC56X**	**Open Elective – I Or Institute Elective**	OE	3 – 0 – 0	3	3	50	50	100
7.	18ECL57	VLSI Lab	L1	0 – 0 – 2	2	1	25	25	50
8.	18ECL58	Information Theory and Digital Communication Lab	L2	0 – 0 – 2	2	1	25	25	50
9.	18EC59A	Employability Skills – I	MNC	3 – 0 – 0	3	MNC	50	-	50
		Total			**31**	**24**	**400**	**350**	**750**

**** One Course of 4 credits exempted in 5th semesterfor Diploma lateral entry students to maintain the same credits as regular.**

Operating System has been exempted.

Course Code	Professional Elective – I
18EC551	Power Electronics
18EC552	System Modeling
18EC553	Speech Processing
18EC554	Artificial Neural Networks
18EC555	Cryptography and Network Security

Course Code	Open Elective – I
18EC561	Consumer Electronics
18EC562	Fuzzy Logic and Applications
18EC563	Heterogeneous Computing
18EC564	Requirements Engineering
18INT51 (Institute Elective)	**Biomedical Image Understanding and Analysis**

<u>Note:</u> Open Elective (OE) courses are offered to other branch students.

****However, institute elective can be opted by ECE students.**

Fifth Semester (Diploma)									
S. No.	**Course Code**	**Course Title**		**Contact Hours**	**Total Contact Hours/week**	**Total credits**	**Marks**		
				L – T – P			**CIE**	**SEE**	**Total**
1.	18DMATEC51	Partial Differential Equations, Z – Transforms and Stochastic Processes	BS	4 – 0 – 0	4	4	50	50	100
2.	18EC52	CMOS VLSI Design	PC1	4 – 0 – 0	4	4	50	50	100
3.	18EC53	Information Theory and Digital Communication	PC3	4 – 0 – 0	4	4	50	50	100
4.	18EC54	Engineering Electromagnetics	PC2	3 – 2 – 0	5	4	50	50	100
5.	18EC55X	Professional Elective-I	PE	3 – 0 – 0	3	3	50	50	100
6.	**18EC56X**	**Open Elective – I Or Institute Elective**	OE	3 – 0 – 0	3	3	50	50	100
7.	18ECL57	VLSI Lab	L1	0 – 0 – 2	2	1	25	25	50
8.	18ECL58	Information Theory and Digital Communication Lab	L2	0 – 0 – 2	2	1	25	25	50
9.	18EC59A	Employability Skills – I	MNC	3 – 0 – 0	3	MNC	50	-	50
10.	**18EC59B**	Communicative English	HS	1 – 0 – 1	2	MNC	25	-	25
		Total			**32**	**24**	**425**	**350**	**775**

**** One Course of 4 credits exempted in 5thsemester for Diploma lateral entry students to maintain the same credits as regular.**

Operating System has been exempted.

Course Code	**Professional Elective – I**
18EC551	Power Electronics
18EC552	System Modeling
18EC553	Speech Processing
18EC554	Artificial Neural Networks
18EC555	Cryptography and Network Security

Course Code	**Open Elective – I**
18EC561	Consumer Electronics
18EC562	Fuzzy Logic and Applications
18EC563	Heterogeneous Computing
18EC564	Requirements Engineering
18INT51 (Institute Elective)	**Biomedical Image Understanding and Analysis**

*****However, institute elective can be opted by ECE students.**

Sixth Semester									
S. No.	**Course Code**	**Course Title**		**Contact Hours**	**Total Contact Hours/week**	**Total credits**	**Marks**		
				L – T – P			**CIE**	**SEE**	**Total**
1.	18EC61	Image Processing and Computer Vision	PC1	3 – 2 – 0	5	4	50	50	100
2.	18EC62	Computer Communication Networks	PC2	4 – 0 – 0	4	4	50	50	100
3.	18EC63	Sensors and Signal Conditioning	PC3	3 – 2 – 0	5	4	50	50	100
4.	18EC64X	Professional Elective-II	PE	3 – 0 – 0	3	3	50	50	100
5.	18EC65X	Professional Elective-III	PE	3 – 0 – 0	3	3	50	50	100
6.	**18EC66X**	**Open Elective - II**	OE	3 – 0 – 0	3	3	50	50	100
7.	18ECL67	Advanced C and C++ Lab	L1	0 – 0 – 2	2	1	25	25	50
8.	18ECL68	Networking Lab	L2	0 – 0 – 2	2	1	25	25	50
9.	18EC69A	Constitution of India, PE and HV	HS	1 – 0 – 0	1	1	25	25	50
10.	18EC69B	Employability Skills – II	MNC	3 – 0 – 0	3	MNC	50	-	50
		Total			**31**	**24**	**425**	**375**	**800**

Course Code	**Professional Elective – II**
18EC641	Requirements Engineering
18EC642	Virtual Instrumentation
18EC643	Machine Learning
18EC644	Robotics & Automation
18EC645	Data Base Management System

Course Code	**Professional Elective – III**
18EC651	Digital Forensics
18EC652	Biomedical System Design
18EC653	Heterogeneous Computing
18EC654	Remote Sensing and GIS
18EC655	Human Computer Interaction
18EC656	Electric and Hybrid Vehicles

Course Code	**Open Elective - II**
18EC661	Nano Electronics
18EC662	Artificial Neural Networks
18EC663	Embedded System Design
18EC664	IoE

Seventh Semester									
S. No.	**Code**	**Course Title**		**Contact Hours**	**Total Contact Hours/week**	**Total credits**	**Marks**		
				L – T – P			**CIE**	**SEE**	**Total**
1.	18EC71	Management and Entrepreneurship With Branch specific case studies	HS	3 – 0 – 0	3	3	50	50	100
2.	18EC72	Microwave and Antenna Engineering	PC1	3 – 0 – 0	3	3	50	50	100
3.	18EC73	Wireless and Mobile Communication	PC2	3 – 0 – 0	3	3	50	50	100
4.	18EC74X	Professional Elective-IV	PE	3 – 0 – 0	3	3	50	50	100
5.	18EC75X	Professional Elective-V	PE	3 – 0 – 0	3	3	50	50	100
6.	**18EC76X**	**Open Elective - III**	OE	3 – 0 – 0	3	3	50	50	100
7.	18ECL77	Microwave and Antenna Lab	L1	0 – 0 – 3	3	1.5	25	25	50
8.	18ECL78	Wireless and Mobile Communication Lab	L2	0 – 0 – 3	3	1.5	25	25	50
9.	18EC79	**Seminar on Project synopsis (Design Thinking Approach) Project Phase -1**	**PC**	0 – 0 – 2	2	2	25	--	25
		Total			**26**	**23**	**375**	**350**	**725**

Project Phase -1: CIE- 25 marks (Average of 25 marks –Internal guide and 25 marks- presentation)

Course Code	Professional Elective – IV
18EC741	ASIC Design
18EC742	Analog Mixed Mode VLSI
18EC743	Electronic System Design
18EC744	RF System Design
18EC745	Deep Learning

Course Code	Professional Elective – V
18EC751	Low Power VLSI
18EC752	Multimedia Communication
18EC753	IoT
18EC754	Wireless Ad Hoc and Sensor Networks
18EC755	Data Analytics for Wearable Technology
18EC756	Salesforce Lightning (Integrated)
18EC757	AWS Cloud Computing (Integrated)

Course Code	Open Elective – III
18EC761	Sensors and Signal Conditioning
18EC762	Multimedia Processing
18EC763	System Modeling
18EC764	Digital Forensics
18EC765	Biomedical System Design
18EC766	Electric and Hybrid Vehicles

Eight Semester									
S. No.	**Code**	**Course Title**		**Contact Hours**	**Total Contact Hours/week**	**Total credits**	**Marks**		
				L – T – P			**CIE**	**SEE**	**Total**
1.	18EC81	Internship	PC			2	50	--	50
2.	18EC82	Intellectual Property Rights	HS	Self-Study		1	50		50
3.	18EC83	Professional Certification – 1(English / any other foreign language)	HS			1	25	--	25
4.	18EC84	Professional Certification – 2	PC			1	25	--	25
5.	18EC85	Project Phase – 2	PC			2	50(25+25)	--	50
6.	18EC86	Project Phase – 3	PC			4	50(25+25)	--	50
7.	18EC87	Project Phase – 4(Final Viva Voce)	PC	Final		5	--	100	100
						16	**250**	**100**	**350**

Internship: 6 to 8 weeks duration

Project Phase -2 and 3: CIE- 50 marks (25 marks –Internal guide + 25 marks- presentation)

Operating Systems

Course Code	18EC51	**Credits**	4
Course type	PC1	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 2 – 0	**SEE Marks**	50 marks
Total Hours:	50Hrs	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To study the evolution, key functions and structure of Operating systems.
2. To understand the mechanism of process control and concepts related to concurrency.
3. To comprehend the different strategies for resource management and prevention of deadlock.
4. To learn and apply the principal techniques for file organization and access.
5. To understand secondary storage structure and key aspects of system security.

Unit – I **10 Hours**

Introduction: Goals of os, classes of operating systems: batch processing os, multiprogramming os, time – sharing os, real – time os, distributed os, modern os (Text 1)
Structure of operating systems: Policies and mechanisms, portability and extensibility of operating systems, operating systems with monolithic structure, layered design of os, virtual machine os, kernel-based os, microkernel-based os. (Text 1)
Case study: Installing an operating system using virtual machine

Unit – II **10 Hours**

Process management: Process, process states, process description, process control, execution of the operating system, security issues. (Text 3)
Process scheduling: Basic concepts, scheduling criteria, scheduling algorithms. (Text 2)
concurrency: Principles of concurrency, mutual exclusion: hardware support, semaphores, monitors, message passing, readers/writes problem (Text 3)
Case study: Simulate a) FCFS b) SJF c) Round Robin d) Priority cpu scheduling algorithms.

Unit – III **10 Hours**

Deadlock and starvation: Principles of deadlock, deadlock prevention, deadlock avoidance, deadlock detection, an integrated deadlock strategy, dining philosopher's problem. (Text 3)
Memory management: Swapping, contiguous memory allocation, paging, segmentation, demand paging, page replacement, allocation of frames, thrashing (Text 2).
Case Study: Simulate a) Paging technique of memory management b) Page replacement algorithms.

Unit – IV **10 Hours**

File system interface and implementation: File concept, access methods, directory structure, file system mounting, file sharing, protection, file – system structure, file– system implementation, directory implementation, allocation methods, free–space management. (Text 2)

Secondary storage: Disk structure, disk scheduling, disk management (Text 2)

Case study: Simulate file allocation strategies: a) Sequential b) Indexed c) Linked.

Unit – V **10 Hours**

Computer security: The security problem, user authentication, program threats, system threats. (Text 2)

Basics of rtos: Introduction, characteristics of real-time tasks, real-time scheduling, operating system designs, rtos for safety critical systems, multi-core architectures, operating systems for wireless sensor networks, real-time requirements of multimedia application. (Text 4)

Case Study: a) Study of Linux operating system. b) Implement system calls of UNIX operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir.

Books

Text Books:

1. Dhananjay M. Dhamdhere, "Operating Systems – A Concept – Based Approach", Tata McGraw–Hill, 3rdEdition, 2012 and onwards.
2. Silberschatz, Galvin, Gagne, "Operating System Concepts" John Wiley,6thEdition, 2004 and onwards.
3. William Stallings, "Operating Systems–Internals and Design Principles" Pearson,6th Edition,2012 and onwards.
4. Charles Crowley, "Operating Systems-A Design Oriented approach", McGraw Hill. 2012 and onwards.

Reference Books:

1. Elmasri, Carrick, Levine, "Operating Systems–Aspiral Approach",Tata McGraw–Hill,2012 and onwards.
2. H. M. Deitel, P. J.Deitel and David R. Choffnes, "Operating Systems". PHI,3rdEditionand onwards.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Explain the key functions and structure of Operating systems.	L2
2.	Compare the various scheduling algorithms for process control.	L4
3.	Describe the concept of deadlock, starvation and simulate paging and segmentation techniques necessary for memory management.	L4

4.	Explain the structure of file system and examine the file implementation and access techniques.	L4
5.	Recognize the security issues in operating systems and demonstrate the working of Linux operating system	L4

	Program Outcome of this course (POs)	PO No.
1.	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	**1**
2.	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	**3**
3.	**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.	**5**
4.	**Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	**12**

Course delivery methods	**Assessment methods**
1. Blackboard Teaching	1. Internal Assessment
2. PPT's	2. Quiz
3. Videos	3. Assignment
4. Animations	4. Activity

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Partial Differential Equations Z -Transforms and Stochastic Processes

Course Code	18DMATEC51 (for lateral entry)	**Credits**	4
Course type	BS	**CIE Marks**	50 marks
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	50	**SEE Duration**	3 Hours for 100 marks

Course learning objectives

Students should

1. Get acquainted with joint probability distribution
2. Study the concept of stochastic processes.
3. Understand the concept of partial differential equations
4. Apply partial differential equations to solve practical problems.
5. Study the concept of Z-transforms and its applications

Pre-requisites :

1. Partial differentiation
2. Basic probability, probability distributions
3. Basic integration

Unit - I **10 Hours**

Joint PDF: Discrete joint PDF, conditional joint PDF, expectations (Mean), Variance and Covariance.

Unit - II **10 Hours**

Stochastic Processes: Definition and classification of stochastic processes. Discrete state and discrete parameter stochastic process, unique fixed probability vector, regular stochastic matrix, transition probability, Markov chains.

Unit - III **10 Hours**

Partial Differential Equations: Formation of PDE by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration, solution of homogeneous PDE involving derivative with respect to one independent variable.

Unit - IV **10 Hours**

Applications of Partial Differential Equations: Derivations of one dimensional Heat and Wave equations. Solutions of one dimensional heat and wave equations. Solution of two dimensional Laplace equations by the method of separation of variables. Numerical solution of one dimensional heat and wave equations, two dimensional Laplace equations by finite differences.

Unit - V **10 Hours**

Z-Transforms: Definition, Z-transforms of standard functions, linearity, damping rule, shifting properties, initial and final value theorems with examples. Inverse Z-transforms and solution of difference equations by Z-transforms.

Books

Text Books:

1. B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012 and onwards.
2. Erwin Kreyszig –Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006 and onwards.
3. B. V. Ramana - Higher Engineering Mathematics, Tata McGraw-Hill Education Private Limited, Tenth reprint 2010 and onwards.

Reference Books:

1. P. N. Wartikar & J. N. Wartikar – Applied Mathematics (Volume I and II) Pune Vidyarthi Griha Prakashan, 7th Edition 1994 and onwards.
2. Peter V. O' Neil –Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th Edition, 2011 and onwards.
3. Glyn James – Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	**Apply** joint probability distribution to solve relevant problems	L2
2.	**Apply** stochastic processes to solve relevant problems	L1, L2
3.	**Form** and **Solve** partial differential equations.	L1, L2
4.	**Develop** heat and wave equations	L2, L3
5.	**Apply** partial differential equations to solve practical problems.	L3
6.	**Apply** Z-Transforms to solve engineering problems.	L1, L2

	Program Outcome of this course (POs)	**PO No.**
	Students will acquire	
1.	An ability to apply knowledge of mathematics, science and engineering.	**PO1**
2.	An ability to identify, formulate and solve engineering problems.	**PO5**
3.	An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	**PO11**

Course delivery methods	**Assessment methods**
1. Black board teaching	1. Internal Assessment Tests
2. Power point presentation	2. Assignments
3. Scilab/ Matlab/ R-Software	3. Quizes

CMOS VLSI Design

Course Code	18EC52	**Credits**	4
Course type	PC	**CIE Marks**	50 marks
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	50	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To study the fundamentals of CMOS and the non-ideal effects.
2. To analyze the RC delay parameters affecting the design basic gates and circuits.
3. To apply the Lambda based design rules for developing the layout diagrams.
4. To delve into the various CMOS logic families and their applicability to combinational and/or sequential circuits.
5. To understand the basics of CAD Systems.

Prerequisites: Analog Electronics, Digital Electronics.

Unit – I 10 Hours

MOS Transistor Theory: Introduction, ideal I-V characteristics, long-channel I-V characteristics, C- V Characteristics; simple MOS capacitance models, detailed MOS gate capacitance model, detailed MOS diffusion capacitance model; non-ideal I-V effects: mobility degradation and velocity saturation, channel length modulation threshold voltage effects, leakage, DC transfer characteristics, beta ratio effects, noise margin. **(conceptual overview with numerical problem solving for analysis)**

Case Study: C-V characterization, 2^{nd} order effects, β effects.

Text – 1:- Chapter 2

Unit – II 10 Hours

Characterization & performance Estimation: Definitions; RC delay model: effective resistance, gate and diffusion capacitance, equivalent RC circuits; linear delay model: logical effort, parasitic delay.

Case Study: Design of gates for a specified delay, Elmore delay model analysis for basic gates, and simple circuits.

Text – 1:- Chapter 4

Unit – III 10 Hours

CMOS Fabrication and Layout: CMOS fabrication and layout: layout design rules, gate layouts, stick diagrams; sheet resistance and area capacitance concepts, delay unit **(conceptual overview with numerical problem solving for analysis)**.

Case Study: Stick and layout diagrams for basic gates/SOP/POS equations; RC delay calculations from layout

Text – 1:- Chapter 1

Text – 2:- Chapter 4

Unit – IV **10 Hours**

Combinational Circuit Design: Introduction; circuit families: ratioed circuits: pseudo-nMOS, Cascode Voltage Switch Logic (CVSL), dynamic circuits, Domino logic, pass-transistor circuits, Bi-CMOS circuits.

Sequential MOS Logic Circuits: Introduction, behavior of bi-stable elements, SR latch circuits, clocked latch and flip flop circuits, CMOS D-latch and edge triggered flip-flop.

Case Study: Designing of Logical Gates/Circuits, with Different CMOS Logic Structures.

Text – 1:- Chapter 9.

Text – 3:- Chapter 8

Unit – V **10 Hours**

CAD Systems and Algorithms: Introduction, CAD systems, switch level simulation, layout synthesis, layout analysis, timing and optimization, logic synthesis, test generation sequential machine optimizations. scheduling and binding, hardware/software co-design.

Case Study: - Switch Level Simulation, K – L Partitioning Algorithm.

Books

Text Books:

1. Neil Weste, and David Harris, "*CMOS VLSI Design, A Circuits and Systems Perspective*", 4th Edition; Pearson Education, India.
2. Douglas Pucknell, and Kamran Eshragian, "*Basic VLSI Design*", PHI Publications India Pvt. Ltd.
3. Sung-Mo Kang and Yusuf Leblebci, "*CMOS Digital Integrated Circuits, Analysis and Design*", McGraw Hill Publications.
4. Wayne Wolfe, "*Modern VLSI Design, System-On-Chip Design*", Prentice Hall, 2002 onwards

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Understand the non-ideal behavior effects of a MOS device.	L2
2. Design basic gates and circuits for a given delay.	L3
3. Apply knowledge of design rules to construct stick diagrams and layout diagrams.	L3
4. Design combinational and/or sequential circuits using CMOS concepts	L3
5. Discuss the CAD Systems layout and design.	L2

Program Outcome of this course (POs)	PO No.
1. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
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.	**2**
3. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the	**5**

	limitations.	
4.	**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.	**10**
5.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	**12**

Course delivery methods	**Assessment methods**
1. Black board	1. Assignments
2. Presentation	2. Quiz
3. Videos and MOOC	3. Case studies with real time examples.
4. Practical with EDA tools.	4. Projects/ Literature survey.

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Information Theory and Digital Communication

Course Code	18EC53	**Credits**	4
Course type	PC3	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	50
Total Hours:	50	**SEE Duration**	3 Hours for 100Marks

Course Learning Objectives (CLOs)

1 To study the various digital coding techniques.
2 To analyze power spectral densities of various discrete PAM signals and study the effects of ISI.
3 To understand channel coding and analyze linear, block and cyclic codes and convolutional codes.
4 To understand and evaluate the performance of various digital modulation techniques.
5 To generate PN code sequence and analyze the performance of various spread spectrum modulation Techniques.

Pre-Requisites:

1 Communication Theory and Techniques

Unit – I **10 Hours**

WAVEFORM CODING: Review of Sampling theory, Pulse Code Modulation, Quantization noise and SNR, Robust Quantization, DPCM, Delta Modulation, Adaptive Delta Modulation.
SOURCE ENCODING: Properties of codes, Shannon's encoding algorithm, Shannon-Fano, and Huffman's coding algorithm.
Case Study: Digital Multiplexers, Light wave Transmission.

Unit – II **10 Hours**

Baseband Transmission: Gram Schmidt orthogonalization, Properties of Line codes, Power Spectral Density of Uni-polar, Polar, Bipolar and Manchester RZ and NRZ, ISI in band limited channels, Zero-ISI condition- the Nyquist criterion, Solution for zero ISI, Raised cosine filters, Corelative Coding.
Channel Coding: Discrete Communication Channel, Mutual Information and its properties, Types of channels.
Case Study: Eye Diagram.

Unit – III **10 Hours**

Linear Block codes: Matrix Description of LBC, Encoding, Decoding and Syndrome circuits, Error calculation.
Binary Cyclic Codes: Properties, encoding using (n-k) shift registers, Syndrome calculation.
Convolutional Encoding: Convolutional encoder representation in time and transform domain.

Case Study: General form of decoder for cyclic codes, State Diagrams and Code tree for convolutional codes.

Unit – IV **10 Hours**

Digital Modulation Schemes: Geometric Representation of signals, Generation, Detection, Bit error rate of Coherent Binary PSK, Binary FSK. Introduction to MSK, QPSK and QAM.

Unit –V **10 Hours**

Spread Spectrum Modulation: Need for Spread Spectrum Modulation, PN sequence and its properties, Direct sequence SS system- DS/BPSK Transmitter & Receiver, processing gain, Jamming margin, Frequency hop SS system- FH-FSK transmitter and Receiver, Fast and slow hop.

Case Study: Code division multiple access, Multipath Suppression.

Books

Text Books

1. Simon Haykin, "Digital Communications", John Wiley, 2005 and onwards.
2. Shu Lin, Daniel J. Costello, "Error Control Coding", PHI, 2nd Edition, and onwards
3. George Kennedy, Bernard Davis, SRM Prasanna "Electronics Communication Systems",5th edition, McGraw Hill Education (India) Pvt. Ltd.

Reference Books

1. B. Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition, Pearson Education, 2009 and onwards.
2. B.P.Lathi, "Modern Digital and Analog Communication Systems" 3rd Edition, Oxford University Press 2007 and onwards.
3. Dr.K. N Hari Bhat, "Digital Communications" 2nd Edition, Sanguine Technical Publishers 2005 and onwards.

E-resourses

1. Digital Communication- https://nptel.ac.in/courses/117101051/
2. Digital Communication- https://nptel.ac.in/courses/108102096/

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Analyze various waveform and source coding techniques	L3
2. Apply suitable line codes for given application and suggests methods to control ISI effects	L4
3. Analyze methods to detect and correct the error capabilities	L4
4. Evaluate the spectral characteristics of band pass signaling schemes	L4
5. Analyze performances of spread spectrum modulation techniques	L3

Program Outcome of this course (POs)	PO No.
1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1
2. **Problem analysis**: Identify, formulate**,** review, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2
3. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4
4. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Simulation	3. Quiz
	4. Course Activity

CIE and SEE pattern:

Theory courses having 4-0-0 / 3-0-0 distribution

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA Tests	Average of two assignments	Course Activity/Seminar/ Mini project /Industry	Total Marks
Maximum Marks: 50	15+15=30	10		50
➢ Writing two IA test is compulsory. ➢ Minimum marks required to qualify for SEE**:**20				

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum marks required in SEE to pass: 40
3. Question paper contains 10 questions each carrying 20 marks. Students have to answer FIVE full questions selecting one question from each unit

Engineering Electromagnetics

Course Code	18EC54	**Credits**	4
Course type	PC4	**CIE Marks**	50
Hours/week: L-T-P	3 – 2 – 0	**SEE Marks**	50
Total Hours:	50	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1 To develop a comprehensive and rigorous treatment of the fundamentals of static electric fields.
2 To discuss the fundamentals of static magnetic fields and develop Maxwell's equations. To compare and address the analogous nature of Maxwell's equations for static electric and magnetic fields.
3 To build and understand Maxwell's equations both in point and integral form for electrodynamics.
4 To formulate the concepts leading to basic wave equation and properties of wave travelling in free space, dielectrics and conductor.
5 To infer basic concepts of radio wave propagation.

Pre-Requisites

1 Engineering Physics.
2 Engineering Mathematics.

Unit – I **10 Hours**

Introduction to Static Electric Fields - I: Review of Vector analysis, Co-ordinate systems and transformations, Coulomb's law, Electric Field Intensity (EFI), EFI due to various charge configurations (line charge, surface charge and volume charge), Electric Flux Density (EFD),Gauss' Law & its applications, Gauss's Law in Point form, Divergence Theorem.
Case Studies: Simulating and visualizing electric and magnetic fields using Software tool.

Unit – II **10 Hours**

Introduction to Static Electric Fields - II: Energy spent in moving charge, Definition of Potential Difference and Potential, Potential field due to Point Charge and System of Charge, Potential gradient, Energy Density, Boundary conditions of static electric field at the interface of materials, Laplace and Poisson's equations.
Introduction to Static Magnetic Fields: Biot-Savart's Law, Ampere's circuital law, Stokes Theorem, Magnetic Flux, Flux Density, Scalar and Vector Magnetic Potentials Magnetic forces, Force on a moving charge, Magnetic Boundary Condition, Energy stored in magnetic field.
Case Studies: Study of electromagnetic interference in telecommunication systems.

Unit – III **10 Hours**

Time Varying Fields and Maxwell's Equations: Faraday's Law, Continuity equation for time varying field, Displacement Current, Maxwell's correction to Ampere's Circuit Law, Summary of Maxwell's Equations in Point, Integral and Harmonic form, Retarded Potentials Wave equations, UPW (TEM wave) propagation in free space, dielectrics and good conductors

Case Studies: Visualizing Maxwell's equations using software tool.

Unit – IV **10 Hours**

Poynting vector: Poynting's Theorem, Instantaneous, Average and Complex Poynting vector, Power loss in a plane conductor, Wave Power, Polarization.

Plane waves: Reflection of UPW at normal incidence, Total reflection.

Case Study: Study of 60 GHz technology.

Unit –V **10 Hours**

Propagation Characteristics of Radio Waves: Radio and Optical Horizon, Ground wave propagation, Tropospheric scatter propagation, The Atmosphere, Ionospheric behavior variations, Sky wave propagation, Virtual height & Critical frequency, Maximum Usable Frequency (MUF), Skip distance.

Case Study: Study of IEEE draft standard (3 KHz to 300 GHz) for safety levels with respect to human exposure to radio frequency electromagnetic fields.

Books

Text Books

1. Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 6th Edition, 2014 and onwards.
2. William H.Hayt Jr. and John A. Buck, "Engineering Electromagnetics", Mc.Graw-Hill Education, 2nd Edition, 2014 and onwards.
3. A. R. Harish and M. Sachidananda, "Antennas and Wave Propagation", Oxford University Press, 2007 and onwards.

Reference Books

1. David K. Cheng, "Field and Wave Electromagnetics", Pearson Education Asia, 2nd Edition,1989 and onwards.
2. V. V. Sarwate, "Electromagnetic Fields and Waves", Wiley Eastern Limited, 1stEdition, 1993 and onwards.
3. Joseph A. Edminister, "Theory and Problems on Electromagnetics", Schaum's outline series,Mc.Graw-Hill, 2nd Edition, 1993 and onwards.

E-recourses

1. Introduction to Electromagnetic Theory (IIT Kanpur)
   https://nptel.ac.in/courses/115104088

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Define, understand and explain concepts on electrostatics and apply the same to solve numerical problems on various configurations of distribution of electric charges.	L3
2. Explain and apply various laws involved in electrostatics and magnetostatics.	L3
3. Summarize and solve Maxwell equations for time-varying electric and magnetic fields.	L4
4. Explain and analyze EM wave propagation and understand the power flow mechanism in an unbounded media.	L4
5. Explain and compare various radio wave propagation modes.	L2

Program Outcome of this course (POs)	PO No.
1. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	1
2. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.	4
3. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5
4. **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.	6
5. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
	4. Activity

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks

Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Power Electronics

Course Code	18EC551	Credits	3
Course type	PE	CIE Marks	50 marks
Hours/week: L – T – P	3 – 0 – 0	SEE Marks	50 marks
Total Hours:	40	SEE Duration	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To learn the basics of power electronics and power devices.
2. To understand the characteristics and turn-on methods of silicon-controlled rectifiers.
3. To study various gate triggering circuits and turn-off methods.
4. To explain the working of phase-controlled rectifiers.
5. To discuss and summarize working of inverters, dc choppers and ac regulators.

Pre-requisites:

1. Basic electronics
2. Fundamentals of analog electronics

Unit - I **8 Hours**

Introduction: Applications of power electronics, power semiconductor devices, types of power electronic circuits, power transistors: switching characteristics, power MOSFETs: switching characteristics. (Text book 1)

Experiment:

Static characteristics of MOSFET.

Unit - II **8 Hours**

Thyristor: Principles and characteristics: principle of operation of SCR, static anode-cathode characteristics of SCR, two-transistor model of SCR, gate characteristics of SCR, turn-on methods, turn-off mechanism. (Text book 2)

Experiment:

Static characteristics of SCR.

Unit - III **8 Hours**

Triggering circuits: Thyristor firing using unijunction transistor. Triggering circuits of MOSFETs and IGBTs, optical isolators.

Turn-off methods: Concept of natural commutation, forced commutation (Text book 2)

Experiment:

SCR turn-on using UJT firing circuit.

Unit - IV **8 Hours**

Single phase and three phase-controlled rectifiers: Introduction, phase angle control, 1ϕ full-wave half and full controlled rectifiers, 3ϕ uncontrolled and half controlled bridge rectifiers. (All converters with R and RL load)

Experiments:

1. 1ϕ controlled full wave rectifier.
2. 3ϕ uncontrolled rectifier.

Unit - V **8 Hours**

Inverters: Introduction, classification, basic square wave inverter.

DC choppers: Introduction, principle of chopper operation, step-up/step-down chopper, chopper configuration using block diagram representation.

AC regulators: Introduction, single phase bidirectional ac regulators with R load only. (Text book 2)

Experiments:

1. Voltage commutated chopper.
2. Speed control of universal motor using AC voltage regulator.

Books

Text Books:

1. M. H. Rashid, "Power Electronics", PHI / Pearson publisher,2nd edition.
2. M. D. Singh and Kanchandani K. B., "Power Electronics", TMH publisher,2nd edition.

Reference Books:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics", John Willey & Sons, Inc,3rd edition.
2. Dr. P. S. Bimbhra, "Power Electronics", Khanna publishers,4th edition.
3. L. Umanand, "Power Electronics" – Essentials and applications, Wiley India Pvt. Ltd, copyright 2009.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Define and classify power electronics circuits.	L2
2.	Explain principle of operation of SCR, interpret static anode-cathode characteristics of SCR, analyze and explain two-transistor model of SCR.	L3
3.	Analyze and explain different gate triggering circuits and turn-off methods.	L4
4.	Analyze and explain phase-controlled rectifiers.	L4
5.	Analyze and explain inverters, DC choppers and AC regulators.	L4

	Program Outcome of this course (POs)	**PO No.**
1.	**Fundamentals of Engineering:** Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.	**1**

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.	**2**
3.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
4.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	12

Course delivery methods	**Assessment methods**
1. **Chalk and board**	1. **Assignments**
2. **PPT Presentation**	2. **IA tests**
3. **Experimentation**	3. **Quiz/Seminar/Course Project**

CIE and SEE Pattern:

Theory courses having 3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

4. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
5. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
6. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

System Modeling

Course Code	18EC552	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours	40	**SEE Duration**	3 Hours for 100 marks

Course Learning Objectives (CLOs)

1. Understand fundamental need of mathematical modeling of physical systems and demonstrate the basic steps related to system modeling.
2. Develop system model equations for linear physical systems and find interrelationship between the combinational system models.
3. Determine the mathematical models for non-linear systems from the fields of hydraulics, economics, and finance with model linearization technique.
4. Develop models for analysis of biological, societal and crucial decision-making processes and estimate their performance.
5. Design controllers for model-based control and related applications.

Pre-requisites:

1. Elements of Electrical Engineering
2. Engineering Mathematics
3. Control Systems

Unit - I 8 Hours

Basics of System Modeling: Necessity and basic principles of system modeling, 'Wisdom Hierarchy' of system model in this age of data, REDCAPE – the seven uses of system models, dimension analysis of systems, 'One to Many' approach of model, bagging or bootstrap aggregation of model, approximation of system model, validation of system model, error analysis of system model, system model from given data, exponential growth and decay.

Unit – II 8 Hours

Modeling of Linear Physical Systems: Basic modeling concept for linear systems, translational and rotational mechanical system models, electrical model equivalent of mechanical systems,

models of basic hydraulic, pneumatic & thermal systems, combinational linear system models – electromechanical (rack and pinion arrangement), hydro-mechanical systems, multivariable linear system models.

Unit – III **8 Hours**

Non-linear, Economic and Financial System Models: Introduction to non-linear functions (concavity and convexity) and non-linear system models, linearization of non-linear system models.

(Economic Systems): Market forces of supply-demand and government policies, economic growth model of a country, feedback control system model for measurement and control of national income.

Case Study: The Model for Making Money 'Making money with algebra', buying a car now or later, financial planning for retirement.

Unit - IV **8 Hours**

Biological, Societal and Decision Models: Mathematical model of diabetes, human brain information processing dynamic model, SEIR – model for understanding the spread of infectious disease like Covid19, model for growth of cancerous cell in human body and its control by chemotherapy, computational modeling of arterial biomechanics - for treatment of vascular diseases.

Case Study: Societal models like Lotka-Volterra prey-predator model, resource management at fisheries, population dynamics within a country, Markov's decision-making model.

Unit - V **8 Hours**

Controller Design for Modeled Systems: Controller parameters, single loop and multi loop controllers, on-off controller, proportional controller, PID controller, tuning of PID controller, model-based design of controllers.

Case Study: Kalman filter-based design.

Text Books

1. Clive L. Dym, "Foundations and Applications of Mathematical Modeling," Elsevier Academic Press, 2nd edition, 2004, ISBN: 978-0-122-26551-8 (e-book).
2. Scott E. Page, "The Model Thinker – What You Need to Know to Make Data Work for You," Basic Books, Hachette Group Inc., NY, 1st edition, 2018, ISBN: 978-0-465-09463-9 (e-book).
3. W. Bolton, "Mechatronics – Electronics Control Systems in Mechanical and Electrical Engineering," Pearson Education Limited, 3rd edition, 2003, ISBN:0-131-21633-3.
4. N. Gregory Mankiw, "Principles of Economics," CENGAGE Learning, 8th edition, 2018, ISBN: 978-1-305-58512-6 (e-book).

5. Su Whan Sung, Jietae Lee, and In-Beum Lee, "Process Identification and PID Control," John Wiley and Sons (Asia) Pte Ltd., IEEE Press, 1st edition, 2009, ISBN 978-0-470-82410-8.

6. Mohinder S. Grewal, and Angus P. Andrews, "KALMAN Filtering – Theory and Practice using MATLAB®," Wiley Publication, 4th edition, 2015, ISBN 978-1-118-85121-0.

E-resources

1. Prof. S. D. Agashe - Control Systems Video Lecture Series - Electrical Engineering IIT Bombay

   Web Link - https://nptel.ac.in/courses/108101037/

2. Prof. M. Gopal - Control Systems Video Lecture Series - Electrical Engineering IIT Delhi

   Web Link - https://nptel.ac.in/courses/108102043/

3. MATLAB based Control System - Pdfs – 10 module notes - Electrical Engineering IIT Delhi

   Web Link - https://nptel.ac.in/courses/108102044/

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
CO-1	*Illustrate* the necessity and basic principles of system modeling and also validate whether the model is proper or not through model error *analysis*.	L3
CO-2	*Develop* system transfer function for basic linear physical systems & *determine* the *relationships* between combined system models from multiple domains.	L4
CO-3	*Apply* the basic concepts to model non-linear systems from the fields of economics, finance and *appraise* the model linearization technique used to facilitate system analysis using standard tools and software.	L4
CO-4	*Model* biological, and societal events of both linear and non-linear types and also *examine* Markov's model for more judicious decision making.	L5
CO-5	*Utilize* the standard controller algorithms for model-based system control and also *examine* the effectivity of Kalman Filtering for system model analysis.	L3

Sr. No.	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	1

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.	2
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.	3
4.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.	4
5.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5
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.	6
8.	**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.	10
9.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	12

	Course delivery methods		**Assessment methods**
1.	Classroom teaching (Chalk-Board)	1.	IA Tests
2.	Power Point presentations	2.	Assignments
3.	Video lecture show in classroom	3.	Quiz
4.	Live MATLAB based demo in class	4.	Course Project / Seminar

CIE and SEE pattern:

Theory courses having 3 – 0 – 0 distributions

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Speech Processing

Course Code	18EC553	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To introduce speech production and related parameters of speech.
2. To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech.
3. To understand different speech modeling procedures such as Markov and their implementation issues.

Pre-requisites: DSP and Algorithms

Unit - I **8 Hours**

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

Unit - II **8 Hours**

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures– mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

Unit - III **8 Hours**

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

Case Study: (Read Sections 2.1-2.3 and 3) M. Mohri, F. Pereira, M. Riley, Speech recognition with weighted finite-state transducers, Springer Handbook of Speech Processing, 559-584, 2008.

Unit - IV **8 Hours**

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

Case Study: M. Mohri, F. Pereira, M. Riley, The Design Principles of a Weighted Finite-State Transducer Library, Theoretical Computer Science, 231(1): 17-32, 2000.

Unit - V **8 Hours**

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.
Case Study: M. Mohri, F. Pereira, M. Riley, Weighted finite-state transducers in speech recognition, Computer Speech and Language, 2001.

Books

Text Books:

1. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson, Education, 2003.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 2002.
3. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, 1997.
4.

Reference Books:

1. Steven W. Smith, "The Scientist and Engineer"s Guide to Digital Signal Processing", California Technical Publishing, 1997.
2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education, 2004.
3. Claudio Becchetti and Lucio PrinaRicotti, "Speech Recognition", John Wiley and Sons, 1999.
4. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing, Processing and Perception of Speech and Music", Wiley- India Edition, 2006

E-resourses (NPTEL/SWAYAM.. Any Other)- mention links

1. Digital speech processing https://nptel.ac.in/courses/117105145/

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Model speech production system and describe the fundamentals of speech.	L2
2. Extract and compare different speech parameters.	L3
3. Choose an appropriate statistical speech model for a given application.	L3
4. Design a speech recognition system.	L4
5. Use different speech synthesis techniques.	L3

Program Outcome of this course (POs)	PO No.
1. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	1
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.	2

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.	3
4.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5
5.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	12

Course delivery methods	**Assessment methods**
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
	4. Activity

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Artificial Neural Networks

Course Code	18EC554	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. Understand different neural network models.
2. Study the different learning strategies applied for pattern classification task.
3. Explore the hard problems and apply multilayer neural networks solve the same.
4. Understand and interpret the energy analysis applied to feedback neural networks.
5. Explore different architectures of neural networks for complex pattern recognition tasks.

Pre-requisites: Engineering Mathematics.

Unit – I Introduction **8 Hours**

Basics of Artificial Neural Networks: Trends in computing, Pattern and Data, Pattern recognition tasks. Basic methods of pattern recognition, Basics of Artificial Neural Networks, Biological Neural Network, Models of neuron: McCulloch-Pitts(MP) Model, Perceptron, Adaline, topology, Supervised and unsupervised learning, Basic learning laws, Realization of logic functions using MP neuron.

Case Study: Identify an application and analyze its performance using any two network models.

Unit – II Functional units of ANN & Single layer perceptron **8 Hours**

Functional units of ANN & Single layer perceptron: Basic ANN Models (architectures) for Pattern recognition task**,** Pattern recognition tasks by i) Feed-forward ii) Feed-back iii) competitive learning Neural networks. Feed-forward neural network: Linear associative network, Analysis of pattern classification networks.

Self-Study: Linear separability, Perceptron convergence theorem.

Unit – III Multi-Layer perceptron **8 Hours**

Multi-Layer perceptron: Linear Inseparability**:** Hard problems, MLFFNN: Back propagation learning, draw backs of back propagation algorithm, Heuristics to improve the performance of Back propagation learning discussion on error back propagation, Convolution neural network (CNN).

Case Study: Review a research paper on CNN application and analyze the architecture.

Unit – IV Feedback Neural Networks **8 Hours**

Feedback Neural Networks: Analysis of pattern storage networks, The Hopfield Model, State transition diagram, Pattern storage: Hard problems, Stochastic Networks and simulated annealing.

Case Study: Compare the different parameters of feedback neural networks with each other

Unit – V Architectures for complex pattern recognition tasks **8 Hours**

Architectures for complex pattern recognition tasks: Bidirectional associative memory, Architecture of Radial basis function (RBF) networks, Theorems for function approximation, RBF networks function approximation, The XOR problem, RBF Networks for pattern Classification,

Case Study: Compare RBF with MLP networks.

Books

Text Books:

1. Artificial neural networks", –B. Yegnanarayana, PHI, 2010 onwards.

Reference Books:

1. Simon Haykin, "Neural Networks and Learning Machines", Pearson Education, 3rd edition, 2008 onwards.
2. Robert J. Schalkoff, "Neural Networks for Pattern Recognition", Mcgraw-Hill Inc.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Analyze performance of different neuron models with reference to identified application.	L3
2.	Apply different learning strategies for pattern recognition tasks.	L3
3.	Apply multilayer neural networks to solve hard problems	L3
4.	Compare different parameters of feedback neural networks.	L4
5.	Compare different neural network architectures applied to complex pattern recognition tasks.	L4

	Program Outcome of this course (POs)	**PO No.**
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**PO-1**
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.	**PO-2**
3.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.	**PO-4**
4	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**PO-5**

Course delivery methods	Assessment methods
1. Classroom teaching using Black board	1. Internal assessment tests
2. Classroom teaching using PPTs	2. Assignments Course activities like mini projects, seminars, surveys, case studies
	3. Quizzes

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Cryptography and Network Security

Course Code	18EC555	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. Study the network security model, security attacks, mechanisms and services and to demonstrate use of various symmetric key ciphers and their principles.
2. Understand the concept of Modular Arithmetic and its application in public key cryptography and apply the knowledge to solve security related problems.
3. Understand the design principles of Public key cryptosystems for encryption, key exchange and authentication.
4. Comprehend the concept of secured electronic transaction with web security considerations.
5. Study the security threats to networks and their counter measures.

Unit - I 8 Hours

Security services, mechanisms and attacks, OSI security model, symmetric key cryptography, substitution techniques: playfair and transposition techniques, SDES: encryption, decryption and key generation, DES: design principles, AES: encryption and decryption model, steganography.

Case Study:

1. Perform encryption and decryption on a file using the principle of substitution and transposition cipher.
2. Survey research papers which use multiple techniques to perform image watermarking and report the findings.

Unit - II 8 Hours

Galois fields, extended Euclid's theorem, discrete log problem, Chinese remainder theorem, elliptic curve arithmetic, principles of public key cryptosystems.

Case Study:

1. Survey of extended Euclid's algorithm in cryptographic applications.
2. Develop a code to implement ECC algorithm.

Unit - III 8 Hours

Principles of public-key cryptosystems: public-key cryptosystems, applications for public-key cryptosystems, requirements for public-key cryptography, public-key cryptanalysis, the RSA: description of the algorithm, computational aspects, the security of RSA algorithm, Diffie Hellman key exchange, cryptographic hash functions: applications of cryptographic hash

functions, two simple hash functions, requirements and security, hash functions based on cipher block chaining, secure hash algorithm (SHA).

Case Study:

1. Identify the applications of RSA in public key cryptosystems.
2. Develop a code for implementing simple hash function.

Unit - IV **8 Hours**

Web security considerations: web security threats, web traffic security approaches, secure sockets layer and transport layer security: SSL architecture, SSL record protocol, change cipher spec protocol, alert protocol, handshake protocol, cryptographic computations, transport layer security, secure electronic transaction: SET overview, Dual signature, payment processing.

Case Study:

1. Demonstration of secure socket layers applications.
2. Survey and report the recent challenges in secure electronic transactions.

Unit – V **8 Hours**

Viruses and related threats: Malicious programs, the nature of viruses, types of viruses, macro viruses, e-mail viruses, worms, firewalls: Firewall characteristics, types of firewalls, firewall configurations, Trusted systems: Data access control, the concept of trusted systems, trojan horse defense.

Case Study:

1. Document the history of any two recent viruses and their impact.
2. Identify the limitations of any two antivirus programs.

Books

Text Books:

1. William Stallings, "Cryptography and Network security: principles and practice", 2nd Edition, Prentice Hall of India, New Delhi,2002 and onwards.
2. Behrouz A. Fourouzan, "Cryptography and Network security" Tata McGraw-Hill, 2008 and onwards.

Reference Books:

1. Atul Kahate," Cryptography and Network security", 2nd Edition, Tata McGraw-Hill, 2008 and onwards.
2. H. Yang et al., Security in Mobile Ad Hoc Networks: Challenges and Solution, IEEE Wireless Communications, 2004 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Identify and describe different techniques in modern cryptography	L2
2.	Employ the modular arithmetic fundamentals to cryptography	L4
3.	Describe, recognize and use the principles of Public key cryptosystems for various applications.	L4

4.	Recognize the use of cryptography in Data Networks	L4
5.	Analyze the security issues related to internet and networks	L5

	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
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.	**2**
3.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
4.	**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	**10**
5.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	**12**

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IAtest
2. Presentation	2. Assignment
3. Videos	3. Quiz
4.	4. Mini Project

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Consumer Electronics

Course Code	18EC561	**Credits**	3
Course type	OE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To describe operating principle and applications of different types of microphones and Speakers.
2. To learn various components of Colour TV & differentiate between hue, brightness, saturation, luminance and chrominance.
3. To acquaint with various devices related to telecommunication system.
4. To describe working of Automatic washing machine, Digital Camera system, Microwave ovens with block diagram.
5. To understand the working principles of various consumer electronic gadgets.

Pre-requisites: Elements of Electrical and Electronics Engineering.

Unit - I 08Hours

Audio System: Microphones, Loudspeaker, Public address (PA) system, Magnetic sound recording, Tape recorder, Audio compact disc (CD) system: comparison of CD and tape, High fidelity Audio system, Stereo sound system.

Case Study: Implementation of PA system in Conference Room

Unit – II 08Hours

Television: Introduction, Radio and TV Transmission & Reception, Persistence of vision, Scanning, Synchronization, CCIR-B System, Block diagram of TV transmitter& TV receiver, TV camera tube, Composite video signal, Bandwidth of TV signal, TV channel, Television Receiver antenna, Monochrome picture tube, Black & White TV Receiver, Colour TV signal, Colour TV Receiver, PAL signal, CCTV, Cable TV, HDTV.

Case Study: Set-Top Box with Video-on-Demand

Unit – III **08Hours**

Telecommunication Systems: Basics of Telecommunication system, line and radio communication, Caller ID Telephone, Intercoms, Cordless Telephones, Cellular mobile systems,
4G Network models.

Case Study: Implementation of Intercoms in a residential society.

Unit – IV **08Hours**

Home Electronics: Digital Camera system, Microwave ovens, Washing Machines, Air Conditioners and Refrigerators.

Case Study: Home Automation

Unit – V **08Hours**

Miscellaneous Devices: Digital Clock, Calculators, Facsimile (FAX), Automated Teller Machines (ATM's), Battery charger, IC regulator, UPS, Inverter, Decorative Lighting.

Case Study: In- Car Computers.

Books

Text Books:

1. S.P. Bali, "Consumer Electronics", Pearson Education, 2005 and onwards
2. B.R. Gupta and V. Singhal, "Consumer Electronics", S.K. Kataria& Sons, 2013 and onwards.
3. R. R. Gulati, "Monochrome and Color Television", New Age International Publisher, 2009 and onwards.

Reference Books:

1. A. Dhake, "Color Television", McGraw Hill Education, 2004, 2nd Edition and onwards.

E-resources:

1. IEEE Consumer Electronics Magazine- IEEE Xplore
2. https://ieeexplore.ieee.org/document/6851994/

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	List technical specification of electronics Audio system (microphone and speaker).	L2
2.	Identify and explain working of various colour TV transmission blocks.	L2
3.	Explain the telecommunication system, telephone devices	L2
4.	Understand consumer electronic products like washing machine and AC.	L2
5.	Understand the basic functions of various other consumer electronic goods.	L2

	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
2.	**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.	**3**
3.	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	**6**
4.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change	**12**

	Course delivery methods		Assessment methods
1.	Power-point presentations	1.	Internal Test
2.	Hands-on sessions	2.	Quiz
3.	Videos of a few applications	3.	Assignments
		4.	Activity

CIE and SEE Pattern:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Fuzzy Logic and Applications

Course Code	18EC562	**Credits**	3
Course type	OE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:40	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To understand the basic principles of crisp and fuzzy sets.
2. To discuss Fuzzification & Defuzzification modules, understand adaptive fuzzy controllers and their classification.
3. To analyze fuzzy control systems.
4. To design fuzzy logic control for various applications.
5. To introduce concept of neural networks and discuss applications.

Pre-requisites: Concepts of Set Theory

Unit – I **08 Hours**

INTRODUCTION TO FUZZY LOGIC: Basic concepts of fuzzy logic, Fuzzy sets and Classical Sets (Crisp sets), Fuzzy and Crisp relations¸ fuzzy if-then statements, Inference rules in fuzzy logic

Case study: Study of Sugeno Fuzzy Models.

Unit – II **08 Hours**

MEMBERSHIP FUNCTIONS AND ADAPTIVE FUZZY CONTROLLER: Fuzzifications & Defuzzification modules, Adaptive fuzzy Controller, features of membership functions, membership value assignments-intuition and inference methods to assign membership values to fuzzy variables.

Case Study: Apply angular fuzzy set for the motion control of motor.

Unit – III **08 Hours**

FUZZY CONTROL SYSTEMS: Review of Control System theory, Simple fuzzy logic controllers, general fuzzy logic controllers, special forms of fuzzy logic control system models, examples of fuzzy logic control system design.

Case Study: Study of classical fuzzy control problem-Inverted pendulum.

Unit – IV **08 Hours**

APPLICATIONS OF FUZZY LOGIC CONTROLLER (FLC): Aircraft Landing Control problem, fuzzy logic control of Blood pressure during anesthesia, fuzzy logic applications to Image processing equipment, Customer adaptive fuzzy control of Home Heating system.

Case Study: Survey of fuzzy logic control in washing machines.

Unit – V **08 Hours**

FUZZY LOGIC AND HYBRID SYSTEM APPLICATIONS: Membership functions in the example of bridge rating (Bridge condition rating), fuzzy sets of fuzzy relations involved in medical diagnosis, introduction to neuro-fuzzy controller, comparison of fuzzy and neural systems.

Case Study: Design of Neuro-fuzzy traffic signal control.

Books

Text Books:

1. George J Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall NJ,1995.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Willey, 2010.
3. Driankov, Hellendroonb, "Introduction to fuzzy control", Narosa Publishers,2001.

Reference Books:

1. Bart Kosko, ―Neural network and Fuzzy Systems -Prentice Hall-1994.
2. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, New Delhi,1991.
3. Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", Prentice Hall, NewDelhi, 2004.

E-resourses:

1. Course name: Fuzzy Sets, Logic and Systems & Applications (https://swayam.gov.in/nd1_noc20_ee03/preview)
2. Course name: Fuzzy Sets, Logic and Systems & Applications (https://nptel.ac.in/courses/108/104/108104157/)

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Understand fuzzy set theory and apply the concept of fuzziness involved in various systems.	L2
2.	Understand adaptive fuzzy controllers and the concepts of membership functions, fuzzification and defuzzification.	L2
3.	Design and analyze a typical fuzzy logic controller for various applications.	L5
4.	Apply fuzzy control by examining simple control problem examples.	L3
5.	Apply knowledge of fuzzy logic control to real time systems.	L3

	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	PO1
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.	PO2
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.	PO3
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.	PO4
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.	PO5
6	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.	PO12

Course delivery methods	Assessment methods
1. Chalk Board	1. Internal Assessment Tests
2. Power Point Presentations	2. Quiz
	3. Assignments
	4. Course activity

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Heterogeneous Computing

Course Code	18EC563	**Credits**	3
Course type	OE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To understand the features of heterogeneous computers in general and of the solutions provided by OpenCL in particular.
2. To study the introductory concepts of parallel computing in heterogeneous computing environment.
3. To leverage the OpenCL framework to build interesting and useful applications and explore the benefits of heterogeneous computing.

Pre-requisites: C programming

Unit - I **8 Hours**

Introduction to parallel programming: introduction, thinking parallel, concurrency and parallel programming models, threads and shared memory, message-passing communication, different grains of parallelism, data sharing and synchronization.
Introduction to OpenCL: the OpenCL standard, platform and devices, the execution environment, memory model, writing kernels
case study: study of source code example for vector addition

Unit - II **8 Hours**

OpenCL Device Architectures: Introduction, Hardware Trade-offs: Performance increase by frequency and its limitations, Superscalar Execution, VLIW, SIMD and Vector Processing, Hardware Multithreading, Integration: Systems-On-Chip and the APU, Cache Hierarchies and Memory Systems, The Architectural Design Space: CPU Designs, GPU Architectures, APU and APU-Like Designs.
Case study: Study of Multi-Core Architectures

Unit - III **8 Hours**

Basic OpenCL Examples: Introduction, Simple Matrix Multiplication Example, Image Convolution, Compiling OpenCL Host Applications.
Case study : Study of image rotation with OpenCL

Unit - IV **8 Hours**

OpenCL's Concurrency and Execution Model: Kernels, Work-Items, Workgroups and the Execution Domain, OpenCL Synchronization: Kernels, Fences and Barriers, Queuing and Global Synchronization, The Host-Side Memory Model, The Device-Side Memory Model.
Case study: Memory Performance Considerations in OpenCL

Unit - V **8 Hours**

OpenCL Case Study: Video Processing: Introduction, Getting Video Frames: Decoding on the CPU, Decoding Video on the GPU, processing a video in OpenCL, Processing Multiple Videos with multiple special effects: Event Chaining, Display to screen of final output: OpenCL/OpenGL Interoperability.
Self learning topics: Debugging OpenCL Applications, Overview of Gdebugger.

Books

Text Books:

1. Benedict R Gaster, Lee Howes, David R KaeliPerhaad Mistry Dana Schaa, "Heterogeneous Computing with OpenCL", MGH, 2011 and onwards.
2. Jason Sanders, Edward Kandrot, "CUDA By Example – An Introduction to General-Purpose GPU Programming", Addison Wesley, 2011 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Understand the meaning and the importance of heterogeneous systems	L2
2.	Develop codes to support general-purpose heterogeneous systems	L3
3.	Identify the power utilization and flexibility features of OpenCL programming standard	L3

	Program Outcome of this course (POs)	PO No.
1.	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	**PO 1**
2.	**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.	**PO 5**
3.	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	**PO 12**

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
	4. Activity

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0 / 3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Requirements Engineering

Course Code	18EC564	**Credits**	3
Course type	OE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To understand the importance of requirements engineering.
2. To describe the roles and responsibilities of key stakeholders in the requirements engineering processes.
3. To understand and apply the requirements elicitation techniques and their relevance to business situations.
4. To describe the use of tools to support requirements engineering.
5. To identify problems with requirements and explain how requirements documentation may be improved.

Unit – I 8Hours

Introduction to requirements engineering:
Framework for requirements engineering, Requirements engineering activities – elicitation, analysis, validation, documentation, management, rationale for requirements engineering and the problems with requirements, the importance of requirements planning and estimating, The business rationale and inputs, The business case, Terms of reference / project initiation document (PID). –Text-1

What are requirements?
What are requirements? Requirement gathering and systems modelling. Why do I need requirements? What is a requirement? - Text-2

Case Study: Study of "The Ice Breaker" project

Unit – II 8 Hours

Hierarchy of requirements: Building the hierarchy, Categories of requirements within the hierarchy
Stakeholders in the requirements process: Project Stakeholders, Business stakeholders, External stakeholders. -Text-1

Evolution of requirements: The template, The requirements process -Text 2

Case Study: Generate the requirements for mobile banking service system.

Unit – III 8 Hours

Requirements elicitation: Knowledge types – tacit and non-tacit, Elicitation techniques, Understanding the applicability of techniques. -Text-1

Use of models in requirements engineering: The purpose of modelling requirements, Modelling the business context for the system, developing a model to represent the system processing requirements, Interpreting a data model. -Text-1
Case Study: Application of agile techniques to requirements engineering

Unit – IV **8 Hours**

Requirements documentation: Documentation styles and levels of definition, Requirements catalogue. -Text-1
Requirements analysis: Prioritizing and packaging requirements for delivery, Organizing requirements, Ensuring well-formed requirements, Prototyping requirements, Verifying requirement. -Text-1
Mini Project: Identify a project idea and apply requirement engineering for project management.

Unit – V **8 Hours**

Requirements validation: Agreeing the requirements document, Types of reviews, Stakeholders and their areas of concern.
Requirements management: Dealing with changing requirements, The importance of traceability, Traceability and ownership, Requirements Engineering support tools.
Mini Project: Compare the different requirements engineering processes applied to the identified project idea

Books

Text Books:

1. Debra Paul, Donald Yeates and James Cadle, Business Analysis, 2nd Edition, BCS Publisher, 2010 and onwards.
2. Suzanne Robertson and James Robertson, "Mastering the Requirements Process", Addison Wesley, 1999 and onwards.

Reference Books:

1. Gerald Kotonya and Ian Sommerville, "Requirements Engineering: Processes and Techniques", John Wiley & Sons.
2. James Cadle, Debbie Paul and Paul Turner, "Business Analysis Techniques: 72 Essential Tools for Success", BCS.
3. Alistair Cockburn, "Writing Effective Use Cases", Addison-Wesley, 2000 and onwards.

E-resourses(NPTEL/SWAYAM.. Any Other)- mention links

1. Analyzing requirements engineering processes: a case study
   DOI: 10.1109/DEXA.2000.875146
2. Agile project management - a case study on agile practices
   DOI: 10.13140/RG.2.2.14048.33283

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Understand of concepts of the requirements engineering	L2
2. Describe the process and stakeholders involved in requirements validation	L2

3.	Develop a model and explain the use of a range of requirements elicitation techniques and the relevance of the techniques to business situations	L4
4.	Analys**e** the requirements and describe the documentation methods required.	L4
5.	Evaluate the performance of requirements management process and apply them to manage a business requirement.	L4

	Program Outcome of this course (POs)	**PO No.**
1.	**Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.	**2**
2.	**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.	**3**
3.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.	**4**
4.	**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.	**11**
5.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	**12**

Course delivery methods	**Assessment methods**
1. Chalk / Blackboard	1. Assignments
2. Presentations	2. Internal Assessment Tests
3. Videos	3. Quiz
4. Demonstration	4. Seminar

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory.				

Minimum marks required to qualify for SEE: 20 out of 50 marks

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Bio Medical Image Understanding and Analysis

Course Code	**18INT51**	**Course type**	**Institute Elective**	**Credits** **L-T-P**	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	50 marks
Flipped Classes content	10 Hours			**SEE Marks**	50 marks

Course learning objectives

1. Identify applications of different Radiological modalities for solving real time problems
2. Appreciate the use and applications of transforms in extraction of features from objects
3. Examine the history of Artificial Neural Network (ANN) and its limitations in Biomedical Imageries applications.
4. Appreciate the evolution of Deep Neural Network from ANN
5. Design and deploy simple Convolution Neural Network (CNN) model for Biomedical Image classification and identification for specific Radiological Modalities.

Pre-requisites: Linear Algebra, Statistics and Probability

Unit – I **Contact Hours = 8 Hours**

Introduction to Biomedical Image Processing **Flipped Classes Content = 2 Hours**

Digital Image Processing System, Medical Image modalities, Image Algebra, Image transform (FT, DCT, DWT, HOUGH, KL) Image Enhancement in spatial and frequency domain, Image Restoration, Medical applications of Imaging, Frontiers of Image processing in Medicine.

Practical Session: Introduction to Mathwork Matlab and Image Processing Toolbox

Topics for Flipped Classes: Case study review on Image Morphology, Image Fusion, Image Super Resolution

Unit – II	**Contact Hours = 8 Hours**
Artificial Neural Networks and Evolutions of Deep Learning	**Flipped Classes Content = 2 Hours**

Overview of Biological Neural Networks (BNN), McCulloch-Pitts Neuron Model of Biological Neuron, Artificial Neuron Basic Element and its structure, Different activation function, Training, Testing and Validation, Forward and Back propagation with example, Single layer Feed forward network, Multi-layer Feed forward network, classification of learning algorithms, Limitations of Artificial Neural Networks (ANN), Evolutions of Deep Learning.
Practical Session: Introduction to Mathworks Matlab Deep Learning Toolbox
Topics for Flipped Classes: Case study review on Artificial Neural Networks and Biomedical Image applications

Unit – III	**Contact Hours = 8 Hours**
Convolution Neural Networks and Applications	**Flipped Classes Content = 2 Hours**

Introduction to Convolutional Neural Networks (CNNs / ConvNets), architecture overview and terminologies of CNN, motivation behind CNN, study and comparisons of pretrained CNN (limited to only ResNet -34 and ResNet -50)

Topics for Flipped Classes: Case study review on to Convolutional Neural Networks (CNNs / ConvNets) and Biomedical Image applications

Unit – IV	**Contact Hours = 8 Hours**
Deep Learning Medical Image Segmentation	**Flipped Classes Content = 2 Hours**

Introduction to Digital Image Segmentation, operators - filters for edge and line detection, simple segmentation algorithms, significance of Image Segmentation in Medical Image, classification of digital image segmentation algorithms, automatic image segmentation, Architecture of U-Net segmentation.

Topics for Flipped Classes: Case study review on Biomedical Image Segmentation

Unit – V **Contact Hours = 8 Hours**

Deep Learning Medical Image Classification, Analysis and Visualization **Flipped Classes Content = 2 Hours**

Features, Features reduction using Principal Component Analysis (PCA), feature reduction using Image Transforms (DWT), Pre trained CNN Model for feature extraction (only ResNet - 50), Example and demonstration of CNN pretrained model for image classification and Identification – Covid-19 Diseases detection using Computed tomography (CT) imageries.
Topics for Flipped Classes: Case study review on Pre trained CNN Model

Unit No.	**Self-Study Component**
1.	Linear algebra and probability
2.	Learning algorithms and intelligence in algorithm
3.	LeNet -5 CNN Architecture for number classification
4.	Sematic Segmentation and V-net
5.	Clustering algorithm for image classification in Biomedical Imagery applications

Books

Text Books:

1. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989
2. Kevin Zhou, Medical Image Recognition, Segmentation and Parsing: Machine Learning and Multiple Object Approaches, 1st Edition, Elsevier Science, 2015
3. Kevin Zhou, Hayit Greenspan and Dinggang Shen, Deep Learning for Medical Image Analysis Elsevier Science, 2017

Reference Books (Journals) :

1. **IEEE Transactions on Medical Imaging**
2. **Medical Image Analysis*, Elsevier, Journal***

E-resourses (NPTEL/SWAYAM.. Any Other)- mention links

1. Debdoot Sheet, Indian Institute of Technology Kharagpur, MEDICAL IMAGE ANALYSIS, NPTEL course

Link: https://nptel.ac.in/courses/108/105/108105091/**GE ANALYSIS**

Course delivery methods	Assessment methods
1. Chalk and Talk	1. IA tests
2. PPT and Videos	2. Online Quizzes (Surprise and Scheduled)
3. Flipped Classes	3. Open Book Tests (OBT)
4. Online classes	4. Course Seminar
	5. Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Design appropriate feature extraction using artificial neural network.	L2	1	1
2.	Analyze the state of art techniques applied in deep learning research	L 3	2	1,2
3.	Develop deep learning models for simple classification and identification problems.	L 4	3	1,2
4.	Analyze different deep learning models for different applications of Diseases detection and identification using Computed tomography (CT) and Magnetic resonance imaging (MRI)	L 4	5	1,2,3
5.	Apply knowledge of deep learning algorithms to solve real life problems related to health care and radiology.	L 5	7	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBTs	Course Seminar	Total	Final Marks

Theory	20+20 = 40	20	10+10 =20	20	100 **(Reduced to 50)**	50
Minimum score to be eligible for SEE: 20 out of 50						

Self-Study topics could be evaluated during Quiz/ Assignments

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: 40 %**
3.	Question paper contains two questions from each unit each carrying 20 marks. Students have to answer one full question from each unit.

Rubrics:

Levels	**Target**
1 (Low)	**50 % of the total marks is scored by 60% of the students.**
2 (Medium)	**61%-80% of the total marks is scored by 60% of the students.**
3 (High)	**81% and above of the total marks is scored by 60% of the students.**

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	**3**				**2**							**2**	**2**	**3**	**1**
2	**3**				**2**							**1**	**2**	**2**	**2**
3	**3**				**2**							**1**	**1**	**1**	**3**
4	**3**				**2**							**2**	**1**	**2**	**3**
5	**3**				**2**							**2**	**2**	**2**	**3**

VLSI Lab

Course Code	**18ECL57**	**Credits**	1
Course type	L1	**CIE Marks**	25 marks
Hours/week: L – T – P	0 – 0 – 3	**SEE Marks**	25 marks
Total Hours:	36	**SEE Duration**	3 Hours for 50 marks

Course learning objectives

1. To draw the schematic, generate the symbol and verify the CMOS circuit on the tools.
2. To Study the functionality of the circuit for various operating conditions.
3. To draw the layout of the schematic
4. To verify & optimize for time, power and area

List of experiments

1. To verify DRC, LVS and QRC for Inverter
2. To verify DRC, LVS and QRC for 2 input NAND gate
3. To verify DRC, LVS and QRC for 2 input NOR gate
4. To verify DRC, LVS and QRC for Clocked SR latch using AOI Logic
5. To verify DRC, LVS and QRC for Clocked JK Latch using AOI Logic
6. To verify DRC, LVS and QRC for 3 transistor DRAM Cell
7. To verify DRC, LVS and QRC for 6 transistor SRAM Cell
8. To verify DRC, LVS and QRC for Common Source Amplifier
9. To verify DRC, LVS and QRC for Common Drain Amplifier
10. To verify DRC, LVS and QRC for Differential Amplifier

Books

1. Neil Weste, and David Harris, "*CMOS VLSI Design, A Circuits and Systems Perspective*", 4th Edition; Pearson Education, India.
2. Douglas Pucknell, and Kamran Eshragian, "*Basic VLSI Design*", PHI Publications India Pvt. Ltd.
3. Sung-Mo Kang and Yusuf Leblebci, "*CMOS Digital Integrated Circuits, Analysis and Design*", McGraw Hill Publications.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Develop the schematic and verify the DC analysis and transient analysis	L3
2.	Develop the layout and analyze the DRC, ERC, and LVS to extract RC and back annotate.	L4
3.	Analyze & optimize for time, power and area.	L4

	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
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.	**2**
3.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
4.	**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.	**10**
5.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	**12**

Assessment methods

1. Activity
2. Internal Exams

Lab courses:

Scheme of Continuous Internal Evaluation (CIE):

Components	Attendance/conduct of lab	Journal	Lab project	Total Marks
Maximum marks :25	10	10	5	25
Submission and certification of journal is compulsory to qualify for SEE Minimum marks required to qualify for SEE: 10 out of 25 marks				

Semester End Examination (SEE):

1.	It will be conducted for 50 marks having 3 hours/2 hours duration. It will be reduced to 25 marks for the calculation of SGPA and CGPA.		
2.	Only one experiment to be conducted. In case, there are two parts then one experiment from each part.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiment(s), result and conclusion	20 marks	

	One marks question	10 marks	
	Viva-voce	10 marks	
4.	Viva voce is conducted for individual student and not in group		
5.	Minimum passing marks to be scored in SEE: 20 out of 50 marks		

Information Theory and Digital Communication Lab

Course Code	18ECL58	**Credits**	1
Course type	L2	**CIE Marks**	25 marks
Hours/week: L – T – P	0 – 0 – 3	**SEE Marks**	25 marks
Total Hours:	30Hours	**SEE Duration**	3 Hours/2 Hours for 50 marks

Course learning objectives

1. To study the sampling techniques and its applications.
2. To understand various waveforms, source coding and companding techniques.
3. To study various line codes and its characteristics.
4. To study digital modulation techniques.
5. To understand the performance spread spectrum.

Pre-requisites: Communication lab

List of Experiments

PART A (Software)

1. Pulse Code Modulation and Companding.
2. Source Encoding.
3. Power Spectral Density of line codes.
4. Generation of Digital Modulated waves.
5. Linear block codes and Syndrome calculation.

PART B (Hardware)

6. Pulse Amplitude Modulation.
7. Sample and Hold circuit.
8. Amplitude Shift Keying.
9. Phase and Frequency Shift Keying.
10. PN sequence generation.

Books

Text Books

1. Simon Haykin, "Digital Communications", John Wiley, 2005 and onwards.
2. Shu Lin, Daniel J. Costello, "Error Control Coding", PHI, 2nd Edition, and onwards
3. George Kennedy, Bernard Davis, SRM Prasanna "Electronics Communication Systems",5th edition , McGraw Hill Education (India) Pvt. Ltd.

Reference Books

1. B. Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition, Pearson Education, 2009 and onwards.
2. B.P.Lathi, "Modern Digital and Analog Communication Systems" 3rd Edition, Oxford University Press 2007 and onwards.

3. Dr.K. N Hari Bhat, "Digital Communications" 2nd Edition, Sanguine Technical Publishers 2005 and onwards.

E-resourses:

1. Digital Signal Processing Virtual Laboratory http://vlabs.iitkgp.ernet.in/dsp/index.html

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Analyze the sampling techniques	L4
2. Analyze various waveform and source coding techniques	L3
3. Apply suitable line codes for given application and analyze its characteristics	L4
4. Distinguish between various digital modulation techniques	L3
5. Analyze performances of spread spectrum modulation techniques	L3

	Program Outcome of this course (POs)	PO No.
1.	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	**1**
2.	**Problem analysis**: Identify, formulate**,** review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	**2**
3.	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	**3**
4	**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	**5**
5	**Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	**12**

Assessment methods

1. Open ended questions
2. Viva voce

Lab courses:

Scheme of Continuous Internal Evaluation (CIE):

Components	Attendance/conduct of lab	Journal	Lab project	Total Marks
Maximum marks :25	10	10	5	25

Submission and certification of journal is compulsory to qualify for SEE Minimum marks required to qualify for SEE: 10 out of 25 marks

Semester End Examination (SEE):

1.	It will be conducted for 50 marks having 3 hours/2 hours duration. It will be reduced to 25 marks for the calculation of SGPA and CGPA.		
2.	Only one experiment to be conducted. In case, there are two parts then one experiment from each part.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiment(s), result and conclusion	20 marks	
	One marks question	10 marks	
	Viva-voce	10 marks	
4.	Viva voce is conducted for individual student and not in group		
5.	Minimum passing marks to be scored in SEE: 20 out of 50 marks		

EMPLOYABILITY SKILLS - I

Course Code	18EC59A	**Credits**	MNC
Course Type	MNC	**CIE Marks**	50 Marks
Hours/Week: L-T-P	3 – 0 – 0	**SEE Marks**	-
Total Hours	30 Hours	**SEE Duration**	

Course Learning Objective: The course is designed to develop the employability skills of a student.

SYLLABUS

Module 1 **6 Hours**

***Quantitative Aptitude*:** Number System (3 Hours)

***Soft Skills*:** Body Language (1.5), Grooming and Etiquette (1.5)

Module 2 **6 Hours**

***Quantitative Aptitude*:** Ratio, Proportion & Partnership (1.5), Average (1.5)

***Logical Reasoning*:** Number Series (1)

Verbal Ability: Comprehension (2)

Module 3 **6 Hours**

***Quantitative Aptitude*:** Percentages (2)

***Logical Reasoning*:** Blood Relations (1), Letter Series (1)

Verbal Ability: Sentence Correction (2)

Module 4 **6 Hours**

***Quantitative Aptitude*:** Profit and Loss (2)

***Logical Reasoning*:** Seating Arrangement (1), Data Arrangement (1)

Verbal Ability: Ordering of Sentences (2)

Module 5 **6 Hours**

Quantitative Aptitude: Time & Work (2)

***Logical Reasoning*:** Analogy (1), Direction Sense Test (1.5)

***Soft Skills*:** Group Discussions (1.5)

TEXT BOOKS:

1. How to prepare for Quantitative Aptitude for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 4th Edition, 2018.

2. How to prepare for Logical Reasoning for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 8th Edition, 2018.

3. How to prepare for Verbal Ability and Reading Comprehension for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 8th Edition, 2018.

4. How to prepare for Data Interpretation for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education (India) Private Limited, 5th Edition, 2018.

Course Outcomes (Cos):

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

1. Clear the Aptitude round of recruiters during placements

2. Perform confidently during the GD and Interview process

3. Develop behaviors that are appropriate for a professional

Course Delivery Methods	**Assessment Methods**
-Black Board Teaching	- Internal Assessment Test
-Power Point Presentation	- Assignments
-Class Room Exercise	- Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two IA tests out of	Average of two	Class	Total
Maximum	25	15	10	50

- Writing two IA tests is compulsory
- **Minimum marks required to clear the subject: Minimum IA test marks (Average) 10 out of 25 AND total CIE marks 20**

Communicative English

Course Code	**18EC59B (for Diploma)**	**Credits**	1 (MNC for Diploma)
Course type	HS	**CIE Marks**	25 marks
Hours/week: L-T-P	1 – 0 – 1	**SEE Marks**	NA
Total Hours:	30	**SEE Duration**	NA

Course learning objectives:

1. To assist the students in developing necessary language skills in the areas like vocabulary, grammar, presentation and interactive communication.
2. To enable them to express their ideas coherently.
3. To help to comprehend and write effectively.
4. To aid them in understanding the importance of verbal and non-verbal communication.

Pre-requisites:

- Basic knowledge of English Language.
- Conversant with Basic English Grammar.
- Ability to frame sentence in English.

Unit – I: Grammar and Vocabulary 5 Hours

1. Frame grammatically acceptable sentences using Articles, Prepositions, Tenses, Modals and Subject-Verb agreement.
2. Enhance day to day general vocabulary and business vocabulary using every day words, appropriate collective nouns, idioms, phrases and phrasal verbs.

Self-learning topics: Improve vocabulary by reading.

Unit – II: Reading Skills 5 Hours

1. Comprehend and interpret the texts such as notices, advertisements, memos, emails, charts etc. using reading techniques like skimming and scanning.
2. Using the knowledge of Phonetics to identify the right pronunciation from a dictionary.
3. Reading to enrich work place / business vocabulary.

Self-learning topics: Solve reading assignments from Cambridge Business BENCHMARK Pre-intermediate to Intermediate.

Unit – III: Listening Skills

7 Hours

1. Interpret recorded audio-video scripts in order to pick specific information in a short extract.
2. Listening exercises to understand factual information like dates, prices, telephone numbers etc.
3. Listening for gist (general meaning) to understand the speaker's opinions and pick out the specific information.

Self-learning topics: Solve listening exercises from www.cambridge.org and www.businessenglishsite.com.

Unit – IV: Speaking Skills **8 Hours**

1. Interact effectively as an individual and also as a member in a team using correct grammar using wide range of vocabulary and avoiding common errors in English.
2. Design and formulate presentations using Microsoft PowerPoint and Non-Verbal communication cues (Kinesics, Proxemics, Chronemics and Paralinguistic).
3. Speak in a logical way and speak for the right amount of time with proper pronunciation on general topics and business topics.

Self-learning topics: Self-evaluation by recording their speech.

Unit – V: Writing Skills **5 Hours**

1. Write Business Letters, Emails, Memos and Notes using British English Standards/Etiquettes.
2. Writing skills using appropriate registers (formal and informal), correct grammar, correct spelling, vocabulary, linking words and phrases.

Self-learning topics: Practice e-mail, memos, and report writing.

Books

1. Prof. M.B. Kudari, "Passage to English", Self-Publication, Gokak, 2011.
2. T. M. Farhathulla, "Communication Skills for Undergraduates" - RBA-Chennai, 2006.
3. K.R. Lakshminarayanan, "English for Technical Communication", Scitech-Chennai, 2002.
4. Prof. G.S. Mudambadithya, "Functional English", Sapna- Bangalore,
5. Norman Whitby, "Cambridge English Business Benchmark", Cambridge University Press, 3rd Printing 2014.

Course Outcome (COs)

	At the end of the course, the student will be able to	Bloom's Level
1.	***Define*** various grammatical concepts such as Articles, Prepositions, Subject-Verb Agreement, and Tenses.	L1
2.	***Explain*** their ideas in their own words in English.	L2
3.	***Interpret*** the given information or data in the form of reading or listening materials.	L3
4.	***Distinguish*** among the various grammatical concepts like sentence patterns, sub-verb agreement, tenses etc.	L4
5.	***Evaluate*** the grammatically acceptable sentences, and ***Defend*** their view-points.	L5
6.	***Design*** and ***Formulate*** oral and written presentations.	L6

	Program Outcome of this course (POs)	**PO No.**
1.	The course will help students to enhance their communicative skills and Business English.	PO8
2.	The course also helps the students to enhance their ability to work in a group.	PO7, PO9
3.	The course will encourage students to interact confidently and effectively.	PO11
4.	The course will promote self-learning.	PO10

Course delivery methods

1. Lecture
2. Learn-soft Software
3. PPT
4. Vocabulary activities/games/videos

Assessment methods

1. Individual speech
2. PPT (Group activity)
3. Writing assignment
4. Online Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	**Individual activity - Speech**	**Group Activity – Power Point Presentation**	**Writing Skills – email/memo/letters**	**Class Performance (Attendance)**	**Online Test**	**Total**
Maximum Marks (25)	5	15	10	5	15	50

Continuous Internal Evaluation (CIE) is of 50 marks. It will be reduced to 25 marks for the calculation of SGPA and CGPA.

Image Processing and Computer Vision

Course Code	18EC61	**Credits**	4
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 2 – 0	**SEE Marks**	50 marks
Total Hours:	50	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To learn the basic concepts of digital image processing and various image transforms.
2. To familiarize the student with the image enhancement techniques.
3. To introduce the student to a broad range of image processing techniques and their applications.
4. To appreciate the use of current technologies those are specific to image processing systems.
5. To expose the students to computer vision applications.

Pre-requisites: Digital Signal Processing and Algorithms

Unit – I **10 Hours**

FUNDAMENTALS OF IMAGE PROCESSING: Introduction, applications of image processing, steps in image processing applications, digital imaging system, sampling and quantization, pixel connectivity, distance measures.

Case Study: Study of image processing toolbox and basic image processing operations.

Unit – II **10 Hours**

IMAGE ENHANCEMENT: Spatial Domain: Some Basic Intensity Transformation Functions,

Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.

Case Study: Study of image processing toolbox to perform different Fourier transforms operations.

Unit – III **10 Hours**

IMAGE RESTORATION: Noise models, Restoration in the presence of noise only using spatial filtering and frequency domain filtering, linear, position invariant degradations, estimating the degradation function, inverse filtering, minimum mean square error (Wiener) filtering, constrained Least squares filtering.

Case Study: Study of different image restoration operations using image processing toolbox.

Unit - IV **10 Hours**

IMAGE SEGMENTATION AND FEATURE EXTRACTION: Image segmentation - Detection of discontinuities, edge operators, edge linking and boundary detection, thresholding, region-based segmentation. Image features and extraction- image features, types of features, feature extraction, SIFT, surf and texture, feature reduction algorithms.

Case Study: Design of edge detection algorithms using various operators and masks.

Unit - V **10 Hours**

IMAGE REPRESENTATION AND RECOGNITION: Boundary representation – Chain code, polygonal approximation, signature, boundary segments, boundary description, shape number, Fourier descriptor, moments, regional descriptors, topological feature, texture, patterns and pattern classes, recognition based on matching.

Case Study: Study of face/character recognition and classification using image processing toolbox.

Books

Text Books:

1. Rafael Gonzalez, Richard E. Woods, "Digital Image Processing", Fourth Edition, Pearson Education, 2018.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", PHI, 2011.

Reference Books:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing Analysis and Machine Vision

E-resourses (NPTEL/SWAYAM.. Any Other)- mention links

1. Digital Image Processing https://nptel.ac.in/courses/117105079

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Implement basic image processing operations.	L2
2.	Apply and develop new techniques in the areas of image enhancement and restoration.	L3
3.	Understand the image segmentation algorithms.	L2
4.	Apply descriptors for boundary detection and pattern classification.	L3
5.	Design and develop computer vision application that uses different concepts of image processing.	L4

	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
2.	**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.	**3**
3.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis	**4**

	and interpretation of data and synthesis of information to provide valid conclusions.	
4	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	**12**

Course delivery methods	**Assessment methods**
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Videos	3. Quiz
4. Notes	4. Mini Project

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Computer Communication Networks

Course Code	18EC62	**Credits**	4
Course type	PC2	**CIE Marks**	50 marks
Hours/week: L – T – P	4 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	50	**SEE Duration**	3 Hours

Course learning objectives (CLOs)

1. To familiarize with the working model of OSI and TCP/IP protocol suite.
2. To discuss the data link protocols to understand the reliable data communication.
3. To explain the working of networking resources and channel access techniques.
4. To compare the different methods of switching and to understand the challenges in IP addressing.
5. To understand the significance of TCP and UDP in computer communications networks and investigate the network performance.

Pre-requisites: Information theory and Digital Communication.

Unit - I **10 Hours**

Data Communications: Components, Representations, Data Flow, Networks: Physical Structures, Network Types: LAN, WAN, Switching, Internet. TCP/IP Protocol Suite: Layered Architecture, Description of layers, Addressing. The OSI Model: OSI Versus TCP/IP.
Case Study: Study of Telephone Networks.

Unit - II **10 Hours**

Data Link Control: Framing, Flow and Error Control, Protocols, Noiseless Channels and Noisy Channels, HDLC. Data Link Layer Protocols: Reliable Transmission, Simple Protocol, Stop and Wait protocol, Sliding Window, Piggybacking.
Case Study: Data Encryption Techniques.

Unit - III **10 Hours**

Media Access Control: Random Access, ALOHA, CSMA, CSMA/CD, CSMA/CA. Controlled Access: Reservation, Polling, Token Passing. Connecting Devices: Hubs, Switches, Routers. Gateways. Virtual LANs: Membership, Configuration, Communication between Switches, Advantages.
Case Study: Demonstration of LAN configuration and it's working.

Unit - IV **10 Hours**

Network Layer services: Packetizing, Switching and forwarding, Datagram, Virtual Circuit Switching, Source Routing. IPV4 Addresses: Address Space, Classful Addressing, DHCP, Network Address Resolution and Border Gateway Protocols (BGP). The IPV6 : Addressing Scheme, Address Space Assignment, Embedding IPv4 Addresses in IPv6 For Transition.

Case Study: Simulating of LAN and study of packet transfer using packet tracer tool.

Unit - V **10 Hours**

Transport Layer: Introduction, Transport Layer Services, Connectionless and Connection oriented Protocols. Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-Back-N Protocol, Selective repeat protocol. User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Windows in TCP, Flow control, Error control, TCP congestion control.

Case Study: With help of research papers document the various network working scenarios in which TCP/UDP are preferable.

Books

Text Books:

1. Behrouz A Forouzan, "Data Communication and Networking", Tata McGraw-Hill publishing Company Limited, Indian Edition, 2006 and onwards.
2. Andrew S. Tanenbaum, "Computer networks", Prentice-Hall, 2010

Reference Books:

1. Larry L. Peterson and Bruce S. Devie, Computer Networks, Morgan Kaufmann Publications, 5thEdition and onwards.
2. William Stallings, "Data and Computer Communications", Prentice-Hall, 2007

E-resources

Course Title: Computer Communications Specialization
https://www.coursera.org/specializations/computer-communications#courses

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Compare and contrast the OSI model and TCP/IP architecture suite.	L2
2.	Compare the various data flow control methods with respect to general data network communication.	L2
3.	Understand the relevance of networking components and methods of channel access techniques.	L2
4.	Design and analyze the network addresses using the knowledge of data switching and IPV4 addressing.	L4
5.	Compare and analyze the relevance of Transport Control Protocol and User datagram protocol to design congestion free network.	L4

	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
2.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
3.	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	**12**

Course delivery methods	Assessment methods
1. Blackboard Teaching	1. Assignments
2. Presentation	2. Internal Assessment Tests
3. Notes	3. Tutorials
4. Video presentations	4.

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Sensors and Signal Conditioning

Course Code	18EC63	**Credits**	3
Course type	PC	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 2 – 0	**SEE Marks**	50 marks
Total Hours:	50	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To introduce various types of sensors, classification and sensor-based measurement system.
2. To study resistive sensors and signal conditioning for resistive sensors.
3. To study reactance, variation and electromagnetic sensors and their signal conditioning.
4. To study signal conditioning for self-generating sensors.
5. To study digital and intelligent sensors and their signal conditioning methods.

Pre-requisites: Basic Engineering Mathematics and Basic Electrical and Electronic Engineering.

Unit – I: Introduction to Sensor-Based Measurement Systems 10 Hours

General Concepts and Terminology, Sensor Classification, General Input-Output Configuration, Static Characteristics of Measurement Systems, Dynamic Characteristics, Other Sensor Characteristics, Primary Sensors, Materials for Sensors, Micro sensor Technology and Problems as applicable

Case Study: Sensors used in local industries such as foundries, energy micro system and milk factories

Unit – II: Resistive Sensors & Self-Generating Sensors 10 Hours

Potentiometers, Strain Gages, Resistive Temperature Detectors (RTDs), Thermistors, Magneto resistors, Light-Dependent Resistors (LDRs), Resistive Hygrometers, Resistive Gas Sensors, Liquid Conductivity Sensors and Problems as applicable, Thermoelectric Sensors, Thermocouples, Piezoelectric Sensors, Pyro electric Sensors, Photovoltaic Sensors, Electrochemical Sensors and Problems as applicable

Case Study: Industrial applications of LDRs, RTDs, Pyro Electric Sensors, Photovoltaic and Electrochemical Sensors.

Unit – III: Signal Conditioning for Resistive Sensors 10 Hours

Measurement of Resistance, Voltage Dividers, Wheatstone Bridge: Balance Measurements, Wheatstone Bridge: Deflection Measurements, Differential and Instrumentation Amplifiers, Interference and Problems as applicable

Case Study: Use of resistive sensors in industries.

Unit – IV: Signal Conditioning for Self-Generating Sensors 10 Hours

Chopper and Low-Drift Amplifiers, Electrometer and Trans impedance Amplifiers, Charge Amplifiers, Noise in Amplifiers, Noise and Drift in Resistors and Problems as applicable
Case Study: Biomedical Sensors and related signal conditioners.

Unit – V: Digital, Intelligent Sensors and Applications **10 Hours**

Position Encoders, Resonant Sensors, Variable Oscillators, Conversion to Frequency, Period, or Time Duration, Direct Sensor-Microcontroller Interfacing, Communication Systems for Sensors, Intelligent Sensors and Problems as applicable
Case Study: Sensors used in Instrument Landing system at Airport.

Books

Text Books:

1. Ramon Pallaas-Areny, John G. Webster "SENSORS AND SIGNAL CONDITIONING", 2nd Edition, Wiley- Interscience Publication

Reference Books:

1. Sawhney A.K. and Sawhney P., A Course in Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai (2008)
2. Murthy D.V.S. Transducers and Instrumentation, Prentice Hall of India (2003)

E-resources (NPTEL/SWAYAM.. Any Other)- mention links

1. A brief introduction of Micro-Sensors by IISER Bhopal
2. Optical Sensors https://nptel.ac.in/courses/115/107/115107122

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Select the appropriate sensor for given application	2
2. Design a suitable signal conditioning circuit for given application	4
3. Design data acquisition system for instrumentation application	4
4. Develop suitable interface for reading sensor data	3
5. Analyze, formulate and select suitable sensor for the given industrial applications	3

	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
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.	**2**
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.	**3**
4.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
5.	**The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and	**6**

	the consequent responsibilities relevant to professional engineering practice.	
6.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	**12**

Course delivery methods	**Assessment methods**
1. Blackboard teaching	1. Internal Assessment
2. PowerPoint presentation.	2. Quiz
3. Scilab/Matlab tools.	3. Seminar
4. Industrial visit	4. Activity

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Requirements Engineering

Course Code	18EC641	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To understand the importance of requirements engineering.
2. To describe the roles and responsibilities of key stakeholders in the requirements engineering processes.
3. To understand and apply the requirements elicitation techniques and their relevance to business situations.
4. To describe the use of tools to support requirements engineering.
5. To identify problems with requirements and explain how requirements documentation may be improved.

Unit – I **8Hours**

Introduction to requirements engineering:
Framework for requirements engineering, Requirements engineering activities – elicitation, analysis, validation, documentation, management, rationale for requirements engineering and the problems with requirements, The importance of requirements planning and estimating, The business rationale and inputs, The business case, Terms of reference / project initiation document (PID). –Text-1

What are requirements?
What are requirements? Requirement gathering and systems modelling. Why do I need requirements? What is a requirement? - Text-2

Case Study: Study of "The Ice Breaker" project

Unit – II **8 Hours**

Hierarchy of requirements: Building the hierarchy, Categories of requirements within the hierarchy
Stakeholders in the requirements process: Project Stakeholders, Business stakeholders, External stakeholders. -Text-1

Evolution of requirements: The template, The requirements process -Text 2

Case Study: Generate the requirements for mobile banking service system.

Unit – III **8 Hours**

Requirements elicitation: Knowledge types – tacit and non-tacit, Elicitation techniques, Understanding the applicability of techniques. -Text-1

Use of models in requirements engineering: The purpose of modelling requirements, Modelling the business context for the system, Developing a model to represent the system processing requirements, Interpreting a data model. -Text-1

Case Study: Application of agile techniques to requirements engineering

Unit – IV **8 Hours**

Requirements documentation: Documentation styles and levels of definition, Requirements catalogue. -Text-1

Requirements analysis: Prioritizing and packaging requirements for delivery, organizing requirements, Ensuring well-formed requirements, Prototyping requirements, Verifying requirement. -Text-1

Mini Project: Identify a project idea and apply requirement engineering for project management.

Unit – V **8 Hours**

Requirements validation: Agreeing the requirements document, Types of reviews, Stakeholders and their areas of concern.

Requirements management: Dealing with changing requirements, The importance of traceability, Traceability and ownership, Requirements Engineering support tools.

Mini Project: Compare the different requirements engineering processes applied to the identified project idea

Books

Text Books:

1. Debra Paul, Donald Yeates and James Cadle, Business Analysis, 2nd Edition, BCS Publisher, 2010 and onwards.
2. Suzanne Robertson and James Robertson, "Mastering the Requirements Process", Addison Wesley, 1999 and onwards.

Reference Books:

1. Gerald Kotonya and Ian Sommerville, "Requirements Engineering: Processes and Techniques", John Wiley & Sons.
2. James Cadle, Debbie Paul and Paul Turner, "Business Analysis Techniques: 72 Essential Tools for Success", BCS.
3. Alistair Cockburn, "Writing Effective Use Cases", Addison-Wesley, 2000 and onwards.

E-resourses(NPTEL/SWAYAM.. Any Other)- mention links

1. Analyzing requirements engineering processes: a case study
   DOI: 10.1109/DEXA.2000.875146
2. Agile project management - a case study on agile practices
   DOI: 10.13140/RG.2.2.14048.33283

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Understand of concepts of the requirements engineering	L2
2.	Describe the process and stakeholders involved in requirements validation	L2
3.	Develop a model and explain the use of a range of requirements elicitation techniques and the relevance of the techniques to business situations	L4
4.	Analys**e** the requirements and describe the documentation methods required.	L4
5.	Evaluate the performance of requirements management process and apply them to manage a business requirement.	L4

	Program Outcome of this course (POs)	**PO No.**
1.	**Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.	**2**

2.	**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.	**3**
3.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.	**4**
4.	**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.	**11**
5.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	**12**

Course delivery methods	**Assessment methods**
1. Chalk / Blackboard	1. Assignments
2. Presentations	2. Internal Assessment Tests
3. Videos	3. Quiz
4. Demonstration	4. Seminar

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Virtual Instrumentation

Course Code	18EC642	**Credits**	3
Course type	PE	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hours for 100 Marks

Course Learning Objectives (CLOs)

1. To study and analyze the features of Virtual Instrumentation Tools.
2. To apply the concepts of loops and arrays to the graphical design structures.
3. To study data visualization using Virtual Instrumentation Tools.
4. To implement customized string and file I/O functions.
5. To learn and understand signal conditioning and data acquisition device.

Pre-requisites: Basics of any programming language.

Unit – I 8 Hours

Graphical System Design: Introduction, Graphical system design (GSD) model, Design flow with GSD, Virtual Instrumentation, Virtual instrument and traditional instrument, Hardware and Software in virtual instrumentation, Virtual instrumentation for Test, control & design, Graphical programming & textual programming, Graphical system design using LABVIEW. (Text 1)

Introduction to LABVIEW: Introduction, Advantages of LABVIEW, Software Environment, Palettes, Front Panels Controls and Indicators, Block Diagram, Data Types, Data Flow Programs, Creating, Opening, Editing, Placing and Saving Sub VI's, Creating a standalone application. (Text 1)

Case Studies: Survey and identify any real-life problem. Make use of different data types to create a VI. Plot the components needed for the front Panel and the block diagram.

Unit – II 8 Hours

Repetition and Loops: For loops, while loops, structure tunnels, terminals inside or outside loops, shift registers, feed-back nodes, control timing, communicating among multiple-loops, local variables, Global variables.

Arrays: Introduction, arrays in LABVIEW, creating one - dimensional array controls, indicators and constants, initializing arrays, deleting, inserting, and replacing elements, rows, columns, and pages with in arrays, array functions, auto indexing, identification of data structure (scalar and arrays) using wire, using auto-indexing to set the FOR-loop count matrix operation with arrays, polymorphism. (Text 1)

Case Studies: Build a VI making use of for and while loops to create the arrays of data with an auto-indexing feature for the identified-problem.

Unit – III **8 Hours**

String and File I/O: Creating string controls and indicators, String functions, Editing, formatting and parsing strings, Formatting strings, Configuring string controls and indicators, Basics of file I/O, Choosing a file I/O format, File I/O Vi's. (Text 1)

Case Studies: Apply file I/O, conversion and concatenation techniques to the identified real-time problem.

Unit – IV **8 Hours**

Data Visualization: Types of waveforms, Waveform graphs, Waveform charts, XY graphs, Intensity graphs & charts, Digital waveform graphs, 3D graphs, customizing graphs &charts, Configuring a graph or chart, planners on the XY graph. (Text 1)

Case Studies: Integrate a component into VI to visualize the graph for the recorded dataset for the identified problem.

Unit –V **8 Hours**

Data Acquisition: Introduction, signal conditioning, DAQ hardware configuration, Analog inputs, counters, Digital I/O (DIO), DAQ software architecture, DAQ Assistant, Channels & Task configuration, Selecting & configuring a data acquisition device, Components of computer-based measurement system. (Text 1)

Case Studies: Configure the NI-DAQ to read the inputs in real-time from any sensors, process it and visualize it graphically on the VI.

Text Books

1. Jovitha Jerome, "Virtual Instrumentation using LABVIEW", PHI Learning, 10th Edition, 2011
2. Jeffrey Travis, Jim Kring, "LABVIEW for Everyone", Prentice Hall, 3rd Edition, 2006

Reference Books

1. Virtual Instrumentation using LABVIEW – Sanjay Gupta, Joseph John, TMH, McGraw Hill Second Edition, 2011
2. S. Gupta and J P Gupta, ''PC Interfacing for Data Acquisition and Process Control", Instrument Society of America, 1994.

E-Resources

1. LABVIEW Graphical Programming Course – Malan Shiralkar and National Instruments in Connection with Rice University, Houston, Texas. (URL: http://cnx.org/content/col10241/1.4/)
2. Basic LABVIEW Programming: https://www.halvorsen.blog/documents/teaching/courses/labview_automation/labview_basic.php

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Appreciate the features of graphical system model and virtual instrumentation.	2
2. Identify a real-world problem and apply concepts of looping functions and arrays.	3
3. Interpret the data and visualize it in a VI environment.	4
4. Apply the concepts of file I/O for the identified problem.	3
5. Learn and understand signal conditioning, data acquisition device, its I/O, configuration and selection parameters.	2

Program Outcome of this course (POs)	PO No.
1. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	1
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.	2
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.	3
4. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5
5. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	12

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Videos	3. Quiz
4. Notes	4. Mini Project

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0 / 3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks: 50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Machine Learning

Course Code	18EC643	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. Appreciate the underlying mathematical relationships of learning models from data.
2. Understand a wide variety of machine learning algorithms.
3. Read and comprehend state-of-the-art approaches to deep learning from current research articles and identify a real-world problem.
4. Understand how to evaluate models generated from data.
5. Apply the algorithms to the identified real-world problem, optimize the models learned and evaluate models based on the expected accuracy.

Pre-requisites: Concepts of Linear Algebra

Unit – I **8 Hours**

Introduction: Basic definitions, Machine learning: what and why?, Supervised learning, Unsupervised learning. **Probability**- A brief review of probability theory.
Case Study: Compare Supervised and Unsupervised learning for a specific learning application.

Unit – II **8 Hours**

Linear Models for Regression: Linear Basis Function Models, Bayesian Linear Regression, The Evidence Approximation
Linear Models for Classification - Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models, Bayesian Logistic Regression.
Case Study: Performance analysis of Principal Component Analysis (PCA) and Independent Component Analysis (ICA).

Unit – III **8 Hours**

Generative models for discrete data: Introduction, Bayesian concept learning, The beta-binomial model, The Dirichlet-multinomial model, Naive Bayes classifiers
Case Study: Identify an application and apply Naïve Bayes classification.

Unit – IV **8 Hours**

Neural Networks: Feed-forward Network Functions, Network Training, Error Backpropagation, The Hessian Matrix, Regularization in Neural Networks, Bayesian Neural Networks.
Kernel Methods: Dual Representations, Constructing Kernels, Gaussian Processes.

Sparse Kernel Machines: Maximum Margin Classifiers, Relevance Vector Machines
Case Study: Visualize the operation and learning principles of neural networks (backpropagation algorithm).

Unit – V **8 Hours**

Deep learning: Introduction, Deep generative models, Deep neural networks, Applications of deep networks
Convolutional Networks: The Convolution Operation, Motivation, Pooling, Variants of the Basic Convolution Function, Data, Efficient Convolution Algorithms.

Case Study / Mini project: Create dataset for the identified real-world problem and apply deep learning algorithms to evaluate their performance.

Books

Text Books:

1. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006
2. Kevin Murphy, "Machine Learning - a Probabilistic Perspective", MIT Press, 2012.

Reference Books:

1. Joachims, "Learning to Classify Text using Support Vector Machines", Kluwer, 2002.
2. Ian Goodfellow and YoshuaBengio and Aaron Courville, "Deep Learning", An MIT Press book

E-Resourses (NPTEL/SWAYAM. Any Other)- (mention course title and then url)

1. Introduction to Machine Learning (IIT Madras) https://nptel.ac.in/courses/106106139/
2. Introduction to Machine Learning (IIT Kharagpur) https://nptel.ac.in/courses/106105152/

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Understand Supervised and Unsupervised learning techniques.	L2
2. Analyze the state of art techniques applied in deep learning research.	L4
3. Develop machine learning models for the problem identified.	L3
4. Evaluate the different deep learning models used for different applications.	L4
5. Apply knowledge of Kernel Methods and Sparse Kernel Machine algorithms to solve real world problems.	L5

	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
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.	**2**
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.	**3**

4	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
5	**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.	10
6	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	12

Course delivery methods	**Assessment methods**
1. Classroom Teaching (Black Board)	1. IA Test
2. Presentation	2. Assignment
3. Handouts	3. Quiz
4. Video Presentations	

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Robotics & Automation

Course Code	18EC644	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To understand fundamentals of industrial automation and robotics
2. To understand different types of actuators, motors, grippers used in robot drive system
3. To apply the knowledge of Sensors and actuators to Control systems
4. To develop programming skills related to automation
5. To identify the faults in the system and troubleshoot.

Pre-requisites: Digital Electronics, Microcontrollers.

Unit - I **8 Hours**

Fundamentals of Robot: Introduction, industrial robot, robot, laws of robotics, types of robot,
robot specification, benefits of robot, need for robot, manufacturing applications of robot, the future of robotics
Case Study: Conduct a survey on Non-manufacturing robotic applications.

Unit - II **8 Hours**

Robot Drive Systems and End Effectors: Introduction, actuators, types of actuators or drives, DC servomotor, types of D.C. motors, A.C. motors, stepper motor, selection of motors, comparison of pneumatic, hydraulic electrical drives, end-effectors, grippers, classification of grippers, drive system for grippers, types of grippers, hooks scoops, other miscellaneous devices, selection and design considerations of gripper.
Case Study: Study the control of a two-wheeled robot

Unit - III **8 Hours**

Sensors and Machine Vision: Sensors, requirements of sensors, classification of sensors, position sensors, velocity sensor, acceleration sensors, force sensors, external sensors, acquisition of images, machine vision.
Case Study: Identify an application that uses machine vision for obstruction detection.

Unit - IV **8 Hours**

Control Methods: Performance objectives, electrical power, servo-controlled robots, non-servo-controlled robots, actuators, controllers, programmable controllers.
Robot Programming: Introduction, methods for robot programming, defining a robot program, method of defining position in space, motion interpolation, basic programming commands in

work-cell control, branching, robot programming languages / textual programming, structure of robot language, VAL programming.

Case Study: Understand the working principles of a robotic arm control system.

Unit - V **8 Hours**

Uses for Robots: Performance objectives, loading and unloading, materials handling, fabricating, assembling, painting, welding, inspecting and testing, the future of flexible automation, objectives of CIM, the future of robots, social impact of robots, new uses and new forms.

Troubleshooting and Maintenance: Performance objectives, preventive maintenance, maintenance of small electric motors, motor problems, common motor problems and their causes, troubleshooting aids, power-supply disturbances, motors with squirrel-cage rotors, testing the centrifugal switch in a single-phase motor, testing for short circuits between run and start windings, capacitor testing, using meters to check for problems, troubleshooting guide.

Case Study: Design a simple automation system that employs the knowledge of sensors and actuators.

Books

Text Books:

1. Ramachandran S., "Robotics", AIRWALK PUBLICATIONS (2017), **ISBN: 978-93-84893-69-9**
2. Rex Miller, Mark R. Miller - Robots and Robotics_ Principles, Systems, and Industrial Applications-McGraw-Hill Education (2017)
3. Mike Wilson - Implementation of Robot Systems_ An introduction to robotics, automation, and successful systems integration in manufacturing-Butterworth-Heinemann (2014)
4. Dey, Nilanjan_ Mukherjee, Amartya - Embedded systems and robotics with open source tools-CRC Press (2016)

Reference Books:

1. Lina J. Karam, Naji Mounsef - Introduction to Engineering_ A Starter's Guide with Hands-on Digital and Robotics Explorations (Synthesis Lectures on Engineering) (2010)
2. John J. Craig - Introduction to Robotics Mechanics and Control 3rd edition-Pearson Education, Inc. (2005)

E-resourses (NPTEL/SWAYAM.. Any Other)

1. https://nptel.ac.in/courses/108/105/108105063/

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Understand the fundamentals of Robotics.	L2
2.	Identify the appropriate proper actuators and sensors required for the robotic application.	L3
3.	Program a controller to sense from sensors and control the actuators.	L4
4.	Understand the impact of sensor placements for the proper functioning of the robotic system.	L3
5.	Understand the common problems in automation and troubleshoot.	L2

	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	1
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.	2
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.	3
4.	**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.	5
5.	**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.	11
6.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change	12

Course delivery methods	Assessment methods
1. Black board	1. Assignments
2. Presentation	2. Quiz
3. Practical with EDA tools.	3. Case studies with real time examples.
	4. Projects/ Literature survey.

CIE and SEE Pattern:

Theory courses having 3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Database Management System

Course Code	18EC645	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. Appreciate the need of database system and understand the contribution of each individual role involved in the database design and development.
2. Learn and practice data modelling using the entity-relationship and developing database designs.
3. Comprehend the concepts of relational database model
4. Construct simple and moderately advanced database queries using Structured Query Language (SQL).
5. Study the concept of database normalization, transaction and related facilities

Unit - I **8 Hours**

Introduction: Characteristics of database, Advantages of using DBMS approach, A brief history of database applications, when not to use a DBMS, Data models, Schemas and instances, Three-schema architecture and data independence.
Case Study: Identify the actors, workers and database architecture for a company database

Unit - II **8 Hours**

Entity-Relationship model: Using high-level conceptual data models for database design, An example database application, Entity types, Entity sets, Attributes and keys, Relationship types, Relationship Sets, Roles and structural constraints, Weak entity types, Refining the ER design, ER diagrams, Naming conventions and design issues.
Case Study: Construct a ER model for Hospital Management System

Unit - III **8 Hours**

Relational model and relational algebra: Relational model concepts, Relational model constraints and relational database schemas, Update operations, Unary relational operations: SELECT and PROJECT, Relational algebra operations from set theory, Binary relational operations: JOIN and DIVISION; Examples of queries in relational algebra.
Case Study: Document the case study related to the database concepts on any one of the following:
a. Faculty database system for education
b. Student database System for education

Unit - IV **8 Hours**

SQL:SQL data definition and data types, Specifying basic constraints in SQL, Schema change statements in SQL, Basic queries in SQL, More complex SQL queries.

Mini Project: Develop a database application that includes a user interface as part of front end and integrate DBMS at the backend.

Unit - V **8 Hours**

Database design: Informal design guidelines for relation schemas, Functional dependencies, Normal forms 1NF, 2NF and 3NF, Boyce-Codd normal form.

Introduction to transaction processing concepts and theory: Transaction and system concepts. Introduction to concurrency control techniques.

Mini Project: Identify and develop an online booking system to demonstrate normalization process.

Books

Text Books:

1. Elmasri and Navathe, "Fundamentals of Database Systems", 5th Edition, Pearson Education, 2007and onwards.

2. Silberschatz, Korth and Sudharshan, "Data base System Concepts", 6th Edition, Mc-GrawHill, 2010and onwards.

Reference Books:

1. C. J. Date, A. Kannan andS. Swamynatham, "An Introduction to Database Systems", 8th Edition,Pearson Education, 2006and onwards.

E-resourses(NPTEL/SWAYAM.. Any Other)- mention links

1. Education: A Case Study at School of Public Health, University of Ghana DOI: 10.11648/j.ajsea.20150402.11
2. "Eddie Bean" catalog sales company. https://docs.oracle.com/cd/A91202_01/901_doc/rac.901/a89870/dbdesign.htm

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Understand the basic concepts of the database management system	L2
2.	Identify a real-world scenario and develop databases using the design principles of E-R modelling.	L4
3.	Familiarize with the relational database theory, and write relational algebra expressions for queries	L3
4.	Design and implement SQL for the identified database application	L5
5.	Apply normalization techniques to the database and appreciate the concept of transaction processing	L3

	Program Outcome of this course (POs)	**PO No.**
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
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.	**2**

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.	**3**
4.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
5.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	**12**

Course delivery methods	**Assessment methods**
1. Chalk / Blackboard	1. Assignments
2. Presentations	2. Internal Assessment Tests
3. Videos	3. Quiz
4. Demonstration	4. Seminar

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Digital Forensics

Course Code	18EC651	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To understand the key aspects of Digital Forensics.
2. To study the nature of a typical digital forensics case, the correct procedures for searching and seizing evidence and evaluation of a case.
3. To study the E-mail and Social Media Investigations related to Digital Forensics.
4. To comprehend the Mobile Device Forensics and Cloud Forensics.

Pre-requisites: Basics of electronic systems

Unit - I **8 Hours**

Understanding the digital forensics profession and investigations: an overview of digital forensics, preparing for digital investigations, maintaining professional conduct, preparing a digital forensics investigation, procedures for private-sector high-tech investigations, understanding data recovery workstations and software, conducting an investigation

Data acquisition: understanding storage formats for digital evidence, determining the best acquisition method, contingency planning for image acquisitions, using acquisition tools
Case Study: Study of Redundant Array of Independent Disks (RAID) Data Acquisition from a computer.

Unit - II **8 Hours**

Processing crime and incident scenes: identifying digital evidence, collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case.
Case Study: Study of SHA-1, MD5

Unit - III **8 Hours**

Working with windows and Command Line Interface systems: understanding file systems, exploring Microsoft file structures, examining NTFS disks, understanding whole disk encryption, understanding the windows registry, understanding virtual machines
Digital forensics analysis: determining what data to collect and analyze, addressing data-hiding techniques
case study: Understanding bootstrap loader sequence in a computer.

Unit - IV **8 Hours**

E-mail and social media investigations: exploring the role of e-mail in investigations, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensics tools, applying digital forensics to social media.

Case Study:

1. Study of "Elephant in the Room: Case Studies of Social Media in Civil and Criminal Cases," Mark Lanterman, http://blog.x1discovery.com/2014/06/10/elephantin-the-room-case-studies-of-social-media-in-civil-and-criminal-cases/, June 2014.
2. Demonstrate the use of Forensic Toolkit (for Facebook by Afentis Software) to discover friends and other information of a public profile.

Unit - V **8 Hours**

Mobile device forensics: understanding mobile device forensics, understanding acquisition procedures for mobile devices

Cloud forensics: an overview of cloud computing, legal challenges in cloud forensics, technical challenges in cloud forensics, acquisitions in the cloud, conducting a cloud investigation, tools for cloud forensics

Case Study: Study of SIM Manager tool to read the sim card messages.

Books

Text Books:

1. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations: Processing Digital Evidence", Fifth Edition, Cengage Learning, 2015 and onwards.
2. Cory Altheide, Harlan Carvey, "Digital Forensics with Open Source Tools", Elsevier, Syngress publications, 2011 and onwards.

Reference Books:

1. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Second Edition, ISBN 1-58450-389-0, 2005 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Understand the basic concepts of digital forensics and study the forensic tools	L2
2.	Analyze the forensic data acquired from an electronic system	L4
3.	Analyze the e-mail and social media digital forensics and document	L5
4.	Understand the digital forensics applied to mobile and cloud scenario	L3

	Program Outcome of this course (Pos)	**PO No.**
1.		**PO 1**
2.	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	**PO 3**
3.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis	**PO 4**

	and interpretation of data, and synthesis of the information to provide valid conclusions.	
4.	**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.	**PO 5**
5.	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	**PO 6**
6.	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	**PO 8**

Course delivery methods	**Assessment methods**
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
	4. Activity

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0 / 3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Biomedical System Design

Course Code	18EC652	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. Introduce students to Biomedical Engineering and its related areas.
2. Explain and apply basic concepts of semiconductor physics relevant to building circuit and device models.
3. Explain, describe, and use physics-based device and circuit models for biomedical applications.
4. Learn the process of modelling a Human Physiological System.
5. Select models appropriate to a specific need and apply those models to analyze the models.

Pre-requisites: Engineering Mathematics, Devices, Circuits, Signals and Embedded Systems

Unit - I 8 Hours

Introduction to System Science: Notion of dynamic systems: modeling and simulation using

Simulation tool - Biomedical systems as dynamic systems - Compartmental modeling of biological systems - Eye movement model – Muscle model - Classical system identification. Moral and ethical issues in developing Biomedical Systems Morality and ethics - Two moral norms: beneficence and nonmaleficence - Human experimentation - Regulation of medical device innovation – Ethical issues in feasibility studies - Ethical issues in treatment use.

Case Study: Baroreceptor Modeling: An Interactive Cardiovascular Simulation.

Unit - II 8 Hours

Anatomy and Physiology: Introduction-Cellular organization – Tissues - Major organs and systems – Homeostasis Biomedical sensing Bioelectric phenomena - Origin of bio-potentials - Notion of Hodgkin-Huxley and Soliton models - Biopotential measurements – ECG, EEG, EMG, ERG, ENG.

Case Study: Revisiting the mechanics of the action potential (Nature Communications).

https://blogs.princeton.edu/research/2015/04/01/revisiting-the-mechanics-of-the-action-potential-nature-communications/

Unit - III **8 Hours**

Biomedical Sensors: Chemical biosensors – Electrochemical sensors and chemical fibro-sensors - Notion of ion selective field effect transistor (ISFET) and immunologically sensitive field effect transistor (IMFET) - Fundamentals of light propagation in biological tissue – Biophysical measurement techniques using light – photoplethysmography – Acoustic biosensors – phonocardiography – Photoacoustic bio-signals – estimation of blood glucose.

Case Study: A fetal biophysical profile.

https://www.mayoclinic.org/tests-procedures/biophysical-profile/about/pac-20393061

Unit - IV **8 Hours**

Bio-signal processing: Characterization of bio-signals – morphological, statistical and transform features - Frequency domain representation of bio-signals – Noise characteristics - Noise reduction by Ensemble Averaging and Linear Time Invariant A Posteriori - filtering techniques - Signal averaging –

Wavelet transform - Compression of bio-signals - lossless and lossy compression.

Case Study: Neuro-Fuzzy Model for Arrhythmia Diagnostic System.

https://pdfs.semanticscholar.org/591f/26b4940a59afa5762ea23a760f02ad152dbf.pdf

Unit - V **8 Hours**

Biomedical embedded systems: Choice of embedded core - Notion of Internet of Things as extended to biomedicine – Embedded processing for disease diagnosis – Wearable biomedical embedded systems - Point of care testing devices – Diagnostic processing for detection and classification of diseases –

Computational intelligence techniques for disease diagnosis - Classification of cardiac, neuromuscular, neurological and haematological diseases - Memory management issues for diagnostic processing - Power reduction techniques in diagnostic systems.

Case Study: Ultralow-Power Electronics for Biomedical Applications.

https://www.semanticscholar.org/paper/Ultralow-power-electronics-for-biomedical-Chandrakasan-Verma/453f0b69deb71fbc6bd2850c54acd3c9f2527009

Books

Text Books:

1. 1. J. Enderle, S. Blanchard, J. Bronzino, “Introduction to Biomedical Engineering”, Elsevier Academic Press, 2009.

2. R. Begg, D.T.H. Lai, M. Palaniswami, “Computational Intelligence in Biomedical Engineering”, CRC Press, 2008.

Reference Books:

1. L. Sornmo, P. Laguna, “Bioelectrical Signal Processing in Cardiac and Neurological Applications”, Elsevier Academic Press, 2005.

2. J.G. Webster, “Medical Instrumentation: Application and Design”, John Wileyand Sons, 2003.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom’s Level
1.	Describe what biomedical engineers do in their professional activities	L2
2.	Familiarize themselves with the basic components that constitute biological systems (at organs and systems level)	L2
3.	Understand and apply generalizable engineering concepts to describe many types of systems found in biology and medicine. Systems include physiological systems (organs and systems level), bioelectronics systems, sensing and transducing systems, computational systems, etc.	L3
4.	Apply standard device models to explain/calculate critical internal parameters and standard characteristics of the device	L3
5.	Analyze physiological systems and design engineering systems to measure various pathophysiological parameters	L4

	Program Outcome of this course (POs)	PO No.
1.	Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	1
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.	2
3.	Modern Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. Internal Assessment Test
2. Presentation	2. Assignment
3. Video presentations	3. Course Seminar/Project
	4. Case Study

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Heterogeneous Computing

Course Code	18EC653	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To understand the features of heterogeneous computers in general and of the solutions provided by OpenCL in particular.
2. To study the introductory concepts of parallel computing in heterogeneous computing environment.
3. To leverage the OpenCL framework to build interesting and useful applications and explore the benefits of heterogeneous computing.

Pre-requisites: C programming

Unit - I **8 Hours**

Introduction to parallel programming: introduction, thinking parallel, concurrency and parallel programming models, threads and shared memory, message-passing communication, different grains of parallelism, data sharing and synchronization.
Introduction to OpenCL: the OpenCL standard, platform and devices, the execution environment, memory model, writing kernels
case study: study of source code example for vector addition

Unit - II **8 Hours**

OpenCL Device Architectures: Introduction, Hardware Trade-offs: Performance increase by frequency and its limitations, Superscalar Execution, VLIW, SIMD and Vector Processing, Hardware Multithreading, Integration: Systems-On-Chip and the APU, Cache Hierarchies and Memory Systems, The Architectural Design Space: CPU Designs, GPU Architectures, APU and APU-Like Designs.
Case study: Study of Multi-Core Architectures

Unit - III **8 Hours**

Basic OpenCL Examples: Introduction, Simple Matrix Multiplication Example, Image Convolution, Compiling OpenCL Host Applications.
Case study: Study of image rotation with OpenCL

Unit - IV **8 Hours**

OpenCL's Concurrency and Execution Model: Kernels, Work-Items, Workgroups and the Execution Domain, OpenCL Synchronization: Kernels, Fences and Barriers, Queuing and Global Synchronization, The Host-Side Memory Model, The Device-Side Memory Model.
Case study: Memory Performance Considerations in OpenCL

Unit - V **8 Hours**

OpenCL Case Study: Video Processing: Introduction, Getting Video Frames: Decoding on the CPU, Decoding Video on the GPU, processing a video in OpenCL, Processing Multiple Videos with multiple special effects: Event Chaining, Display to screen of final output: OpenCL/OpenGL Interoperability.

Self-learning topics: Debugging OpenCL Applications, Overview of Gdebugger.

Books

Text Books:

1. Benedict R Gaster, Lee Howes, David R KaeliPerhaad Mistry Dana Schaa, "Heterogeneous Computing with OpenCL", MGH, 2011 and onwards.
2. Jason Sanders, Edward Kandrot, "CUDA By Example – An Introduction to General-Purpose GPU Programming", Addison Wesley, 2011 and onwards.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Understand the meaning and the importance of heterogeneous systems	L2
2.	Develop codes to support general-purpose heterogeneous systems	L3
3.	Identify the power utilization and flexibility features of OpenCL programming standard	L3

	Program Outcome of this course (POs)	PO No.
1.	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	**PO 1**
2.	**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.	**PO 5**
3.	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	**PO 12**

Course delivery methods	Assessment methods
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
	4. Activity

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0 / 3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

4. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
5. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
6. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Remote Sensing and Geographic Information System

Course Code	18EC654	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To develop an understanding of earth resource satellites and sensors.
2. To expose students to current technologies and issues those are specific remote sensing imagery applications.
3. To develop an understanding of segmentation and classification of satellite image.
4. To become familiar with the basics of transforms in remote sensing image applications.
5. To study the Morphological Image Processing applications in Remote sensing.

Pre-requisites: Image Processing, Linear Algebra

Unit - I **8 Hours**

Remote Sensing Satellites: Introduction to Satellite Communication: Historical background, Basic concepts of Satellite Communications, Communication Networks and Services, Comparison of Network Transmission technologies, Orbital and Spacecraft problems, Growth of Satellite communications. Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications. Earth observation satellites and their characteristics.

Case Study: Study of **LANDSAT**, SPOT, IRS, IKSNOS, SENTINEL.

Unit - II **8 Hours**

Introduction: Remote Sensing basic principles, Remote Sensing Sensors, Hardware and software aspects. Electromagnetic Radiation Theory and Spectral Signatures, the Digital Image the Digital Image, image arithmetic

Case Study: Survey of Image Sensors and Image formats.

Unit - III **8 Hours**

Fundamentals of satellite Image Processing: Image transforms, Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), and application of transforms.

Image Segmentation, feature extraction and Classification: Image segmentation and Classification – Supervised and Unsupervised Classification.

Case Study: Comparison of different Image Fusion techniques.

Unit - IV **8 Hours**

Morphological Image Processing: Basic concepts, Fundamental operations, Erosion and dilation, Compound operations , Morphological Shape Decomposition: Scale-Invariant but Shape-Dependent Measures.

Case Study: Study of Spatial Maps of Epidemic and Pandemic.

Unit - V **8 Hours**

Geographic Information Systems (GIS), Integration of Remote Sensing and Geographic Information Systems (GIS). Urban Landscape Characterization and Analysis, Urban Feature Extraction, Applications of GIS.

Case Study: Study on Urban sprawl.

Books

Text Books:

1. Jensen, John R., *Remote Sensing of the Environment: An Earth Resource Perspective*, 2nd Ed, Prentice Hall, 2007
2. Paul M. Mather, Computer Processing of Remotely-Sensed Images: An Introduction, Wiley; 3rd edition, 1987
3. Gary L. Prost, G. L. Prost, Remote Sensing for Geoscientists: Image Analysis and Integration, Third Edition, Taylor & Francis, 2013
4. Chen Ch, *Signal and Image Processing For Remote Sensing*,Taylor & Francis, 2006
5. Martin E. Liggins, David L. Hall0 and James Llinas, Handbook of Multisensor Data Fusion: *Theory and Practice, 2nd Edt.*, CRS Press, 2015
6. Evangelia Micheli-Tzanakou, *Supervised and Unsupervised Pattern Recognition*,CRS Press, 2000
7. B. S. Daya Sagar, *Mathematical Morphology in Geomorphology and GISci*, Chapman & Hall (Taylor & Francis Group), 2013
8. Liu, Essential Image Processing and GIS For Remote Sensing, John Wiley & Sons, 2009
9. Louis J. Ippolito, Satellite communications systems engineering, Wiley, 2008

E-resourses (NPTEL/SWAYAM.. Any Other)- mention links

1. Remote Sensors https://earthdata.nasa.gov/learn/remote-sensors
2. National Remote Sensing Center (NRSC) EBooks https://www.nrsc.gov.in/Knowledge_EBooks
3. A Remote Sensing Tutorial from World Bank Group https://landsat.gsfc.nasa.gov/a-world-bank-group-remote-sensing-tutorial
4. A tutorial for learning the role of space science and technology in monitoring Earth's surface and atmosphere https://geoinfo.amu.edu.pl/wpk/rst/rst/Front/overview.html
5. Remote Sensing Tutorials | Natural Resources Canada https://www.nrcan.gc.ca/maps-tools-publications/satellite-imagery-air-photos/tutorial-fundamentals-remote-sensing/9309
6. Overview of Earth Observation Training at ESA https://earth.esa.int/web/guest/eo-education-and-training

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Identify and describe hyper spectral and multispectral satellite imagery	L3
2. Compare and contrast the Active and Passive sensors	L2
3. Understand the significance of segmentation and classification	L3

4.	Analyze various transforms used in image analysis	L5

Program Outcomes of this course (POs):

1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
2.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
3.	**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.	**10**

Course delivery methods	**Assessment methods**
1. Blackboard Teaching	1. Assignments
2. Presentation	2. Internal Assessment Tests
3. Notes	3. Tutorials
4. Video presentations	4.

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Human Computer Interaction

Course Code	18EC655	**Credits**	3
Course type	PE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. Learn the basics of human-computer interaction, interactivity, interaction styles, models of interaction and framework of human-computer interaction.
2. Study how software engineering and the design process relate to interactive system design and understand the design rules to develop an effective design process and a universal design.
3. Understand different kinds of software engineering formalisms that can be used to specify the behavior of specific systems and study cognitive models, interaction models and cognitive architectures.
4. Learn the programming support tools available for implementing interactive systems and improve the abstraction by use of toolkits. Study the evaluation techniques and design of user support systems.
5. Study the implementation and applications of groupware, ubiquitous computing and augmented realities applied to interactive systems.

Unit - I **08 Hours**

Foundation:
Introduction to human and computer, The Interaction: Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of WIMP interface, Interactivity.

Self – Learning Topic: Paradigms for interaction

Unit - II **08 Hours**

The Design Process:
Interaction design basics: the process of design, user focus, scenarios, navigation design, screen design and layout, iteration and prototyping. HCI in software process: software life cycle, usability engineering, iterative design and prototyping, design rationale. Design rules: principles, standards, guidelines, golden rules and heuristics, HCI patterns. Universal design: Universal design principles, Multi-modal interaction.
Self – Learning Topic: Designing for diversity

Unit - III **08 Hours**

Models of Interactive Systems:
Standard formalism, Cognitive models: Goal and task hierarchies, Linguistic models, challenge of display-based systems, Physical and device models, Cognitive architectures. Interaction models, modeling rich interaction.
Self – Learning Topic: Socio-organizational issues and stakeholder requirements

Unit - IV **08 Hours**

Implementation and Evaluation:
Implementation support: Elements of windowing systems, Programming the application, using toolkits, User interface management systems. Evaluation techniques: Goals of evaluation, Evaluation through expert analysis, choosing an evaluation method. User support:

Requirements of user support, Approaches to user support, Adaptive help systems, Design of user support systems.

Self – Learning Topic: Evaluation through user participation

Unit - V **08 Hours**

Interactive System Applications:

Groupware: Groupware systems, Computer-mediated communication, Meeting and decision support systems, Shared applications and artifacts, Frameworks for groupware, implementing synchronous groupware. Ubiquitous computing and augmented realities: Ubiquitous computing applications research, Virtual and augmented reality, Information and data visualization.

Self – Learning Topics: Hypertext, Multimedia and the World Wide Web

Text Books

1. Alan Dix, Janet E. Finlay, Gregory D. Abowd and Russell Beale, "Human-Computer Interaction", 3rd Edition, Pearson Education Limited, 2004.

Reference Books

1. Preece, J., Rogers, Y., & Sharp, H., "Interaction design: Beyond human-computer interaction", 4th Edition, John Wiley & Sons Limited, 2015.

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Understand the basic elements of human-computer interaction.	L2
2. Apply software engineering process and design rules in order to develop reliable and effective design process and further a universal design.	L3
3. Analyze different models of interactive systems and infer on the model suitable for required behavior of the systems using software engineering formalisms.	L4
4. Implement an interactive system by using programming support tools and toolkits, perform system evaluation and design user support system.	L5
5. Apply groupware, ubiquitous computing and augmented reality technologies in order to develop a better interactive system.	L3

Program Outcome of this course (POs) **PO No.**

1. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems. 1
2. **Problem Analysis:** Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. 2
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. 3
4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions. 4
5. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and 5

modelling to complex engineering activities with an understanding of the limitations.

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

Course delivery methods

1. Classroom Teaching (Blackboard)
2. Presentation
3. Videos
4. Notes

Assessment methods

1. IA test
2. Assignment
3. Mini Project
4. Seminar

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0 / 3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Electric and Hybrid Vehicles

Course Code	18EC656	**Credits**	03
Course type	PE	**CIE Marks**	50
Hours/week: L-T-P	3 – 0 – 0	**SEE Marks**	50
Total Hours:	40	**SEE Duration**	3 Hrs.

Course learning objectives

Course learning objectives (CLOs)

1. **Understand** environmental impact and vehicle fundamentals due to electric and fuel powered vehicles
2. **Study** different propulsion systems in electric and hybrid vehicles
3. **Realize** various energy storage devices and know the regeneration of energy
4. **Learn** the architecture of electric and hybrid vehicles
5. **Appreciate** various aspects of series and parallel hybrid designs

Pre-requisites: Basic principles of energy conversion

Unit - I **8 Hours**

Environmental Impact and Vehicle Fundamentals

Petroleum resources, induced cost, air pollution, global warming, importance of different transportation development, history of electric and hybrid electric vehicles, history of fuel cell vehicles, general description of vehicle movement, concept of vehicle resistance, power train, tractive effort and vehicle speed, vehicle performance, operating fuel economy

Self-learning topics: Latest update on environmental impact of IC engines

Unit - II **8 Hours**

Propulsion Systems

Spark ignited IC engines, Compression ignition IC engines, gas turbine engines- Operating principle

Electrical Drives: Configuration of electric vehicles,DC Motor Drives- Principle of operation and performance, combined armature and voltage control, chopper control of DC motor drives, Induction motor drive- Basic operating principle, various control methods, BLDC motor drive- Basic principle, Control of BLDC drive, SRM drive- basic principle and control

Self-learning topics: Principle of DC motor

Unit - III **8 Hours**

Energy Storage and Regeneration

Electrochemical batteries and its types- Electrochemical reaction, thermodynamic voltage, specific energy, power, efficiency, different battery technologies in EV and HEV, Battery Management System

Ultra-capacitors- Features, Basic operating principle, Performance, ultra-capacitor technologies

Ultra-high-speed flywheels- operating principle, power capacity, different flywheel technologies

Fundamentals of regenerative braking- Energy consumption in braking, braking power and energy on front and rear wheels, brake system for EV and HEV

Case studies

Self-learning topics: Ultra-high-speed flywheels

Unit - IV **8 Hours**

Electric Vehicles (EV)

Configurations of EV, Performance of EV, Traction motor characteristics, tractive effort and transmission requirement, vehicle performance, tractive effort in normal driving, energy consumption

Hybrid Electric Vehicles (HEV)

Concept of hybrid electric drive trains, architecture of HEV drive trains, series hybrid, parallel hybrid electric drive trains.

Unit - V **8 Hours**

Hybrid Drive Train Designs

Series Hybrid Electric Drive Train Design- Operation patters, control strategies, PPS control, Thermostat control, Sizing of major components, power rating design of traction motor and engine, Design of Peaking Power Source (PPS)

Parallel Hybrid Drive train design –Control strategies, State of charge (SOC) control, engine on-off control, Design of engine, motor and PPS, case studies

Text Books

1. Modern Electric, Hybrid Electric and fuel cell vehicles, MehrdadEhsani, Yimin Gao, CRC Press, 2005
2. Electric and Hybrid Vehicles, Iqbal Husain, CRC Press, 2010
3. Electric Vehicle Technology Explained, James Larminie, John Lowry, John Wiley,2003

Reference Books

1. Fundamentals of Electrical Drives, G. K. Dubey, CRC Press,2002
2. Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Chris Mi, M. AbulMasrur and David Wenzhong Gao, Willey Publications, 2011

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	**Explain** vehicle mechanics & impact on environment of traditional transportation system.	L2
2.	**Describe** suitable energy storage & regeneration system for Electric and Hybrid Electric Vehicles	L3
3.	**Classify** different types of Electric and Hybrid Electric Vehicles	L2
4	**Choose** appropriate propulsion technique for Electric and Hybrid Electric Vehicles	L3
5	**Select** suitable drive train and control mechanism for Electric and Hybrid Electric Vehicles	L3

Program Outcome of this course (POs) **PO No.**

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

2.	Problem analysis: Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.	2
3.	The engineer and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issuesand the consequent responsibilities relevant to professional engineering practice.	6
4.	Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.	7

Course delivery methods

1. Lectures
2. PPT
3. Lab demo

Assessment methods

1. Internal Assessment tests
2. Assignments
3. Quiz
4. Course seminar

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Nano Electronics

Course Code	**18EC661**	**Credits**	03
Course type	OE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours

Course learning objectives (CLOs)

1. Know the principles of nanoscience engineering and carbon nanotubes
2. Understand the effects of particle size of nanomaterials on various properties
3. Identify the fabrication techniques of nano particles and properties used for sensing and the use of carbon nano tubes
4. Apply the knowledge to prepare and characterize nanomaterials
5. Analyse the process flow required to fabricate state-of-the-art transistor technology

Pre-requisites: Basic physics and chemistry

Unit – I **8 Hours**

Introduction: Overview of nanoscience and engineering, Development milestones in microfabrication and electronic industry, Moore‘s law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometer length scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, Ordering of nano systems

Unit - II **8 Hours**

Characterization: Classification, Microscopic techniques, Field ion microscopy, Scanning probe techniques, Diffraction techniques: Bulk and surface diffraction techniques

Inorganic semiconductor nanostructures: Overview of semiconductor physics, Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states

Case Study: Nanostructures

Unit – III **8 Hours**

Fabrication techniques: Requirements of ideal semiconductor, Epitaxial growth of quantum wells, Lithography and etching, Cleaved-edge over growth, Growth of vicinal substrates, Strain induced dots and wires, Electrostatically induced dots and wires, Quantum well width fluctuations, Thermally annealed quantum wells, Semiconductor nanocrystals, Colloidal quantum dots, Self-assembly techniques

Physical processes: Modulation doping, Quantum hall effect, Resonant tunneling, Charging effects, Ballistic carrier transport, Inter band absorption, Intra band absorption, Light emission processes, Phonon bottleneck, Quantum confined stark effect, Nonlinear effects, Coherence and dephasing, Characterization of semiconductor nanostructures: optical, electrical and structural

Case Study: Fabrication of nanomaterials

Unit - IV **8 Hours**

Carbon Nanostructures: Carbon molecules, Carbon clusters, Carbon nanotubes, Application of carbon nanotubes

Case Study: Fabrication of carbon nanotubes

Unit - V **8 Hours**

Nano sensors: Introduction, Sensors and nanosensors, Order from Chaos, Characterization, perception, Nano sensors based on quantum size effects, Electrochemical sensors, Sensors based on physical properties, Nano biosensors, Smart dust sensor for the future

Applications: Injection lasers, Quantum cascade lasers, Single-photon sources, Biological tagging, Optical memories, Coulomb blockade devices, Photonic structures, QWIP's, NEMS, MEMS

Case Study: Nano sensor

Books

Text Books:

1. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, ―Nanoscale Science and Technology‖, John Wiley, 2007.
2. Charles P Poole, Jr, Frank J Owens, ―Introduction to Nanotechnology‖, John Wiley, Copyright 2006, Reprint 2011.
3. T Pradeep, ―Nano: The Essentials-Understanding Nanoscience and Nanotechnology‖, TMH.

Reference Books:

1. Ed William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, ―Hand Book of Nanoscience Engineering and Technology‖, CRC press, 2003.
2. **E-resourses(NPTEL/SWAYAM.. etc)**

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Understand the principles behind Nanoscience engineering and Nanoelectronics Know the properties of carbon and carbon nanotubes and its applications	L2
2. Identify the effect of particles size on mechanical, thermal, optical and electrical properties of nanomaterials	L2
3. Recognise the properties used for sensing and the use of smart dust sensors	L2
4. Apply the knowledge to prepare and characterize nanomaterials	L2
5. Analyse the process flow required to fabricate state-of-the-art transistor technology.	L2

Program Outcome of this course (POs)	PO No.
1. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
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.	**2**
3. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**

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

Course delivery methods	**Assessment methods**
1. Black board teaching	1. IA tests
2. PPT	2. Assignments
3. Videos	3. Course seminar/project

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Artificial Neural Networks

Course Code	**18EC662**	**Credits**	3
Course type	OE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. Understand different neural network models.
2. Study the different learning strategies applied for pattern classification task.
3. Explore the hard problems and apply multilayer neural networks solve the same.
4. Understand and interpret the energy analysis applied to feedback neural networks.
5. Explore different architectures of neural networks for complex pattern recognition tasks.

Pre-requisites: Engineering Mathematics.

Unit – I Introduction 8 Hours

Basics of Artificial Neural Networks: Trends in computing, Pattern and Data, Pattern recognition tasks. Basic methods of pattern recognition, Basics of Artificial Neural Networks, Biological Neural Network, Models of neuron: McCulloch-Pitts(MP) Model, Perceptron, Adaline, topology, Supervised and unsupervised learning, Basic learning laws, Realization of logic functions using MP neuron.

Case Study: Identify an application and analyze its performance using any two network models.

Unit – II Functional units of ANN & Single layer perceptron 8 Hours

Functional units of ANN & Single layer perceptron: Basic ANN Models (architectures) for Pattern recognition task**,** Pattern recognition tasks by i) Feed-forward ii) Feed-back iii) competitive learning Neural networks. Feed-forward neural network: Linear associative network, Analysis of pattern classification networks.

Self-Study: Linear separability, Perceptron convergence theorem.

Unit – III Multi-Layer perceptron 8 Hours

Multi-Layer perceptron: Linear Inseparability**:** Hard problems, MLFFNN: Back propagation learning, draw backs of back propagation algorithm, Heuristics to improve the performance of Back propagation learning discussion on error back propagation, Convolution neural network (CNN).

Case Study: Review a research paper on CNN application and analyze the architecture.

Unit – IV Feedback Neural Networks 8 Hours

Feedback Neural Networks: Analysis of pattern storage networks, The Hopfield Model, State transition diagram, Pattern storage: Hard problems, Stochastic Networks and simulated annealing.

Case Study: Compare the different parameters of feedback neural networks with each other

Unit – V Architectures for complex pattern recognition tasks 8 Hours

Architectures for complex pattern recognition tasks: Bidirectional associative memory, Architecture of Radial basis function (RBF) networks, Theorems for function approximation, RBF networks function approximation, The XOR problem, RBF Networks for pattern Classification,

Case Study: Compare RBF with MLP networks.

Books

Text Books:

1. Artificial neural networks", –B. Yegnanarayana, PHI, 2010 onwards.

Reference Books:

1. Simon Haykin, "Neural Networks and Learning Machines", Pearson Education, 3rd edition, 2008 onwards.
2. Robert J. Schalkoff, "Neural Networks for Pattern Recognition", Mcgraw-Hill Inc.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Analyze performance of different neuron models with reference to identified application.	L3
2.	Apply different learning strategies for pattern recognition tasks.	L3
3.	Apply multilayer neural networks to solve hard problems	L3
4.	Compare different parameters of feedback neural networks.	L4
5.	Compare different neural network architectures applied to complex pattern recognition tasks.	L4

	Program Outcome of this course (POs)	**PO No.**
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**PO-1**
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.	**PO-2**
3.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.	**PO-4**
4	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**PO-5**

Course delivery methods	**Assessment methods**
1. Classroom teaching using Black board	1. Internal assessment tests
2. Classroom teaching using PPTs	2. Assignments Course activities like mini projects, seminars, surveys, case studies
	3. Quizzes

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Embedded System Design

Course Code	18EC663	**Credits**	3
Course type	OE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To understand the concept of Design Principles of an Embedded System.
2. To have clear understanding about the role of firmware, the basic hardware components and their selection method based on the characteristics and attributes of an embedded system
3. To understand the interface with I/O devices to embedded processors using communication protocols
4. To analyze basic tasks, process and architecture of RTOS
5. To write the basic embedded C programs for simple applications.

Pre-requisites: Basic programming knowledge in C

Unit - I **8 Hours**

Introduction to embedded system Introduction to Embedded Systems Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems. Memory: (ROM, RAM), Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers).

Case study: Survey the embedded systems used in everyday life.

Unit – II **8 Hours**

Hardware Software Co-Design embedded firmware design approaches, computational models, embedded firmware development languages, Integration and testing of Embedded Hardware and firmware, Components in embedded system development environment (IDE), Files generated during compilation, simulators, emulators and debugging. Program modeling concepts: DFG, FSM, Petri-net, UML**,**

Case Study: Study of any one IDE

Unit – III **8 Hours**

Embedded Serial Communication: Study of basic communication protocols like UART, SPI, SCI (RS232, RS485), I2C, CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee, Wireless sensor network Reset Circuit.

Embedded firmware: Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

Case Study: Study of industry standard Systems Network Architecture

Unit – IV **8 Hours**

Real-time operating systems: Need of RTOS in Embedded system software, Foreground/Background systems, OS Services, Process management, Timer functions, Event functions, Memory management, and IO subsystems management, Interrupt routines in RTOS environment Multiple process and Multiple threads in an application, multitasking, context switching, ISR, Semaphores, mailbox, message queues, pipes, RTOS services in contrast with traditional OS, How to choose RTOS..
Case Study: Review of RTOS concepts in Global Navigation satellite system (GNNS).

Unit – V **8 Hours**

Embedded C programming and its applications: Embedded C-programming concepts (from embedded system point of view), Features of Embedded C++ and Software Implementation, Testing, Compilation & Linking, Validation and debugging.
Case Study: Design multitasking Embedded System to simulate ATM machines.

Books

Text Books:

1. Shibu K. V. Introduction to Embedded Systems, 2nd Edition, McGraw Hill Education, 2009
2. Raj Kamal, Embedded Systems Architecture, Programming, and Design. (2/e), Tata McGraw Hill, 2008.
3. Dav id E. Simon An Embedded Software Primer, Pearson Education
4. Frank Vahid, Tony Givargis, John Wiley-Embedded System Design

Reference Books:

1. James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008.
2. ARM System on Chip Architecture by Steve Furber, Pearson Education.

E-resourses(NPTEL/SWAYAM.. Any Other)- (mention course title and then url)

1. http://www.nptelvideos.in/2012/11/embedded-systems.html
2. https://nptel.ac.in/courses/108/105/108105057/
3. http://hi-robotics.blogspot.com/2014/02/embedded-c-code-program-for-line.html
4. https://www.elprocus.com/line-following-robotic-vehicle-for-walking-and-climbing/
5. https://en.wikipedia.org/wiki/GNSS_applications
6. https://en.wikipedia.org/wiki/Satellite_navigation

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Understand embedded processor architecture and programming.	L2
2.	Analyze embedded hardware and software co-design development cycles and IDE components.	L3
3.	Interface with I/O devices to embedded processors using communication protocols	L3
4.	Analyze basic tasks and process of RTOS to choose the best RTOS for applications.	L4
5.	Simulate a embedded system environment using Embedded C	L4

Program Outcome of this course (POs) **PO No.**

1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
2.	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	**3**
3.	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	**4**
4.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations	**5**
5.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	**12**

Course delivery methods	**Assessment methods**
1. Classroom Teaching (Blackboard)	1. IA test
2. Presentation	2. Assignment
3. Video presentations	3. Quiz
	4. Activity

CIE and SEE Pattern:

Theory courses having 4 – 0 – 0/3 – 0 – 0 distribution:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Internet of Everything (IoE)

Course Code	**18EC664**	**Credits**	3
Course type	OE	**CIE Marks**	50 marks
Hours/week: L – T – P	3 – 0 – 0	**SEE Marks**	50 marks
Total Hours:	40	**SEE Duration**	3 Hours for 100 marks

Course learning objectives (CLOs)

1. To understand basic principles and framework of IoE.
2. To simulate applications with different data acquisition techniques in Internet of Everything (IoE).
3. To develop applications of IoE in various industrial environments.
4. To study the WSN architecture & various security features.
5. To comprehend the security and privacy issues in IoE.

Pre-requisites: Programming skills

Unit - I 08Hours

Introduction to IoE

Defining IoT, Introduction to IoE, Difference between IoT and IoE, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

Case Study: Identify a practical problem and develop a model for solution in IoE environment.

Unit - II 08 Hours

Smart Objects: Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies

Data Collection, Storage and Computing using a Cloud Platform:

Introduction, Cloud computing paradigm for data collection, storage and computing

Case Study: Create a database by acquiring data from cloud for the problem identified.

Unit - III **08 Hours**

IoT Applications for Industries: Introduction, Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry.

Mini project: Implement a possible solution modeled in unit-I using IoE concepts.

Unit - IV **08 Hours**

Wireless Sensor Networks: WSN Architecture, the node, connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications, challenges: Security

Case Studies: Survey on real time challenges with respect to Security in WSN.

Unit - V **08 Hours**

Internet of Things Privacy, Security and Governance: Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities.

Case Study: 1. Study and document Smart City Security Architecture,

2. Report on Smart City Use-Case Examples.

Books

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014 & onwards
2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice" ,1st edition, Wiley publication, 2010 & onwards
3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013, & onwards

Reference Books:

1. Cuno Pfister, "Getting Started with the Internet of Things", O'Reilly Media, 2011.

Course Outcome (COs)

At the end of the course, the student will be able to		Bloom's Level
1.	Understand the basic principles and features of IoE	L2
2.	Perform data acquisition using smart objects in IoE.	L3
3.	Develop applications by applying concepts of IoE.	L3
4.	Explain the WSN architecture & various security aspects.	L2
5.	Understand security and privacy issues in IoE.	L2

	Program Outcome of this course (POs)	PO No.
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
2.	**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.	**3**
3.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
4.	**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.	**10**
5.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change	**12**

Course delivery methods	Assessment methods
1. Power-point presentations	1. Internal Test
2. Black board teaching	2. Quiz
3. Videos of a few applications	3. Assignments
	4. Activity/Mini project

CIE and SEE Pattern:

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Average of two assignments	Quiz/Seminar/Course Project	Total Marks
Maximum marks :50	15+15 = 30	10	10	50
Writing two IA tests is compulsory. Minimum marks required to qualify for SEE: 20 out of 50 marks				

Semester End Examination (SEE):

1. It will be conducted for 3 hours duration and 100 marks. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2. Minimum passing marks required to be scored in SEE: 40 out of 100 marks
3. Question paper will have 10 questions carrying 20 marks each. Students have to answer FIVE full questions selecting at least one full question from each unit.

Advanced C and C++ Lab (Lab)

Course Code	18ECL67	Credits	1
Course type	L1	CIE Marks	25 marks
Hours/week: L – T – P	0 – 0 – 3	SEE Marks	25 marks
Total Hours:	36 Hrs	SEE Duration	3 Hours for 50 marks

Course learning objectives

1. Design multifunction programs and understand how two functions communicate through parameters.
2. Realize the importance of modularization and develop an in-depth understanding of advanced C concepts like pointers, structures, unions and files.
3. Design C++ classes for code reuse.
4. Understand the three pillars of Object-Oriented Programming namely Encapsulation, Polymorphism and Inheritance and emphasize their benefits in software development.
5. Develop programming and debugging skills.

Pre-requisites: Computer Programming

List of experiments

1. **Basic Programming**: Introduction to computer software, Classification of computer software, Programming languages.
   Functions: Introduction, why are functions needed, using functions, Function prototype, Function definition, Function call, return statement, Passing parameters to the function, Scope of variables
   Pointers: Understanding the computer's memory, Introduction to Pointers, Declaring pointer variables, Function pointers
   Implement a simple calculator application in C. Incorporate modularity for the following.
   i) Read the two numbers and the operation (+, - * /)
   ii) Modules for addition, subtraction, multiplication and Division
   iii) Display the results
   Use pointers to functions for add, subtract, multiply and divide operations.
2. **Programming concepts:** Desirable program characters, Structure of a C program, Files used in a C program, Compiling and executing C programs.
   Arrays: Declaration of arrays, accessing elements of an array, storing values in arrays, Operations that can be performed on arrays, one dimensional array for inter-function communication, two-dimension arrays, Pointers and arrays, Passing an array to a function
   Structures: Introduction, Nested structures, Arrays of structures, Structures and functions
   Implement a shopping cart system for an E-store in C using array of structures with the following functionalities.
   i) Add item
   ii) Delete an item

iii) Display items
iv) Billing information

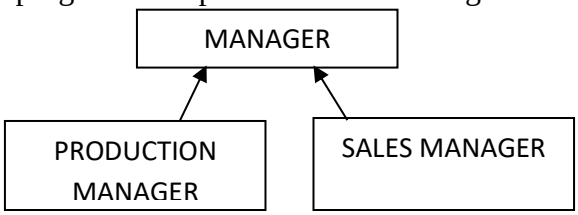
Additional Skills: Code documentation, Error diagnostics, Debugging techniques, Enhancing features to the given problem statement

3. Implement a simple banking application in C by making use of array of structures. Include the modules to
   i) Create a new account
   ii) Deposit amount
   iii) Withdraw amount
   iv) Balance Enquiry

   Additional Skills: Code documentation, Error diagnostics, Debugging techniques, Enhancing features to the given problem statement
4. **Files:** Introduction to files, using files in C, read data from files, writing data to files, Detecting the end of file, Error handling during file operations.
   Implement a simple inventory using data files in C. Include the modules
   i) Add/Delete a new part
   ii) Manufacture/Sales transaction
   iii) Display a particular part
   iv) Display stock of all parts

   Use separate files for each of the above operations and execute them with make utility.
5. **Object oriented programming using C++:** A look at Procedure-oriented Programming, Object-oriented programming paradigm, Basic concepts of OOP, Benefits of OOP, Object Oriented languages, Applications of OOP. Console I/O operations using cin and cout, A sample C++ program, specifying a class, creating objects, accessing class members, Defining member functions. Constructors, Parameterized constructors, Multiple constructors in a class, Destructors
   Write and execute a C++ program to read ***n*** students' details - Name, USN, and Marks in 3 subjects. Calculate and display the total, percentage and grade obtained for each student. Refer the following table for grading
   >= 80 Grade is A
   >=70 and <80 grade B
   >=60 and <70 Grade C
   Create a STUDENT class; initialize the student details using constructors.
6. **OOPs concepts using C++:** Scope resolution operator, Function overloading
   Write and execute C++ program with function overloading to calculate the area of a circle, rectangle and a triangle.

7. Write and execute a C++ program to implement the COMPLEX number class and perform the following operations:
   i) Read a COMPLEX number
   ii) Display a COMPLEX number.
   iii) Add 2 COMPLEX numbers (use objects as function arguments).
   iv) Add an integer number to one of the COMPLEX numbers.
8. **OOPs concepts using C++:** Introduction to Inheritance, Defining Derived classes, Single inheritance, Multilevel inheritance, Friend and Virtual functions, Polymorphism, Write and execute a C++ program to implement the following class hierarchy



Perform the following operations with the help of runtime polymorphism:

i) Read the basic salary and calculate the net salary for both PRODUCTION MANAGER and SALES MANAGER using the following details:
PRODUCTION MANAGER – HRA =10%, DA=75%, Allowance=60%
SALES MANAGER – HRA =10%, DA=75%, Allowance=20%, Travelling Allowance=80%

ii) Display the gross salary of both managers.

iii) Display the number of objects created for each class in the hierarchy using static data member.

Books

1. Reema Thareja, Programming in C, Oxford University Press, First Edition, published in 2011. [Chapters 1,2,4,5,7,8,9]
2. Byron S. Gottfried and Jitender Kumar Chhabra, Schaum's Outlines, Programming with C Tata Mc Graw –Hill Publishing Company Ltd., Second Edition [Chapters 1 and 5]
3. Reema Theraja, Object Oriented Programming with C++, Oxford University Press, First Edition, Published in 2015
4. E. Balaguruswamy, Object-Oriented Programming with C++, Tata McGraw Hill, 6th Edition.

E-Recourses

1. https://www.geeksforgeeks.org/c-programming-language/
2. https://www.programiz.com/

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Analyze given problem and develop the necessary programs using functions, pointers and structures.	L3
2. Identify and demonstrate the need for Object Oriented Programming for software development.	L2
3. Design and develop software programs using OOP concepts like Encapsulation, Polymorphism and Inheritance.	L3
4. Design and develop programs for various problems with the ability to debug and fix errors/bugs.	L4

Program Outcome of this course (POs)	PO No.
1. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
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.	**2**
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.	**3**

4.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
5.	**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.	**11**
6.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.	**12**

Assessment methods

1. Course project
2. Viva
3. Quiz

Lab courses:

Scheme of Continuous Internal Evaluation (CIE):

Components	Attendance/conduct of lab	Journal	Lab project	Total Marks
Maximum marks :25	10	10	5	25
Submission and certification of journal is compulsory to qualify for SEE Minimum marks required to qualify for SEE: 10 out of 25 marks				

Semester End Examination (SEE):

1.	It will be conducted for 50 marks having 3 hours/2 hours duration. It will be reduced to 25 marks for the calculation of SGPA and CGPA.		
2.	Only one experiment to be conducted. In case, there are two parts then one experiment from each part.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiment(s), result and conclusion	20 marks	
	One marks question	10 marks	
	Viva-voce	10 marks	
4.	Viva voce is conducted for individual student and not in group		
5.	Minimum passing marks to be scored in SEE: 20 out of 50 marks		

Networking Lab

Course Code	18ECL68	**Credits**	1
Course type	L1	**CIE Marks**	25 marks
Hours/week: L – T – P	0 – 0 – 2	**SEE Marks**	25 marks
Total Hours:	24 Hours	**SEE Duration**	3 Hours/2 Hours for 50 marks

Course learning objectives

1. To study and understand the packet tracer tool.
2. To design the network and configure the nodes to illustrate the data interactions in the network.
3. To simulate and verify the routing information protocol.
4. To study and simulate the local area network using Nctuns tool.
5. To simulate the computer nodes by different topology & establishing the duplex links between them and finding the performance parameters.

List of experiments

1. Study of networking devices, NIC card and cable crimping process needed for network deployment.
2. Study of CISCO packet tracer.
3. Design a local area network, configure the nodes, switches and illustrate the data flow.
4. Simulate the different network topologies using CISCO packet tracer.
5. Simulate Routing Information Protocol (RIP) algorithm using CISCO packet tracer.
6. Simulate a three nodes point-to-point network with duplex links and find the number of packets dropped using TCP and UDP.
7. Simulate data communication between single sender and multiple receiver and determine the PDR by network using TCP/UDP.
8. Simulate an Ethernet LAN using N-nodes. Change error rate and data rate and compare the throughput.
9. Analyze the PDR for star topology by varying the number of sender and receiver nodes.
10. Simulate the wireless LAN and represent the packet drop and throughput graphically.

Open ended experiment: Configuration of DHCP using CISCO packet tracer

Books

1. Larry L. Peterson and Bruce S. Davie, Computer Networks, Morgan Kaufmann Publications, 5thEdition and onwards.
2. William Stallings, “Data and Computer Communications”, Prentice-Hall, 2007

E-Recourses

2. https://www.coursera.org/lecture/internet-connection-how-to-get-online/packet-tracer-building-a-small-network-dv7Pn

Course Outcome (COs)

At the end of the course, the student will be able to	Bloom's Level
1. Illustrate the computer network with different topology.	L2
2. Develop the routing information protocols (RIP) and analyze the performance using the packet tracer tool.	L3
3. Design the local area networks and demonstrate the performance graphs using Nctuns tool.	L4
4. Simulate and analyze the performance of data networks using TCP/UDP protocols.	L4

Program Outcome of this course (POs)	PO No.
1. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**1**
2. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	**5**
3. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	**12**

Assessment methods

1. Journal submission
2. Internal Assessment Tests
3. Conduction of experiment.

Lab courses:

Scheme of Continuous Internal Evaluation (CIE):

Components	Attendance/conduct of lab	Journal	Lab project	Total Marks
Maximum marks :25	10	10	5	25
Submission and certification of journal is compulsory to qualify for SEE Minimum marks required to qualify for SEE: 10 out of 25 marks				

Semester End Examination (SEE):

1.	It will be conducted for 50 marks having 3 hours/2 hours duration. It will be reduced to 25 marks for the calculation of SGPA and CGPA.		
2.	Only one experiment to be conducted. In case, there are two parts then one experiment from each part.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiment(s), result and conclusion	20 marks	

	One marks question	10 marks	
	Viva-voce	10 marks	
4.	Viva voce is conducted for individual student and not in group		
5.	Minimum passing marks to be scored in SEE: 20 out of 50 marks		

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN VALUES

Course Code	18EC69A	**Credits**	1
Course type	HS	**CIE Marks**	25
Hours/week: L-T-P	1 – 0 – 0	**SEE Marks**	25
Total Hours:	30	**SEE Duration**	2 Hours

Course learning objectives

1. To provide basic information about Indian Constitution.
2. To identify individual role and ethical responsibility towards society

Pre-requisites : English Language, Social Studies

Unit – I Human Values 8 Hours

Chapter 1: Objectives, Morals , Values, Ethics, Integrity, Work ethics, Service learning, Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage ,Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the work place, Spirituality.

Unit – II Professional Ethics 10 Hours

Chapter 2: Engineering Ethics: Overview, senses of engineering ethics, variety of moral issues, types of enquiries, moral dilemma, moral autonomy, moral development (theories), consensus and controversy, profession, models of professional roles, responsibility,

Chapter 3:

Theories about right action (ethical theories), self-control, self-interest, customs, religion, self-respect, case studies (Choice of the Theory), engineering as experimentation, engineers as responsible experimenters.

Chapter 4: Codes of ethics, Environmental ethics, Computer ethics, Engineers as managers, Ethics and code of business conduct in MNC.

Unit – III Constitution of India 12 Hours

Chapter 5: Introduction to Constitution of India- Formation and Composition of the Constituent Assembly –Salient features of the Constitution- Preamble to the Indian Constitution-Fundamental Rights- Fundamental Duties - Directive principles of state policy.

Chapter 6: Parliamentary system of governance-Structure of Parliament- Loksabha and Rajyasabha- Functions of Parliament- Legislative, Executive, Financial functions, Powers of Loksabha and Rajyasabha- Procedure followed in parliament in making law- Lokpal and functionaries.

Structure of union executive- Power and position of President, Vice President, Prime Minister and council of Ministers. Structure of Judiciary- Jurisdiction and functions of Supreme Court, High Court and subordinate courts.

Chapter 7: Federalism in Indian Constitution, Division of Powers- Union List, State List and Concurrent List, Structure of State legislation, Legislative Assembly and Legislative Council, Functions of State legislature, Structure of State Executive- Powers and positions of Governor, Speaker, Deputy Speaker, Chief Minister and Council of Ministers.

Local self government- meaning- Three tier system- Village Panchayat- Taluka Panchayat-Zilla Panchayat- Local Bodies- Muncipalities and Corporations, Bruhath Mahanagara Palike. Functions of Election Commission, UPSC, KPSC.

1. Durga Das Basu : " Introducing to the Constitution on India', (Students Edn.) Prentice – Hall EEE, 19th / 20th Edn., 2001
2. Raman B.S. and Yagi R.K., Constitutional Law and Professional Ethics, United Publishers, 2005
3. Rajaram M., Constitution of India and Professional Ethics, New Age International Publishers, 3rd Ed.,
4. Nagarazan R.S., Professional Ethics and Human Values, New Age International Publishers Pvt.Ltd. 2006

Course Outcome (COs)		
At the end of the course, the student will be able to**:**		Bloom's Level
1.	Know and explain state and central policies, fundamental duties.	L1, L2
2.	Know and explain the functioning of the democracy in the country	L1, L2
3.	Appreciate and practice the ethical issues	L3
4.	Know and apply the code of ethics practiced in the professional bodies.	L1, L3

Program Outcome of this course (POs)		**PO No.**
1.	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6
2.	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	8

Course delivery methods		**Assessment methods**	
1.	Lecture	1.	I. A. test
2.	Presentation	2.	SEE
3.	Expert talks		

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of 2 IA tests	Average of assignments (Two) / activity	Quiz	Class participation	Total Marks
Maximum Marks: 25	25	----	----	-----	25

- Writing two IA tests is compulsory.
- Descriptive type questions.
- One unit each for each IA test.
- **Minimum marks required to qualify for SEE :** 10 marks out of 25

Scheme of Semester End Examination (SEE):

1. SEE question paper for 50 marks having descriptive type questions will be conducted for two hours duration. It will be reduced to 25 marks for the calculation of SGPA and CGPA.
2. Choice in each unit.

EMPLOYABILITY SKILLS – II

Course Code	18EC69B	Credits	MNC
Course Type	MNC	CIE Marks	50 Marks
Hours/Week: L-T-P	3 – 0 – 0	SEE Marks	--
Total Hours	30 Hours	SEE Duration	--

Course Learning Objective: The course is designed to develop the employability skills of a student.

SYLLABUS

Module 1 **6 Hours**

***Quantitative Aptitude*:** Time, Speed and Distance (3)

Verbal Ability: Change of Speech and Voice (3)

Module 2 **6 Hours**

***Quantitative Aptitude*:** Permutation and Combination (2)

Logical Reasoning*:** Coding and Decoding (1), Syllogisms (1.5) ***Soft Skills: Interview Skills (1.5)

Module 3 **6 Hours**

***Quantitative Aptitude*:** Probability (2),

***Logical Reasoning*:** Data Sufficiency (1), Clocks (1.5), Calendars (1.5)

Module 4 **6 Hours**

***Quantitative Aptitude*:** Alligation and Mixtures (2), Data Interpretation (1)

***Logical Reasoning*:** Cubes (1)

Verbal Ability: Closet Test (2)

Module 5 **6 Hours**

***Quantitative Aptitude*:** Simple and Compound Interest (2), Ages (1)

Soft Skills: Resume Writing (1.5), Group Discussions – Mock (1.5)

TEXT BOOKS:

1. How to prepare for Quantitative Aptitude for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education (India) Private Limited, 4th Edition, 2018.

2. How to prepare for Logical Reasoning for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education (India) Private Limited, 8th Edition, 2018.

3. How to prepare for Verbal Ability and Reading Comprehension for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 8th Edition, 2018.

4. How to prepare for Data Interpretation for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education (India) Private Limited, 5th Edition, 2018.

Course Outcomes (Cos):

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

1. Clear the Aptitude round of recruiters during placements.
2. Perform confidently during the GD and Interview process.
3. Develop resumes that are grammatically correct and written in Business English.
4. Develop behaviors that are appropriate for a professional.

Course Delivery Methods

- Black Board Teaching
- Power Point Presentation
- Class Room Exercise

Assessment Methods

- Internal Assessment Test
- Assignments
- Quiz

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two	Average of two	Class	Total
Maximum Marks: 50	25	15	10	50

- Writing two IA tests is compulsory
- **Minimum marks required to clear the subject: Minimum IA test marks (Average)**

10 out of 25 AND total CIE marks 20