KARNATAK LAW SOCIETY'S

GOGTE INSTITUTE OF TECHNOLOGY

"JNANA GANGA" UDYAMBAG, BELAGAVI-590008,
KARNATAKA, INDIA.
Approved by AICTE and UGC
Permanently Affiliated and Autonomous Institution
Under
Visvesvaraya Technological University, Belagavi
www.git.edu

ESTD. 1939

ESTD. 1979

5th to 8th Semester B.E.

Electronics and Communication Engineering

Scheme and Syllabus (2021 Scheme)

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.

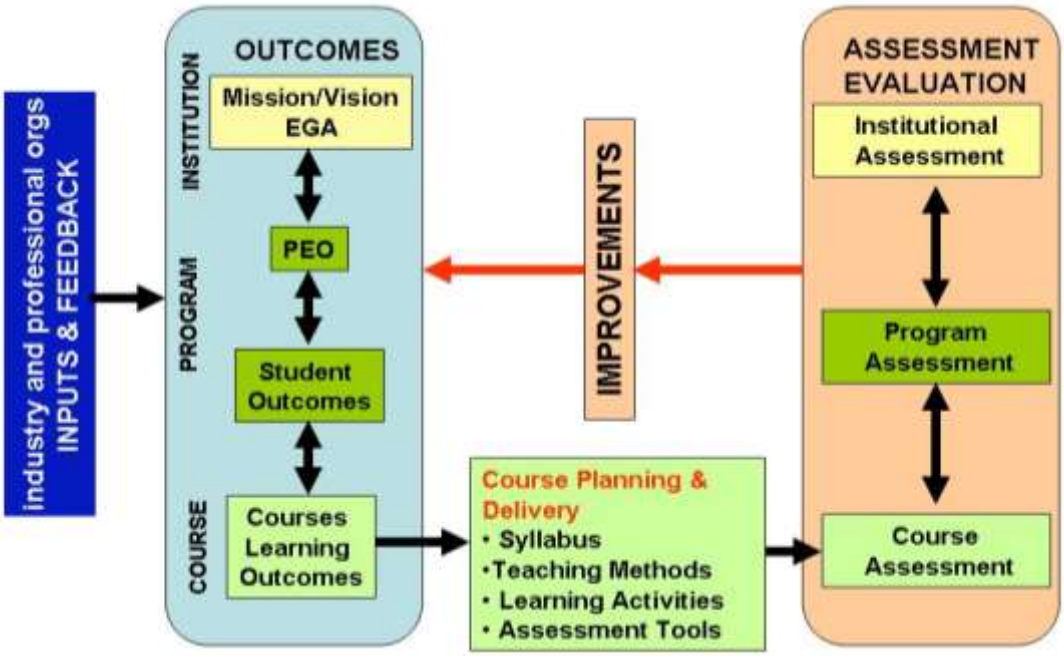
DEPARTMENT MISSION
To augment the national talent pool, with Electronics and Communication Engineers having all-encompassing technical knowledge, principled practices and nationalistic outlook.

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 OUTCOMES (POs)	
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2.	**Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3.	**Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
4.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
5.	**Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6.	**The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7.	**Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8.	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9.	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
10.	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
11.	**Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC 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.

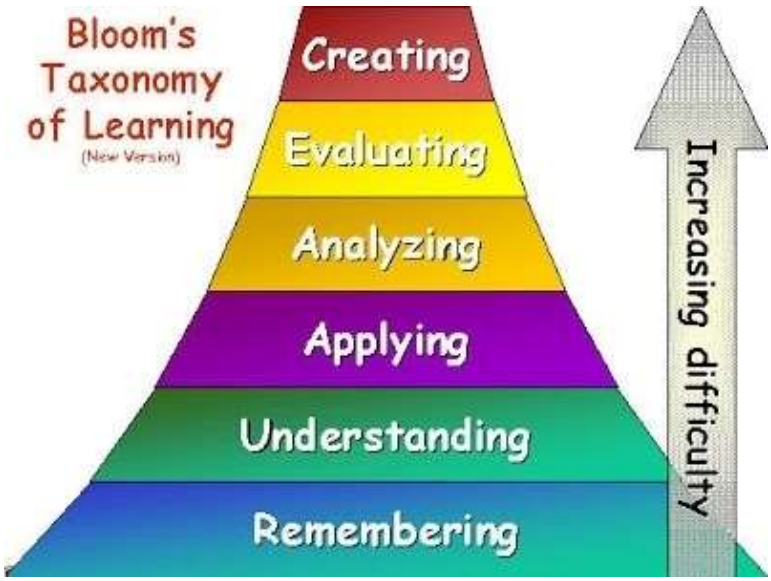
OUTCOME BASED EDUCATION (OBE)



BLOOM'STAXONOMYOFLEARNINGOBJECTIVES

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 21stcentury. 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	Breakdown 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.



KLS Gogte Institute of Technology
B.E. in Electronics and Communication
3rd to 8th Semester B.E. Scheme of Teaching and Examination 2021-22
(Effective from the academic year 2021-22)

Total credits for B.E. Program: 160

As per the guidelines of UGC CBCS the courses can be classified into:
Abbreviations used:
BSC - Basic Science Course, **PCC-** Professional Core Course, **HSMC -** Humanity and Social Science & Management Courses, **PEC-** Professional Elective Course, **OEC –** Open Elective Course, **AEC –** Ability Enhancement Courses. **INT –** Internships, **UHV –**Universal Human Values, **MP -** Mini Project.
L –Lecture, **T –** Tutorial, **P-** Practical/Drawing, **S –** Self Study Component, **CIE –**Continuous Internal Evaluation, **SEE –**Semester End Examination

Foundation Courses: The Foundation Courses are of two kinds:
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 (BSC), Engineering Science Courses (ESC)**.

Professional Core Courses (PCC): 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.

Universal Human Value Courses (UHV): These are value-based courses aimed at man making education.
Humanities and Social Science including Management Studies Courses (HSMS). Humanity and Social Science Courses: The Humanities and Social Sciences are the studies of human behavior and interaction in social, cultural, environmental, economic, and political contexts. The Humanities and Social Sciences have a historical and contemporary focus, from personal to global contexts, and consider challenges for the future. Students will develop the ability to question, think critically, solve problems, communicate effectively, make decisions, and adapt to change. Thinking about and responding to issues requires an understanding of the key historical, geographical, political, economic, and societal factors involved, and how these different factors interrelate. Humanities and Social Science Courses includes-Technical-English, Courses on Regional/State languages (Kannada), etc.

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 Course (PEC)** or may be chosen from other discipline (**Open Elective Course- OEC**).
Ability Enhancement Courses (AEC): The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC).
"AECC" courses are the courses based upon the content that leads to Knowledge enhancement; Environmental Science, English. Biology for Engineers, Bioinformatics, Music and Vibration, Art and Architecture etc

"SEC" courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

Mandatory Non-Credit Courses (MNC): These courses are mandatory but do not have any credits and students must successfully complete these courses before the completion of degree.

Theory courses having the corresponding lab are converted to integrated type course. Also, the electives (if possible) can also be made integrated type.

Integrated courses (Professional Core/Electives): Integrated courses will have **Theory Syllabus with Practical Syllabus of the same course**. In such a course there could be **no Semester End Examination (SEE) for the practical syllabus** of the course, however, Continuous Internal Evaluation (CIE) will be conducted for the practical topics.

Credit definition:

Offline Courses	**Online Courses**
• 1-hour Lecture **(L)** per week = 1 Credit • 2 hours Tutorial **(T)** per week = 1 Credit, • 2 hours Practical /Drawing **(P)** per week = 1 Credit	04 weeks =1 Credit 08 weeks = 2 Credit 12 weeks = 3 Credit
• Four-credit courses are to be designed for 50 hours of Teaching-Learning process. • Three credit courses are to be designed for 40 hours of Teaching-Learning process. • Two credit courses are to be designed for 25 hours of Teaching-Learning process. • One credit courses are to be designed for 15 hours of Teaching-Learning process.	

Semester wise distribution of credits for B.E program

Year	**Semester**	**Credits**	**Total/Year**	**Cumulative Credits**
1st	**AE, CV, ME (I-P & II-C)**	19+21	**40**	**40**
	CSE, EC, EE, ISE (I-C & II-P)	18+22		
2nd	**III**	20	**40**	**80**
	IV	20		
3rd	**V**	23	**45**	**125**
	VI	22		
4th	**VII**	17	**35**	**160**
	VIII	18		
Total			**160**	

Curriculum frame work:

Structure of Undergraduate Engineering program

S.No.	Category of courses	VTU Breakup of credits	KLSGIT Breakup of credits
1	Humanities and Social Sciences including Management courses (English, Kannada, Indian Constitution, Environmental Sciences and Management)	10	8
2	Basic Science courses	23	22
3	Engineering Science courses including workshop, drawing	20	20
4	Professional Core Courses	46	49
5	Professional Elective courses relevant to chosen specialization/branch	9	9
6	Open subjects – Electives from other technical, emerging, arts commerce and	6	9
7	Mini, Project, Major Project work and Seminar	13	9
8	Summer Internship and Research /Industrial Internship	20	20
9	Ability Enhancement Courses, including Research Methodology, NCC/NSS/ Sports/Ex- Curricular, Online Certification Course	11	12
10	Universal Human Values	2	2
	TOTAL	**160**	**160**

L-T-P Model for Courses

	Contact Hours				Credits	
S.No.	**L-T-P**	**Lecture**	**Tutorial**	**Practical**	**L-T-P**	**Total**
1	3 - 0 - 0	3	0	0	3 - 0 - 0	3
2	3 - 2 - 0	3	2	0	3 - 1 - 0	4
3	3 - 0 - 2	3	0	2	3 - 0 - 1	4
4	2 - 0 - 2	2	0	2	2 - 0 - 1	3
5	1 - 0 - 4	1	0	4	1 - 0 - 2	3

3rd Semester B.E. ECE				Teaching Dept.	Hours/week			Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title		L	T	P			CIE	SEE	Total
1	BSC	21MATEC31	Transforms and Probability Theory	Mathematics	3	0	0	3	3	100	100	200
2	IPCC	21EC32	Applied electronic circuits	E & C	3	0	2	5	4	100	100	200
3	IPCC	21EC33	Digital system design	E & C	3	0	2	5	4	100	100	200
4	IPCC	21EC34	Sensors, measurement and data acquisition systems	E & C	3	0	2	5	4	100	100	200
5	INT	21EC35	Summer Internship -I	E & C					2	50	50	100
6	HSMS	21EC36	Constitution of India	E & C	1	0	0	1	1	50	50	100
7	UHV	21EC37	Social Connect and Responsibility	E & C	1	0	0	1	1	50	50	100
8	AEC	21ECAEC38x	AEC- III	E & C	1	0	0	1/2	1	50	50	100
					0	0	2					
9	BSC*	21MATDIP31	MATDIP	Mathematics	3	0	0	3	MNC	100	--	100
			TOTAL						**20**	**600+100***	**600**	**1200+100***

*Only for Diploma Lateral Entry Students

4th Semester B.E. ECE				Teaching Dept.	Hours/week			Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title		L	T	P			CIE	SEE	Total
1	BSC	21MATEC41	Advanced Linear Algebra, Vector Calculus and Statistics	Mathematics	3	0	0	3	3	100	100	200
2	IPCC	21EC42	Microcontrollers	E & C	3	0	2	5	4	100	100	200
3	IPCC	21EC43	Signals and Control Systems	E & C	3	0	2	5	4	100	100	200
4	IPCC	21EC44	Principles of Communication Systems	E & C	3	0	2	5	4	100	100	200
5	AEC	21EC45	Health and Wellness	E & C	2	0	0	2	2	50	50	100
6	HSMS	21EC46	Kannada	Kannada	1	1	0	1	1	50	50	100
7	UHV	21EC47	Universal Human Values and Professional Ethics	E & C	1	0	0	1	1	50	50	100
8	AEC	21ECAEC48x	AEC- IV	E & C	1	0	0	1/2	1	50	50	100
					0	0	2					
9	BSC*	21MATDIP41	MATDIP	Mathematics	3	0	0	3	MNC	100	--	100
			TOTAL						**20**	**600+100***	**600**	**1200+100***

*Only for Diploma Lateral Entry Students

List of Ability Enhancement Courses (AEC)

Course Code	Course Title
21ECAEC381/481	Software development concepts
21ECAEC382/482	Fundamentals of microprocessor & microcontrollers
21ECAEC383/483	MATLAB and Simulink
21ECAEC384/484	Design thinking

Summer Internship-II: At the End of **fourth Semester four - weeks Summer Internship** Shall Be Carried Out – Based on Industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship. It will be credited in fifth Semester. All the students admitted shall have to undergo mandatory internship of 04 weeks during the vacation of IV semesters. A Viva-Voce examination shall be conducted during V semester and the prescribed credit shall be included in V semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements. SEE component will be the only seminar/Presentation and question answer session. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship).

Kannada: Balake Kannada (Kannada for communication) is for non-Kannada speaking, reading, and writing students, and Samskrutika Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

Professional Elective Courses [5th-7th sem]: Electives will be offered by the respective department.
Open Elective Courses [5th-7th sem]: All Open Electives are offered to students of all branches in general. However, a student shall choose an open Elective from the list in such a manner that he/she has not studied the same course in any form during the Programme. Students can select any one of the open electives offered by other Departments except those that are offered by the parent Department.
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.
- Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Mini-project work(Single discipline/Interdisciplinary)[6th sem]: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini-project can be assigned to an individual student or a group having not more than 4 students. (or Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications)
Research/Industrial Internship - At the End of the sixth / Seventh semester (in two cycles to accommodate all the students of the University) Research/Industrial Internship shall be carried out – Based on industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship. All the students admitted shall have to undergo a mandatory internship of 24 weeks during the vacation of VI/VII semesters. A Viva-Voce examination shall be conducted during VII/VIII semester and the prescribed credit shall be included in VII/VIII semester. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.
Research internship: Students have to take up research internships at Centers of Excellence (CoE) / Study Centers established in the same institute and /or out of the institute at reputed research organizations / Institutes. A research internship is intended to give you the flavour of current research going on a particular topic/s. The internships serve this purpose. They help students get familiarized with the field, the skill needed the effort amount and kind of effort required for carrying out research in that field.

Certification (6- 8 weeks duration; shall have proctored examination): **It can be done any time between 5th – 8th sem and credited during the 8th semester.**

- NPTEL/SWAYAM/NASSCOM /Industry-Institute partnered certification (List of the courses will be notified by the departments).

5th Semester B.E. ECE					Hours/week				Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title	Teaching Dept.	L	T	P	S			CIE	SEE	Total
1	PCC	21EC51	DSP and Applications	E & C	3	0	0		3	3	100	100	200
2	IPCC	21EC52	VLSI Circuit Design	E & C	3	0	2		5	4	100	100	200
3	IPCC	21EC53	Electromagnetic Theory and Antenna Engineering	E & C	3	0	2		5	4	100	100	200
4	PEC	**21EC54x**	**Professional Elective – I**	E & C	3	0	0		3	3	100	100	200
5	OEC	**21EC55x**	**Open Elective – I**	E & C	3	0	0		3	3	100	100	200
6	INT	21EC56	Summer Internship – II	E & C	0	0	6		6	3	100	-	100
7	AEC	21EC57	Research Methodology & Intellectual property rights	E & C	1	0	0		1	1	50	50	100
8	AEC	21EC58	Employability Skills – I	Bizotic	1	0	0		1	1	100	-	100
9	HSMS	21EC59A	Environmental Studies	Chem/CV	1	0	0		1	1	50	50	100
10	HSMS	21EC59B	Communicative English*	English	1	0	0		1	MNC*	100*	-	100*
			TOTAL							**23**	**800+100***	**600**	**1400+100***

***Only for Diploma Lateral Entry Students**

Environmental Studies: Paper setting: Civil Engineering Board

Professional Elective: The minimum students' strength for offering professional electives is **05**, if the strength is less than the 05 then the department has to take the permission to offer the course.

Open Elective Courses: All Open Electives are offered to students of all branches in general. However, a student shall choose an open Elective from the list in such a manner that he/she has not studied the same course in any form during the Programme. Students can select any one of the open electives offered by other Departments except those that are offered by the parent Department.

Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.
- Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Courses from Law, Business (MBA), Medicine, Arts, Commerce, may be offered as Open Elective Courses (OEC).

The minimum students' strength for offering professional electives is **05,** if the strength is less than the 05 then departments have to take the permission to offer the course.

Professional Elective – I	
Course Code	**Course Title**
21EC541	Automotive Systems
21EC542	Operating System
21EC543	Power Converters
21EC544	Nano Electronics
21EC545	Embedded System Design
21EC546	Digital Image Processing
21EC547	Multimedia Processing and Communication
21EC548	Cryptography and Network Security
21EC549	Requirements Engineering

Open Elective – I	
Course Code	**Course Title**
21EC551	Health Care Systems
21EC552	Bio Medical Image Understanding and Analysis
21EC553	Modern Electric, Hybrid Electric and Fuel Cell Based Vehicles
21EC554	Embedded Systems with Arduino

6th Semester B.E. ECE					Hours/week				Total contact hours/week	Credits	Examination		
S.No.	**Course Type**	**Course Code**	**Course Title**	**Teaching Dept.**	**L**	**T**	**P**	**S**			**CIE**	**SEE**	**Total**
1	HSMS	21EC61	Management for Electronics Engineering	E & C	3	0	0		3	3	100	100	200
2	PCC	21EC62	Machine learning and Applications	E & C	3	0	0		3	3	100	100	200
3	IPCC	21EC63	Data Communication and Networks	E & C	3	0	2		5	4	100	100	200
4	IPCC	21EC64	Microwave and Radar	E & C	3	0	2		5	4	100	100	200
5	PEC	**21EC65xx**	**Professional Elective – II**	E & C	3	0	0		3	3	100	100	200
6	OEC	**21EC66x**	**Open Elective – II**	E & C	3	0	0		3	3	100	100	200
7	MP	21EC67	Mini Project	E & C	0	0	2		2	1	100	-	100
8	AEC	21EC68	Employability Skills – II	Bizotic	1	0	0		1	1	100	-	100
			TOTAL							**22**	**800**	**600**	**1400**

Mini-project work (Single discipline/Interdisciplinary): Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini-project can be assigned to an individual student or a group having not more than 4 students. (or Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications)

Research/Industrial Internship - At the End of the sixth / Seventh semester (in two cycles to accommodate all the students of the University) Research/Industrial Internship shall be carried out – Based on industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship. All the students admitted shall have to undergo a mandatory internship of 24 weeks during the vacation of VI/VII semesters. A Viva-Voce examination shall be conducted during VII/VIII semester and the prescribed

credit shall be included in VII/VIII semester. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.
Research internship: Students have to take up research internships at Centers of Excellence (CoE) / Study Centers established in the same institute and /or out of the institute at reputed research organizations / Institutes. A research internship is intended to give you the flavour of current research going on a particular topic/s. The internships serve this purpose. They help students get familiarized with the field, the skill needed the effort amount and kind of effort required for carrying out research in that field.

Professional Elective – II	
Course Code	**Course Title**
21EC6501	Modern Electric, Hybrid Electric and Fuel Cell Based Vehicles
21EC6502	Low Power Architecture
21EC6503	Digital System Design on FPGA
21EC6504	Robotics & Automation
21EC6505	Bio Medical Image Understanding and Analysis
21EC6506	Adaptive Digital Signal Processing
21EC6507	Internet of Things and Cyber Physical Systems
21EC6508	Computational Intelligence
21EC6509	Database Management Systems
21EC6510	Digital Forensics

Open Elective – II	
Course Code	**Course Title**
21EC661	Nano Electronics
21EC662	Human Computer Interaction
21EC663	Digital Image Processing
21EC664	Requirements Engineering

7th Semester B.E. ECE					Hours/week				Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title	Teaching Dept.	L	T	P	S			CIE	SEE	Total
1	PCC	21EC71	Wireless Communication Techniques	E & C	3	0	0		3	3	100	100	200
2	PEC	**21EC72x**	**Professional Elective – III**	E & C	3	0	0		3	3	100	100	200
3	OEC	**21EC73x**	**Open Elective – III**	E & C	3	0	0		3	3	100	100	200
4	Project	21EC74	Project work	E & C	0	0	14		14	7	100	100	200
5	AEC	21EC75	Sports/Cultural/NSS/NCC/Club activities		0	0	1		1	1	100	-	100
			TOTAL							**17**	**500**	**400**	**900**

Professional Elective – III	
Course Code	**Course Title**
21EC721	Advanced VLSI Design
21EC722	RF and Microwave Integrated Circuits
21EC723	Biomedical System Design
21EC724	Satellite Communication Techniques
21EC725	Data Science
21EC726	Natural Language Processing
21EC727	Human Computer Interaction
21EC728	Cyber Security – A Practical Approach*

***Project based learning course**

Open Elective – III	
Course Code	**Course Title**
21EC731	Artificial Neural Networks
21EC732	Fundamentals of Robotics
21EC733	Digital Forensics
21EC734	Computational Intelligence

8th Semester B.E. ECE					Hours/week				Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title	Teaching Dept.	L	T	P	S			CIE	SEE	Total
1	Seminar	21EC81	Technical Seminar	E & C	0	0	1		1	1	100	-	100
2	AEC	21EC82	Certification (Minimum 6 - 8 weeks)	E & C	0	0	4		4	2	100	-	100
3	INT	21EC83	Research/Industry Internship (24 weeks)		0	0	30		30	15	100	100	200
			TOTAL							**18**	**300**	**100**	**400**

Certification (Shall have proctored examination):

- NPTEL/SWAYAM/NASSCOM /Industry-Institute partnered certification.
- List of the courses will be notified by the departments

DSP AND APPLICATIONS

Course Code	**21EC51**	**Course type**	**PCC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To perform spectral analysis of a given signal using DFT IDFT method.
2.	To apply efficient algorithms like FFT for spectral and Time domain analysis of DT signals and System
3.	To design IIR and FIR digital Filters to meet the given frequency domain constraints

Pre-requisites: SIGNALS AND CONTROL SYSTEMS (21EC43)

Unit – I	**Contact Hours = 8 Hours**
Discrete Fourier Transforms (DFT): Direct Computation of DFT, Introduction to DFT, DFT as a linear transformation, its relationship with Fourier Series, Fourier and z-transforms. Properties of DFT: Multiplication of two DFTs, Circular convolution, Additional DFT Properties, Use of DFT in linear and Speech filtering applications, Fast Convolution, Overlap-save and overlap-add method.	

Unit – II	**Contact Hours = 8 Hours**
Fast Fourier Transform (FFT): Disadvantages of Direct DFT Computation, Need for efficient computation of the DFT (FFT algorithms), Significance of FFT in DSP Radix-2 FFT algorithm for the computation of DFT and IDFT decimation-in-time and decimation-in-frequency algorithms. Introduction to FFT computation when N is a composite number [N=6 and N=9], Applications of FFT to Voice, Video, and Sensor signal analysis, Vibrations analysis.	

Unit – III	**Contact Hours = 8 Hours**
IIR filter design: Characteristics of commonly used analog filters - Butterworth and Chebyshev Type-1 filter, Analog to analog frequency transformations, Design of Analog BUTTERWORTH and Chebyshev Type-1 filter design. Digital IIR Filter design using Bilinear transformation and Approximation of derivatives Method, Design of A/D-H(z)-D/A Structure to meet the given constraints, Structures for IIR systems[Recursive Structures]: Direct form I and form II systems, cascade, Lattice and parallel Structures. Designing Filter for applications like band limiting, Noise suppression, Enhancing the signal quality.	

Unit – IV	Contact Hours = 8 Hours
FIR Filter Design: FIR Filter design using windows- Rectangular, Hamming, Bartlet and Kaiser windows, Frequency sampling technique of designing FIR Digital filter. Implementation of FIR filter Structures[Non Recursive],Tapped Delay line form, Frequency Sampling and Linear Phase Structures, Designing Filter for applications like speech filtering, band limiting, Noise suppression, Enhancing the signal quality.	

Unit – V	Contact Hours = 8 Hours
Introduction to Programmable DSProcessor, Architectural features, ALU, MAC unit, comparison of commercially available PDSPs, Introduction to instruction set of PDSPs (Comparison of TMS320c54xx and TMS320C6xx), Implementation of algorithms using PDSPs	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	.John G Proakis and Dimitris G Manolakis 'Digital Signal Processing Principles, Algorithms and Applications' Pearson Education/Prentice Hall 4th Edition and onwards
2.	Oppenheim and Schaffer 'Discrete Time Signal Processing ' ,PHI 2003 Edition and Onwards,2002 2nd Edition and onwards.
	Reference Books:
1.	Emannual C Efeachor and Barry W Jervis, 'DIGITAL SIGNAL PROCESSING' A Practical Approach,Pearson Education, 2002 2nd Edition and onwards.
2.	S. K MITRA, 'Digital Signal Processing, TATA Mc Graw HILL,2010 ,3RD edition and onwards
	E-resourses (NPTEL/SWAYAM.. Any Other)-
1.	TMS320C6X Manual (Development Support) http://www.ti.com/lit/ug/spru226/spru226.pdf
2.	2. Digital Signal Processing, IIT Madras: https://nptel.ac.in/noc/individual_course.php?id=noc19-ee50

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 (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Appraise the fundamental DSP concepts, principles, theories, and terminology used in the course.	Ap	1,2	1,2
2.	Apply FFT principles and practices for Spectral Analysis of DT Signals and Systems and to Collaborate effectively within professional teams to update the knowledge in the upcoming areas.	Ap	1,2,3,5, 12	1,2
3.	To develop expertise in the field of Digital filter design and Algorithm implementation, for solving Filtering and SNR Enhancement related practical problems of Industrial and Social relevance.	An	1,2,3,5, 12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓	✓		✓				✓	✓		✓	✓	✓	
2	✓	✓	✓		✓				✓	✓		✓	✓	✓	
3	✓	✓	✓		✓				✓	✓		✓	✓	✓	
4	✓	✓	✓		✓				✓	✓		✓	✓	✓	
Use tick mark (✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Design and Analyze Digital Filters	Communication and Signal Processing, Automobile Industry	DSP System Designer
2	Spectral Analysis using FFT		

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

VLSI CIRCUIT DESIGN

Course Code	21EC52	**Course type**	**IPCC**	**Credits L-T-P**	3 – 0 – 1
Hours/week: L-T-P	3 – 0 – 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To study the fundamentals of CMOS, the non-ideal effects and the basics of CAD Systems.
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 understanding their applicability to combinational and/or sequential circuits.

Required Knowledge of: Digital System Design, Analog Electronics

Unit – I	**Contact Hours = 8 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.	

Unit – II	**Contact Hours = 8 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.	

Unit – III	**Contact Hours = 8 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.	

Unit – IV	**Contact Hours = 8 Hours**
Combinational Circuit Design: Introduction; circuit families: ratioed circuits: pseudo nMOS, Cascode Voltage Switch Logic (CVSL), dynamic circuits, Domino logic, passtransistor circuits, Bi-CMOS circuits. **Sequential MOS Logic Circuits**: Introduction, behaviour 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.	

Unit –V	Contact Hours = 8 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.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
2	**1**	To verify DRC, LVS and QRC for Inverter
2	**2**	To verify DRC, LVS and QRC for 2 input NAND gate
2	**3**	To verify DRC, LVS and QRC for 3 input NAND gate
2	**4**	To verify DRC, LVS and QRC for 2 input NOR gate
3	**5**	To verify DRC, LVS and QRC for 3 input NOR gate
3	**6**	To verify DRC, LVS and QRC for Common Source Amplifier
3	**7**	To verify DRC, LVS and QRC for Common Drain Amplifier
3	**8**	To verify DRC, LVS and QRC for Differential Amplifier
3	**9**	To verify DRC, LVS and QRC for Boolean Expression y=((A*B)+(C*D))'
3	**10**	To verify DRC, LVS and QRC for Boolean Expression y=(A*(B+C))

Books	
	Text Books:
1.	Neil Weste, and David Harris, "CMOS VLSI Design, A Circuits and System Perspective", 4 th 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.
	Reference Books:
1	Wayne Wolfe, "Modern VLSI Design, System-On-Chip Design", Prentice Hall, 2002 Onwards

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)				
Learning Levels: **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the characteristics, non-ideal behaviour effects of a MOS device and CAD systems in VLSI design.	Un	1, 2	1
2.	Analyze RC delay concepts to design basic gates, circuits.	An	1,2,3,4,5,12	1
3.	Apply knowledge of design rules to construct stick diagrams, layout diagrams and design sequential combinational circuits using CMOS logic circuits.	Ap	1,2,3,4,5,12	1

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)/ Course project	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive					
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks 3. Viva voce: 5 marks					
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 10 marks 5. Viva voce: 10 marks					
Eligibility for SEE: 1. 40% and above (24 marks and above) in theory component 2. 40% and above (16 marks and above) in lab component 3. **Lab test is COMPULSORY** 4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks.

	3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓											✓		
2	✓	✓	✓	✓	✓							✓	✓		
3	✓	✓	✓	✓	✓							✓	✓		
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Manufacturing process: CMOS fabrication VLSI design Back-end design: EDA tools Library cells	Analog Circuit Design Design Verification Physical Design and Implementation ASIC design Front end design	Analog Circuit Design Engineer Senior Design Engineer Design Verification Engineer Physical Design and Implementation Engineer

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

ELECTROMAGNETIC THEORY AND ANTENNA ENGINEERING

Course Code	21EC53	**Course type**	IPCC	**Credits L-T-P**	3 - 0 - 1
Hours/week: L - T- P	3 - 0 - 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To discuss the concepts of static electromagnetic (EM) fields.
2.	To develop comprehensive and rigorous treatment of time varying EM fields.
3.	To develop a comprehensive treatment to various antenna applications.

Required Knowledge of: Applied Engineering Mathematics
Analysis and application of the concepts only.

Unit – I	**Contact Hours = 8 Hours**
Review: Vector analysis, Co-ordinate systems and transformations Static Electric Fields: 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. Definition of Potential Difference and Potential, Potential field due to Point Charge and System of Charge, Potential gradient, Laplace and Poisson's equations.	

Unit – II	**Contact Hours = 8 Hours**
Static Magnetic Fields: Biot-Savart's Law, Ampere's circuital law, Stokes Theorem, Magnetic Flux, Flux Density, Scalar and Vector Magnetic Potentials Magnetic forces (no derivations) Time Varying Fields and Maxwell's Equations: Faraday's Law, Displacement Current, Maxwell's correction to Ampere's Circuit Law, Summary of Maxwell's Equations in Point, Integral and Harmonic form,Wave equations, UPW (TEM wave) propagation in free space, dielectrics and good conductors.	

Unit – III	**Contact Hours = 8 Hours**
Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Bandwidth, Radio Communication Link, Antenna Field Zones & Polarization. Strip Lines: Introduction, MicroStrip lines, Parallel Strip lines, Coplanar Strip lines, Shielded Strip Lines.	

Unit – IV	**Contact Hours = 8 Hours**
Point Sources and Arrays: Introduction, Point Sources, Power Patterns, Power Theorem, Radiation Intensity, Field Patterns, Phase Patterns, Arrays of Two Isotropic Point Sources, Pattern Multiplication, Linear Arrays of n–$Isotropic$ point sources of equal Amplitude and Spacing. Electric Dipoles: Introduction, Short Electric Dipole (no derivation), Fields of a Short Dipole (General and Far Field Analyses), Radiation Resistance of a Short Dipole, Thin Linear Antenna (Field Analyses), Radiation Resistances of $\lambda/2$ Antenna.	

Unit – V	Contact Hours = 8 Hours
Loop and Horn Antenna: Introduction, Small loop, Comparison of Far fields of Small Loop and Short Dipole, The Loop Antenna General Case, Far field Patterns of Circular Loop Antenna with Uniform Current, Radiation Resistance of Loops, Directivity of Circular Loop Antennas with Uniform Current, Horn antennas, Rectangular Horn Antennas.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	2	Write a MATLAB code to plot the electric field variations due to line charge, sheet charge and volume charge
		Write a MATLAB program to determine Potential field due to Point Charge, System of Charge and Potential gradient.
2	2	Visualizing Maxwell's equations using MATLAB tool.
		Visualizing UPW (TEM wave) propagation in free space, dielectrics and good conductors using MATLAB tool.
3	2	Radiation pattern for various types of sources using MATLAB tool.
		Characteristics of Microstrip lines devices viz. ring resonator, directional coupler, power divider.
4, 5	4	Beam width, directivity and Radiation pattern for various types of antenna using MATLAB tool and hardware using Patch, Yagi, Dipole, Horn antenna. CST Microwave Studio

Unit No.	Self-Study Topics
1	**Energy Density**
2	**Force on a moving charge**
3	Losses in Microstrip lines
4	Applications of array of antenna
5	Applications of array of various types of antenna

Books	
	Text Books:
1.	Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 6th Edition, 2014 and onwards.
2.	John D. Krauss, "AntennasandWavePropagation",4thEdition, McGraw-Hill International, 2010 and onwards.
	Reference Books:
1.	William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", Mc. Graw-Hill Education, 2nd Edition, 2014 and onwards.
2.	Joseph A. Edminister, "Theory and Problems on Electromagnetics", Schaum's outline series, Mc.Graw-Hill, 2nd Edition, 1993 and onwards.
3.	David M. Pozar, "Microwave Engineering", John Wiley India Pvt. Ltd., 3rd Edition, 2008 and onwards.
4.	C. A. Balanis, "Antenna Theory Analysis and Design",3rd Edition, John Wiley India Pvt. Ltd., 2008

	and onwards.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Introduction to Electromagnetic Theory (IIT Kanpur) https://nptel.ac.in/courses/115104088

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Apply the concepts of static electromagnetic fields to relevant problems.	Ap	1, 4, 5, 6	1,2
2.	Analyze time varying electromagnetic fields to engineering applications of electromagnetic.	An	1, 4, 5, 6	1,2
3.	Analyze the electromagnetic fields to specific antenna types.	An	4, 5, 6, 12	1,2

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			LAB (40 marks)		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)/ Course project	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks

IA Test:

1. No objective part in IA question paper
2. All questions descriptive

Conduct of Lab:

1. Conducting the experiment and journal: 5 marks
2. Calculations, results, graph, conclusion and Outcome: 5 marks
3. Viva voce: 5 marks

Lab test: (Batchwise with 15 students/batch)

1. Test will be conducted at the end of the semester
2. Timetable, Batch details and examiners will be declared by Exam section
3. Conducting the experiment and writing report: 5 marks
4. Calculations, results, graph and conclusion: 10 marks
5. Viva voce: 10 marks

Eligibility for SEE:

1. 40% and above (24 marks and above) in theory component
2. 40% and above (16 marks and above) in lab component
3. **Lab test is COMPULSORY**
4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

CO-PO Mapping (planned)													CO-PSO Mapping (planned)		
CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
1	✓			✓	✓	✓			✓	✓			✓	✓	
2	✓			✓	✓	✓			✓			✓	✓	✓	
3				✓	✓	✓				✓			✓	✓	
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Antenna design Antenna development Antenna measurements	Antenna Design RF systems	Senior Antenna design engineer

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

AUTOMOTIVE SYSTEMS

Course Code	**21EC541**	Course type	**PEC**	Credits L-T-P	**3 – 0 – 0**
Hours/week: L - T- P	**3 – 0 – 0**			Credits	**3**
Total Contact Hours	**L = 40 Hrs; T = 0 Hrs; P = 0 Hrs** **Total = 40 Hrs**			CIE Marks	**100**
Flipped Classes content	**00 Hours**			SEE Marks	**100**

Course Learning Objectives	
1.	Discussion of basic concepts, classification and comparison of various types of vehicles available worldwide, under passanger vehicles and heavy vehicles category.
2.	Understanding various mechanical systems related to engine, lubrication, cooling and electrical systems like power source, starting, charging, body electronics, indicators etc.
3.	Elaborate study of vehicular chassis system like shock absorber, streeing, brake and also study of the manual and auto transmission systems and their basic components.
4.	Detailed discussion of all the above-mentioned system for Formula I cars.

Required Knowledge: Engineering mechanics, basic electrical and electronics engg, analog electronic circuits, network theorems, signals & systems, embedded systems, control systems.

Unit – I Basics of Vehicular Technology and Vehicle Dynamics	**Contact Hrs = 8**
Evolution of vehicular technology, types of vehicles based on propelling mechanisms, advantages & ill effects of fossil fuel-based vehicles, basic vehicle parameters and units, general description of vehicle dynamics, concept of vehicle resistance, power train, tractive effort, speed, acceleration, overall vehicle performance, brake performance, operating fuel economy,	

Unit – II Engine and Related Systems	**Contact Hrs = 8**
Engine mechanics, engine lubrication, engine cooling, air supply exhaust and emissions, fuel systems, ignition systems, hybrid cars, **Case Study** – Engine technology for Formula I cars.	

Unit – III Electrical Systems Related to Vehicles	**Contact Hrs = 8**
Basic principles in electrical & electronic systems, batteries, starting systems, charging systems, lighting and indicators, body electrical and electronic systems, monitoring and instrumentation, air conditioning, **Case Study** – Electrical technology for Formula I cars.	

Unit – IV Chassis Systems	**Contact Hrs = 8**
Suspension – shock absorbers, active suspension; Steering – steering racks and boxes, power steering; Brakes – disc, drum and parking brakes, hydraulic components, ABS and traction control; Wheels and Tyres; **Case Study** – Chassis technology (brakes) for Formula I cars.	

Unit V – Transmission Systems	Contact Hrs = 8
Manual transmission clutch, manual transmission gearbox, automatic transmission, transmission driveline, final drive and differential, **Case Study** – Formula I car transmission.	

Books	
	Text Books:
1.	Tom Denton, "Automobile Mechanical and Electrical Systems: Automotive Technology - Vehicle Maintenance and Repair," Butterworth-Heinemann Imprint of Elsevier, 2013 reprinted edition of 4th Edition of 2011, ISBN: 978-0-08-096945-9.
2.	Richard C. Dorf and Robert H. Bishop, "Modern Control Systems," Pearson International, 11th Edition.
	Reference Books:
3.	William R. Ribbens, "Understanding Automative Electronics – An Engineering Perspective," Butterworth-Heinemann Imprint of Elsevier, 8th edition, 2017.

	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1	Fundamentals of Automotive Systems – IITM NOC – Prof. C. S. Shankar Ram https://www.youtube.com/watch?v=hs7bABMtOMI&list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MlJau4F
2	Fundamentals of Electric Vehicles – Technology and Economics - IITM NOC Prof. Ashok Jhunjhunwala https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=1

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quizzes + OBA vrom NPTEL lectures
2.	PPT and Videos from YouTube	2.	IA tests
3.	Insudtry Expert lecture	3.	MATLAB On Ramp Course Certifications
4.	NPTEL – related course lectures audits	4.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	figure out the whole process of evolution of passanger vehicles and heavy vehicles over last two centuries.	Un	1,2	1
2.	correlate among the functioning of four main subsystems of IC engine based vehicles.	Ap	1,2,3,4	1,2
3.	distinguish among the functioning of a normal vehicle from a ultramodern formula I car.	An	1,2,3,5	1,3
4.	estimate the ill effects of fossil fuel based vehicles and how to minimize the ill effects by using renewable energy based vehicles.	Ap	1,6,7,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

Sr. No.	**Skill and competence enhanced after undergoing the course**	**Applicable industry sectors and domains**	**Job roles students can take up after undergoing the course**
1	Knowledge acquired regarding the various energy sources used applied for vehicular drivetrain design	Mercedes Benz Daimler Truck Bharat Benz	1. Function developer for eMachine and transmission control units 2. EV engineer – battery design and development 3. System App Engineer 4.Overall Vehicle Development VS30 Lead 5. R&D protocol developer 6. Junior application software engineer and developer
2	Calculation for electrical and mechanical load calculation on a vehicle under dynamic conditions.	Bosch Continental Honda Motor Co. Ltd.	
3	Analysis of ill effects of ICEVs on nature, their estimation and mitigations techniques by using renewable energy sources	Tata Motors JBM Auto Ashok Leyland Electric Kia Motors	

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

OPERATING SYSTEMS

Course Code	**21EC542**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Explain main components of OS and their working
2.	Explain the operations performed by OS as a resource Manager
3.	Understand various scheduling policies of OS based on which allotment of I/O devices is done.
4.	Learn the different memory management techniques.

Pre-requisites: Basic Computer Knowledge

Unit – I	**Contact Hours = 8 Hours**
Introduction: Architecture, Goals & Structures of O.S, Basic functions, Interaction of O. S. & hardware architecture, System calls, Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real -time O.S.	

Unit – II	**Contact Hours = 8 Hours**
Process Management: Process Concept, Process states, Process control, Threads, Uni-processor Scheduling: Types of scheduling: Preemptive, Non-preemptive, Scheduling algorithms: FCFS, SJF, RR, Priority, Thread Scheduling, Real Time Scheduling. System calls like ps, fork, join, exec family, wait.	

Unit – III	**Contact Hours = 8 Hours**
Concurrency control Concurrency: Principles of Concurrency, Mutual Exclusion: S/W approaches, H/W Support, Semaphores, pipes, Message Passing, signals, Monitors, Classical Problems of Synchronization: Readers-Writers, Producer Consumer, and Dining Philosopher problem. Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, System calls like signal, kill.	

Unit – IV	**Contact Hours = 8 Hours**
Memory Management: Memory Management requirements, Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Fragmentation, Swapping, and Paging. Segmentation, Demand paging, Virtual Memory: Concepts, management of VM, Page Replacement Policies (FIFO, LRU, Optimal, Other Strategies), Thrashing.	

Unit –V	Contact Hours = 8 Hours
I/O management & Disk scheduling: I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache. Advanced Operating System Basics of Network Operating System, Server Operating System and Real Time Operating System	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2006), Operating System Principles, 7th edition, Wiley India Private Limited, New Delhi.
2.	Stallings (2006), Operating Systems, Internals and Design Principles, 5th edition, Pearson Education, India.
3.	Andrew S. Tanenbaum (2007), Modern Operating Systems, 2nd edition, Prentice Hall of India, India.

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 (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr – Create		Learning Level	PO(s)	PSO(s)
1.	Outline various concepts and features of Operating systems.	Un	2,9,10,11,12	2
2.	Compare various operating systems with respect to characteristics and features	An	4,9,10,11,12	2
3.	Implement algorithm of CPU Scheduling, Memory Scheduling and disk scheduling.	An	1,9,10,11,12	1
4.	Make changes in the OS configurations as per need	An	9,10,11,12	2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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		✓							✓	✓	✓	✓		✓	
2				✓					✓	✓	✓	✓		✓	
3	✓								✓	✓	✓	✓	✓		
4									✓	✓	✓	✓		✓	
Use tick mark(✓)															

	Skill & competence enhanced after undergoing the course	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Operating systems	Computer Industry, Automation	Operating System Engineer/Designer

Name & Signature of Faculty members involved in designing the syllabus

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POWER CONVERTERS

Course Code	21EC543	**Course type**	PEC	**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**	100
				SEE Marks	100

Course Learning Objectives (CLOs)	
1.	To provide a comprehensive understanding of the principles and concepts of power electronics and to introduce the various types of power electronic devices and their characteristics.
2.	To explore problem-solving skills with power electronic circuits and systems.
3.	To explore the applications of power electronics in various fields and to foster the ability to select appropriate power electronic components and devices for specific applications.

Pre-requisites: Basic Electronics, Analog Electronic Circuits

Unit – I	**Contact Hours = 8 Hours**
Thyristor: Principles and Characteristics: Introduction, History of Power Electronics Development, Thyristor Family, Principle of Operation of SCR, Static Anode-Cathode Characteristics of SCR, The Two-transistor Model of SCR (Two Transistor Analogy), Gate Characteristics of SCR, Turn-on Methods of a Thyristor, Dynamic Turn-on Switching Characteristics, Turn-off Mechanism (Turn-off Characteristic), Turn-off Methods, Numerical Problems	

Unit – II	**Contact Hours = 8 Hours**
Gate Triggering Circuits: Introduction, Firing of Thyristors, Pulse Transformers, Optical Isolators (Opto-isolators), Gate Trigger Circuits, Unijunction Transistor, The Programmable Unijunction Transistor (PUT), Numerical Problems	

Unit – III	**Contact Hours = 8 Hours**
Phase Controlled Rectifiers: Introduction, Phase Angle Control, Single Phase Half-Wave Controlled Rectifier (One-quadrant), Single-Phase Full-Wave Controlled Rectifier (Two-quadrant Converters), Single-Phase Half Controlled Bridge Rectifier, (R and L Load), Numerical Problems Self Study: Problem solving with the help of simulation tools and techniques.	

Unit – IV	**Contact Hours = 8 Hours**
Inverters: Introduction, Thyristor Inverter Classification, Series Inverters: Basic Series Inverter, Self-Commutated Inverters, Parallel Inverter: Basic Parallel Inverter Choppers: Introduction, Principle of Chopper Operation, Step-up Choppers, Step-up/down Chopper A.C. Regulators: Introduction, Single-phase A. C. Regulators (With R Load Only), Numerical Problems Self Study: Problem solving with the help of simulation tools and techniques.	

Unit –V	Contact Hours = 8 Hours
Thyristor Applications: Introduction, Overvoltage Protection, Zero Voltage Switch, Integral Cycle Triggering (or Burst Firing), Switched Mode Power Supplies (SMPS), Uninterruptible Power Supplies (UPS), ARC Welding	

Books	
	Text Books:
1.	M. D. Singh, K. B. Khanchandani, "Power Electronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005 onwards
2.	Robert W. Erickson, Dragon Maksimovic, "Fundamentals of Power Electronics", Kluwer Academic Publishers, New York, 2004 onwards
	Reference Books:
1.	Muhammad Rashid, "Power Electronics: Circuits, Devices, and Applications", Pearson Education, 2004 onwards
2.	Dr. P. S. Bimbhra, "Power Electronics", Khanna Publishers,4th edition onwards
3.	L. Umanand, "Power Electronics – Essentials and Applications", Wiley India Pvt. Ltd, Copyright 2009

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 Assignment (OBA)
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 (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand** the fundamental concepts of power electronics, including power semiconductor devices, switching circuits, and converter topologies.	Un	1	1
2.	**Analyze** the dynamic behavior of power electronic circuits and systems.	An	1,2	1
3.	**Evaluate** the performance of power electronic systems.	Ev	1,2,3,5	1
4.	**Evaluate** the impact of power electronics on energy conversion and utilization in different applications.	Ev	1,2,3,5, 7,12	1,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PSO1**	**PSO2**	**PSO3**
1	✓												✓		
2	✓	✓											✓		
3	✓	✓	✓		✓								✓		
4	✓	✓	✓		✓		✓					✓	✓		✓

SN	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Students will gain comprehensive understanding of power electronics principles, and develop skills in designing and analyzing various power electronic circuits.	Renewable Energy, Electric Transportation, Industrial Automation, Aerospace and Defense, Consumer Electronics etc.	Power Electronics Engineer, R & D Engineer, Applications Engineer, Consulting Engineer, Technical Sales Engineer etc.

Satish P. Deshpande
Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

NANO ELECTRONICS

Course Code	21EC544	**Course type**	**PEC**	**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**	100
Flipped Classes content	4 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the principles of nano-science engineering, carbon nanotubes and their applications.
2.	To understand the effects of size of nano-materials on various applications.
3.	To study the fabrication techniques of nano particles.
4.	To identify the properties of nano particles and their usage in various applications.

Pre-requisites: Basic physics and chemistry

Unit – I	**Contact Hours = 8 Hours**
Introduction: Overview of nano-science and engineering, Development milestones in micro-fabrication 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. Case Study: Effects of nano-meter length scale	

Unit – II	**Contact Hours = 8 Hours**
Characterization: Classification, 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. Case Study: Electronic density of states	

Unit – III	**Contact Hours = 8 Hours**
Fabrication methods: Top-down processes, Bottom up processes methods for templating the growth of nano-materials, Ordering of nano systems **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, Electro-statically induced dots and wires, Quantum well width fluctuations, Thermally annealed quantum wells, Semiconductor nanocrystals, Colloidal quantum dots, Self-assembly techniques. **Case Study**: Fabrication of Semiconductor Nanocrystals	

Unit – IV	Contact Hours = 8 Hours
Characterization of semiconductor nanostructures: Optical, electrical and structural **Carbon Nanostructures:** Carbon molecules, Carbon clusters, Carbon nanotubes, Applications of carbon nanotubes. **Case Study:** Fabrication of carbon nanotubes	

Unit – V	Contact Hours = 8 Hours
Nano sensors: Introduction, Sensors and nano-sensors, 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: Applications of Nano sensors	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	0	0	2	2	0

Books	
	Text Books:
1.	Robert Kelsall, Ian Hamley, Mark Geoghegan, —Nanoscale Science and Technology, John Wiley, 2007.(Unit 1, 2,3 and 4)
2.	Charles P Poole, Jr, Frank J Owens, —Introduction to Nanotechnology, John Wiley, Copyright 2006, Reprint 2011. (Unit 4)
3.	T Pradeep, —Nano: The Essentials-Understanding Nanoscience and Nanotechnology, TMH. (Unit 5)
	Reference Books:
1.	William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, —Hand Book of Nanoscience Engineering and Technology‖, CRC press, 2003.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Fundamentals of micro and nanofabrication By Prof. Shankar Selvaraja, Prof. Sushobhan Avasthi, IISc Bangalore https://onlinecourses.nptel.ac.in/noc20_bt37/preview

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.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to(Highlight the **action verb** representing the learning level				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the principles of Nano-electronics, properties of Nano-particles and carbon nanotubes	Un	1,9,10,12	1
2.	Apply concepts of nano-electronics in various fields	Ap	1,2,9,10,12	1,2
3.	Understand the fabrication techniques and Analyze the process flow for sensor design.	Un, An	1,2,3,8,9,10,12	1,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓								✓	✓		✓	✓		
2	✓	✓							✓	✓		✓	✓	✓	
3	✓	✓	✓					✓	✓	✓		✓	✓		✓
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Students will be able to understand the basic concepts, fabrication methods and applications of Nano Science, Nano Electronics.	Sensor designing, Semiconductors	Entry level researcher/ Research assistant, Entry level Application Engineer, Entry level Design Engineer

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Name & Signature of Faculty members verifying/approving the syllabus

EMBEDDED SYSTEM DESIGN

Course Code	**21EC545**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand concepts of Embedded System design
2.	Explain characteristics & attributes of Embedded System
3.	Learn Embedded System Software and Hardware development
4.	Learn RTOS based Embedded system design

Pre-requisites: Microcontrollers

Unit – I	**Contact Hours = 8 Hours**
Introduction, Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design, Design Process: Requirements, Specifications, Hardware Software Partitioning, System Integration Embedded System Architecture Instruction Set Architectures with examples, Memory system Architecture: Von Neumann, Harvard, caches, Virtual Memory, Memory Management, I/O sub system: Busy wait I/O,DMA, Interrupt Driven I/O, Co-Processor & Hardware Accelerators, Processor performance Enhancement: Pipelining, Superscalar Execution, Multi Core CPUs, Benchmarking Standards: MIPS, MFLOPS, MMACS, Coremark	

Unit – II	**Contact Hours = 8 Hours**
Designing Embedded System Hardware –I: CPU Bus: Bus Protocols, Bus Organization, Memory Devices and their Characteristics: RAM, EEPROM, Flash Memory, DRAM; I/O Devices: Timers and Counters, Watchdog Timers, Interrupt Controllers, A/D and D/A Converters	

Unit – III	**Contact Hours = 8 Hours**
Designing Embedded System Hardware –II: Component Interfacing: Memory interfacing with case study, I/O Device Interfacing with case Study, Programmed IO, Memory Mapped IO, Interfacing Protocols: UART, SPI, I2C, Reset Circuits, FPGA based Design, Processor Selection Criteria	

Unit – IV	**Contact Hours = 8 Hours**
Designing Embedded System Software –I: Application Software, System Software, Use of High Level Languages: C,C++, Programming & Integrated Development Environment tools: Editor, Compiler, Linker, Automatic Code Generators, Debugger, Board Support Library, Chip Support Library, Analysis and Optimization: Execution Time, Energy & Power, Program Size; Embedded System Coding Standards: MISRA C 2012/CERT	

Unit –V	Contact Hours = 8 Hours
Designing Embedded System Software –II OS based Design, Real Time Kernel, Process& Thread, Inter Process Communications, Synchronization, Case Study: RTX-ARM, Response time Calculation, Interrupt Latency, Time Loading, Memory Loading, Case Study: Embedded Control Applications-Software Coding of a PID Controller	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Embedded Systems – A contemporary Design Tool, James K Peckol, , John Weily, 2008, ISBN: 0-444-51616-6
2.	Introduction to Embedded Systems,Shibu K V, ,Tata McGraw Hill Education Private Limited, 2009, ISBN: 10: 0070678790
3.	Embedded Software Primer, David Simon, Addison Wesley, ISBN-13: 978-0201615692
4.	The Intel Micro-processors, Architecture, Programming and Interfacing" Barry B.Brey, 6th Edition,Pearson Education.

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/Course Project
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Describe hardware & software of embedded systems for real time applications with suitable processor architecture, memory and communication interface	Un	2,11,12	1
2.	Analyze the use of embedded software & hardware to meet given constraints with the help of modern engineering tools.	Ap	3,9,10,11,12	2
3.	Demonstrate compliance of prescribed safety norms through implementation of the identified engineering problems pertaining to automobiles, aerospace & biomedical applications	Ev	6,9,10,11,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1		✓											✓		
2			✓								✓			✓	
3						✓							✓		
4					✓							✓	✓		
Use tick mark(✓)															

	Skill & competence enhanced after undergoing the course	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Real time systems design	Embedded systems	Embedded Systems Engineer

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

DIGITAL IMAGE PROCESSING

Course Code	**21EC546**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To learn key fundamental concepts and principles of digital image processing.
2.	To study hands-on experience with various image processing techniques and algorithms.
3.	Apply image processing techniques to solve real-world problems and tasks, such as image segmentation, object recognition, and image classification.
4.	Develop the ability to analyze and interpret digital images for different applications.

Pre-requisites: Fundamentals of Signal Processing, mathematical fundamental.

Unit – I	**Contact Hours = 8 Hours**

Introduction to Digital Image Processing

Fundamental steps in digital image processing and its applications, Image formation and representation, Color models and color image processing, Image acquisition techniques and devices.

Image Transforms

Unitary transforms, Two dimensional orthogonal and unitary transformers – separable transformer, basis images, key properties of unitary transforms - Preservation of Magnitude, Preservation of Orthogonality, Invertibility, Energy Conservation, Efficient Computation, Basis Representation, Sparse Representation.

Introduction to Fourier Transform, Discrete Cosine Transform, Karhunen-Loève (KL) transform and Wavelet Transforms in image processing applications.

Practical Session : Introduction to Mathworks Matlab and Image Processing Toolbox / Python coding

Case Study on Medical Image Analysis for Disease Diagnosis.

Unit – II	**Contact Hours = 8 Hours**

Image Enhancement and Restoration

Image enhancement techniques: Basic intensity transformation functions and histogram equalization, Spatial domain. enhancement techniques: filtering, contrast stretching, and sharpeningFrequency domain Fourier transform (2D DFT), smoothing, and noise reduction.

Image restoration techniques: inverse filtering, deconvolution, and super-resolution.

Image denoising techniques: Gaussian filtering, median filtering, and non-local means denoising.

Practical Session : Mathworks Matlab coding using Image Processing Toolbox / Python coding

Case Study on Surveillance and Security System with Real-time Video Analysis

Unit – III	Contact Hours = 8 Hours
Image Compression and Coding Lossless compression techniques (Huffman coding, Run-Length Encoding, Arithmetic Coding), Lossy compression techniques, Image coding standards (JPEG, HEVC), wavelet-based image compression algorithms JPEG2000 standard, Introduction to VoIP protocols such as the H.26X series (Only Decoder Block diagram study). **Practical Session : Mathworks Matlab coding using Image Processing Toolbox / Python coding** **Case Study on Remote Sensing Image Analysis for Environmental Monitoring**	

Unit – IV	Contact Hours = 8 Hours
Image Segmentation, Feature Extraction and Feature reduction **Image segmentation techniques**: Thresholding, region-based, and clustering, Edge detection and boundary extraction. **Advanced segmentation algorithms**: watershed and graph cuts. **Feature extraction methods**: texture analysis and shape descriptors. **Feature reduction:** Principal Component Analysis (PCA). **Practical Session : Mathworks Matlab coding using Image Processing Toolbox/ Python coding** **Case Study on Digital Forensics for Image Authentication and Tampering Detection**	

Unit –V	Contact Hours = 8 Hours
Advanced Topics in Digital Image Processing Machine learning and Deep learning for image processing and analysis, Image registration and alignment, Content-based image retrieval, Image recognition and object detection, Image-based Understanding and analysis. **Case Study on Art Restoration and Preservation using Image Processing.** **Practical Session : Mathworks Matlab coding using Image Processing Toolbox/ Python coding**	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. of Flipped Classroom Sessions	**2**	**2**	**2**	**2**	**2**

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 nnU-net
5.	Clustering algorithm for image classification in Biomedical Imagery applications

Books	
	Text Books:
1.	Anil.K. Jain ,Digital Image Processing, Prentice Hall, 1995.

2.	Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson, 2017.
	Reference Books:
1.	Richard Szeliski , Computer Vision: Algorithms and Applications, Springer, 2010.
2.	John C. Russ , Introduction to Image Processing and Analysis, CRC Press, 2018.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Digital Image Processing, By Prof. Prabir Kumar Biswas, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc23_ee118/preview

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.	**Mini project**	5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr – Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Apply various image processing techniques and algorithms to manipulate and enhance digital images.	Ap	1,2,12	1,2
2.	Demonstrate critical thinking and problem-solving skills in analyzing and interpreting digital images using appropriate image processing techniques.	An	1,2,5,12	1,2
3.	Analyze and evaluate the effectiveness of different image processing methods for specific applications.	An	1,2,5, 12	1,2
4.	Design and implement image processing solutions to solve real-world problems, such as image segmentation, object recognition, and image restoration.	Ev	1,2,5, 12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.

3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓										✓	✓	✓	
2	✓	✓			✓							✓	✓	✓	
3	✓	✓			✓							✓	✓	✓	
4	✓	✓										✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	The course enhances skills and competencies, including technical proficiency, problem-solving, communication, collaboration, research, adaptability, leadership, and ethical standards.	The course is applicable to various industry sectors and domains, including healthcare, finance, manufacturing, transportation, communications, agriculture, energy, education, and entertainment.	After completing the course in digital image processing, students can pursue job roles such as image processing engineer, computer vision specialist, research scientist, image analyst, or software developer in various industries including healthcare, finance, technology, and research.

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

MULTIMEDIA COMMUNICATION AND PROCESSING

Course Code	**21EC547**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the principles and techniques of multimedia data representation and formats, encompassing image, video, audio, and speech.
2.	To gain knowledge of diverse multimedia processing algorithms and techniques, including image enhancement, compression, coding standards, and analysis.
3.	To develop skills in multimedia networking and communication, covering protocols, streaming, synchronization, and Quality of Service considerations.
4.	To acquire knowledge of multimedia security and forensics, focusing on encryption, watermarking, content authentication, and digital rights management, and to comprehend ethical considerations associated with multimedia processing and communication, encompassing privacy, intellectual property rights, and social implications.

Pre-requisites: Fundamentals of signal representation and signal processing.

Unit – I	**Contact Hours = 8 Hours**
Introduction to Multimedia Processing Overview of multimedia processing and its applications, Introduction to multimedia data representation and formats, Multimedia data compression techniques, Basics of human perception in multimedia. **Practical Session: Introduction to Mathworks Matlab and Image Processing Toolbox / Python coding** **Case Study on Analysis of Real-Time Video Streaming Protocols for Multimedia Communication.**	

Unit – II	**Contact Hours = 8 Hours**
Image and Video Processing Fundamentals of image and video representation, Image enhancement techniques, Image and video compression algorithms (JPEG 2000, MPEG 4), Image and video coding standards (H.264 AVC and H.264 SVC – study is limited with only Decoder and Encoder), Image and video analysis and understanding. **Practical Session: Mathworks Matlab coding using Image Processing Toolbox / Python coding** **Case Study on Multimedia Forensics: Detecting and Analyzing Tampered Images**	

Unit – III	Contact Hours = 8 Hours
Audio Processing and Speech Processing Basics of audio signal processing, Audio compression techniques, Speech production and perception, Speech processing and analysis, Speech and audio codecs (G.711, G.729, Adaptive Multi-Rate (AMR), Advanced Audio Coding (AAC)). **Mathworks Matlab coding using Image Processing Toolbox / Python coding** **Case Study on Enhancing Speech Recognition Accuracy Using Deep Learning Models in Multimedia Applications.**	

Unit – IV	Contact Hours = 8 Hours
Multimedia Networking and Communication Multimedia communication protocols (RTP, RTSP), Multimedia streaming and multimedia synchronization, Quality of Service (QoS) considerations in multimedia communication, Multimedia over IP networks, Multimedia content delivery networks. **Mathworks Matlab coding using Image Processing Toolbox / Python coding** **Case Study on Comparative Study of Video Compression Algorithms for Efficient Multimedia Communication.**	

Unit –V	Contact Hours = 8 Hours
Multimedia Security and Forensics Multimedia data encryption and watermarking techniques, Multimedia content authentication and integrity verification, Digital rights management (DRM) for multimedia, Multimedia forensics and steganography, Ethical considerations in multimedia processing and communication. **Mathworks Matlab coding using Image Processing Toolbox / Python coding** Case Study on Multimedia Forensic Analysis: Detecting and Recovering Hidden Information in Images.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Unit No.	Self-Study Component
1.	Immersive and interactive multimedia experiences, such as virtual reality (VR) and augmented reality (AR).
2.	5G and beyond networks for enhanced multimedia communication and streaming capabilities.
3.	Multi-camera systems and multi-view video coding for improved video capture and streaming.
4.	Cloud-based multimedia services and streaming platforms.
5.	Adaptive multimedia streaming techniques for seamless playback across different devices and network conditions.

Books	
	Text Books:
1.	Ze-Nian Li, Mark S. Drew, and Jiangchuan Liu, "Fundamentals of Multimedia," Pearson Education, 2014.
2.	Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing," Pearson Education, 2017.
3.	Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing: Processing and Perception of Speech and Music," John Wiley & Sons, 2011.
	Reference Books:
1.	Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Pearson Education, 2011.
2.	Lajos L. Hanzo, Peter J. Cherriman, Jurgen Streit, and Erozan M. Kurtas, "Video Compression and Communications: From Basics to H.261, H.263, H.264, MPEG4 for DVB and HSDPA-Style Adaptive Turbo-Transceivers", John Wiley & Sons, 2007.
3.	Ian Vince McLoughlin, "Speech and Audio Processing: A MATLAB-Based Approach", Cambridge University Press, 2018.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Multimedia processing, Prof. Somnath Sengupta, IIT Kharagpur https://nptel.ac.in/courses/117105083

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 (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Identify and describe multimedia signal processing and communication	Un	1,2,12	1,2
2.	Evaluate and implement multimedia processing algorithms and techniques to enhance and compress multimedia data.	EV	1,2,5,12	1,2
3.	Apply multimedia security and forensics techniques to protect and ensure the integrity of multimedia data.	Ap	1,2,5, 8,12	1,2,3
4.	Demonstrate proficiency in multimedia networking protocols and techniques for efficient multimedia communication.	An	1,2,5,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓										✓	✓	✓	
2	✓	✓			✓							✓	✓	✓	
3	✓	✓			✓			✓				✓	✓	✓	✓
4	✓	✓			✓							✓	✓	✓	
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	The course in Multimedia Communication and Processing enhances students' skills and competencies in multimedia data representation, processing algorithms, networking, security, and ethical considerations.	The subject of Multimedia Communication and Processing is applicable across various industry sectors and domains, including entertainment, media, advertising, e-commerce, telecommunications, education, healthcare, and information technology.	Students who complete the course in Multimedia Communication and Processing are equipped with the skills and knowledge necessary to pursue diverse job roles in the multimedia industry, such as multimedia specialists, designers, developers, content creators, project managers, engineers, analysts, consultants, and researchers.

Name & Signature of Faculty members
involved in designing the syllabus

Name & Signature of Faculty members
verifying/approving the syllabus

CRYPTOGRAPHY AND NETWORK SECURITY

Course Code	21EC548	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
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.

Pre-requisites:

Unit – I	**Contact Hours = 8 Hours**
Security services, mechanisms and attacks, OSI security model, symmetric key cryptography, substitution techniques: play fair 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	**Contact Hours = 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	**Contact Hours = 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	**Contact Hours = 8 Hours**
Secure socket layer, Transport layer security, secure hyper text transfer protocol, brief introduction to TCP/IP, Firewalls, IP security, and virtual private networks. **Case Study:** 1. Demonstration of secure socket layers applications. 2. Survey and report the recent challenges in secure electronic transactions.	

Unit –V	**Contact Hours = 8 Hours**
Case studies on cryptography and security: introduction, cryptographic solutions, single sign on (SSO), secure intra-branch payment transactions, Denial of services (DoS) attacks, IP spoofing attacks, cross site scripting vulnerability (CSSV) contract signing, secret splitting, virtual electronics, secure multiparty calculation, creating a VPN, cookies and privacy. **Case Study:** 1. Document the history of any two recent viruses and their impact. 2. Identify the limitations of any two antivirus programs.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**2**	**2**	**2**	**2**	**2**

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.
3.	Atul Kahate,” Cryptography and Network security”, 2nd Edition, Tata McGraw-Hill, 2008 and onwards.
	Reference Books:
1.	H. Yang et al., Security in Mobile Ad Hoc Networks: Challenges and Solution, IEEE Wireless Communications, 2004 and onwards.
2.	Cyber Security Operations Handbook – by J.W. Rittiaghouse and William M.Hancok – Elseviers.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/noc22_cs90/preview

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 (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Identify and describe different techniques in modern cryptography & Employ the modular arithmetic fundamentals to cryptography	AP	1,2,5,6,10,12	1
2.	Describe, recognize and use the principles of Public key cryptosystems for various applications including data networks.	AP	1,2,5,6,10,12	1
3.	Analyze the security issues related to internet and networks	An	1,2,5,6,10,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO1 0**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓			✓	✓				✓		✓	✓		
2	✓	✓			✓	✓				✓		✓	✓		
3	✓	✓			✓	✓				✓		✓	✓		
4	✓	✓			✓	✓				✓		✓	✓		
5	✓	✓			✓	✓				✓		✓	✓	✓	
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Networking & System Admin	All industry & Security domain	Cyber security, information security, network security analyst
2	Knowledge of OS & Virtual Machine	All industry & Security domain	Cyber security, information security, network security analyst
3	Network Security control, cloud security & Block chain security	All industry & Security domain	Cyber security, information security, network security analyst

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

REQUIREMENTS ENGINEERING

Course Code	**21EC549**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the significance of Requirements Engineering and the impact of Requirements Engineering in business development
2.	To comprehend the types of requirements and stakeholders involved
3.	To apprehend requirements elicitation, documentation and validation techniques

Pre-requisites:

Unit – I	**Contact Hours = 8 Hours**
Introduction: Definition of Requirements, Why do I need Requirements, Requirements Engineering, problems with requirements, Product/System Development Life Cycle and various approaches, Project management, The business case, Terms of Reference / Project Initiation Document / Project Charter – business objectives, project objectives, scope, constraints (budget, timescale, standards), sponsor (authority), Framework for Requirements Engineering, Actors/ Roles during requirements work Activity: Study the PID for any project and write a summary of the same. Develop an alternate PID for the same and justify why/how the new document is better than the studied one.	

Unit – II	**Contact Hours = 8 Hours**
Types of requirements and Stakeholders : Building the hierarchy through decomposition of requirements, Categories of requirements within the hierarchy, General business requirements, including legal and business policy, Technical policy requirements, Functional requirements, Non-functional requirements, including performance, usability, access, security, archiving, backup and recovery, availability, robustness, Stakeholders, Types of stakeholders and their role and contribution to the requirements engineering process, The Requirements Process . Case Study: Study the Ice Breaker Project (text 2). Activity: 1. Identify the stakeholders of the project. Develop the list of stakeholders for any project you identify. Identify their roles and contributions. 2. Build the list of functional and non-functional requirements for any project you identify.	

Unit – III	Contact Hours = 8 Hours
Requirements Elicitation: Knowledge types – tacit and non-tacit (explicit), Elements of tacit knowledge that cause problems, Elicitation techniques: Interviews, Workshops, Observation: Formal/informal, Shadowing, Focus groups, Prototyping, Scenarios, Document Analysis **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. Activity: 1. Conduct interviews/workshops on the requirements identified for a idea/project. Summarize the outcomes. 2. Develop Prototypes, Scenarios, documents and conduct document analysis for the requirements listed in the above idea/project	

Unit – IV	Contact Hours = 8 Hours
Requirements Analysis: Organizing requirements, requirements Filters for ensuring well-formed requirements **Requirements Documentation**: The importance of Documentation, Structure of Requirements Document, Requirements catalogue, hierarchy of requirements, Documenting a Requirement-Characteristics of an individual requirement Activity: 1. Prepare a requirements document for any identified idea/project.	

Unit – V	Contact Hours = 8 Hours
Requirements validation: Agreeing the requirements document, Representatives of the review group, Outcomes of a review **Requirements management:** Dealing with changing requirements, The importance of traceability, Traceability and ownership, Elements of Requirements management, Requirements Engineering support tools Activity: 1. Trace the changes of a requirement identified based on the reviews.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

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.

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 (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**understand the relevance of requirements engineering in business development**	Un	2, 6,10,11,12	2,3
2.	**Develop a model and analyze the use of a range of requirements elicitation and documentation techniques and the relevance of the techniques to business situations**	An	2, 6,10,11,12	2,3
3.	**Analyze the performance of requirements management process and apply them to manage a business requirements.**	An	2, 6,10,11,12	2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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						✓				✓	✓	✓		✓	✓
2		✓				✓				✓	✓	✓		✓	✓
3		✓				✓				✓	✓	✓		✓	✓
4															
5															
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1			
2			
3			

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

HEALTH CARE SYSTEMS

Course Code	**21EC551**	**Course type**	**OEC**	**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**	100
Flipped Classes content	05 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the Historical Perspective of modern healthcare system.
2.	To study ethical practices in Health care.
3.	To learn the origin of biopotential in neuron cell and various potential measurement techniques.
4.	To understand cardiological signal processing and various patient monitoring systems.

Pre-requisites: Engineering Mathematics, Basic Electronics

Unit – I	**Contact Hours = 8 Hours**
Introduction to Biomedical Engineering: The Evolution of the Modern Health Care System, The Modern Health Care System, Biomedical Engineering, Roles Played by the Biomedical Engineers, Recent Advances in Biomedical Engineering, Professional Status of Biomedical Engineering, Professional Societies.	

Unit – II	**Contact Hours = 8 Hours**
Ethical Practices in Health Care: Morality and Ethics: A Definition of Terms, Two Moral Norms: Beneficence and Nonmaleficence, Human Experimentation, Definition and Purpose of Experimentation, Informed Consent, Regulation of Medical Device Innovation, Marketing Medical Devices, Ethical Issues in Feasibility Studies, Ethical Issues in Emergency Use, Ethical Issues in Treatment Use, The Role of the Biomedical Engineer in the FDA Process.	

Unit – III	**Contact Hours = 8 Hours**
Anatomy and Physiology: Introduction-Cellular organization, Plasma membrane, Tissues, Homeostasis. Bioelectric phenomena: Origin of bio-potentials - Notion of Hodgkin-Huxley model of the action potential, Biopotential measurements – ECG, EEG, EMG, ERG.	

Unit – IV	**Contact Hours = 8 Hours**
Analysis of Bio signals: Cardiological Signal Processing: Methods in Recording ECG, Waves and Intervals of ECG, ECG Data Acquisition, ECG Parameters and Their Estimation, ECG QRS Detection Technique, Template Matching Technique, Differentiation Based QRS Detection Technique, Simple QRS width Detection Algorithm, High Speed QRS detection Algorithm, Estimation of R-R Interval, Estimation of ST Segment.	

Unit – V	**Contact Hours = 8 Hours**
Patient Monitoring Systems: System Concepts, Cardiac Monitor, Bedside Patient Monitoring Systems, Central Monitors; Measurement of Heart Rate, Pulse Rate, Blood Pressure, Temperature, Respiration Rate; Arrhythmia Monitor and Ambulatory Monitoring Instruments; Foetal Monitoring Instruments: Cardiotocograph, Monitoring Foetal Heart Rate and Labour Activity.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	1	1	1	1

Books	
	Text Books:
1.	J. Enderle, S. Blanchard, J. Bronzino, "Introduction to Biomedical Engineering", Elsevier Academic Press, 2009
2.	R. S. Khandpur, Handbook of Biomedical Instrumentation, McGraw-Hill Publishing Company Limited, 2ndedition, 2003.
	Reference Books:
3.	J.G. Webster, "Medical Instrumentation: Application and Design", John Wileyand Sons, 2003.
4.	L. Sornmo, P. Laguna, "Bioelectrical Signal Processing in Cardiac and Neurological 6Applications", Elsevier Academic Press, 2005.

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.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

	Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand** the evolution of the Modern Health Care System and ethical practices in health care system.	Un	6, 7, 8, 9, 12	2
2.	**Understand** the origin of bioelectric potential for neuron cell, various biopotential measurement techniques and **analyze** the cardiological bio signals to detect heart related problems.	An	1,4,5, 6, 7, 8, 9, 12	2
3.	Understand the components and working of medical instrumentation/monitoring systems.	Un	1,6, 7, 8, 9, 12	2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment

Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.

3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

CO-PO Mapping (Planned)												**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1						✓	✓	✓	✓			✓		✓	
2	✓			✓	✓	✓	✓	✓	✓			✓		✓	
3	✓					✓	✓	✓	✓			✓		✓	
Use tick mark(✓)															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Academic competence	GE Healthcare	Sales Executive/Engineer
2	ability to work as a part of a multidisciplinary team	Siemens	Research and development
3		Cardiac Labs	Service Engineer

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

BIO MEDICAL IMAGE UNDERSTANDING AND ANALYSIS

Course Code	**21EC552**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

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.	Appreciate the evolution of Deep Neural Network from ANN
4.	Design and deploy simple Convolution Neural Network (CNN) model for Biomedical Image classification and identification for specific Radiological Modalities.

Required Knowledge of: Linear Algebra, Statistics and Probability

Unit – I	**Contact Hours = 8 Hours**

Introduction to Biomedical Image Processing

Digital Image Processing, Biomedical 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.

Privacy and Ethics in Handling Clinical Data for Experiments: Ensuring privacy and ethics in handling clinical data for experiments is essential to protect patient confidentiality and uphold ethical standards.

Practical Session : Introduction to Mathwork Matlab and Image Processing Toolbox / Python coding

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

Over view 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 Mathwork Matlab Deep Learning Toolbox/ Python coding

Case study review on Artificial Neural Networks and Biomedical Image applications

Unit – III	**Contact Hours = 8 Hours**

Convolution Neural Networks and Applications

Introduction to Convolutional Neural Networks (CNNs / ConvNets), architecture overview and terminologies of CNN, motivation behind CNN, study of architecture and comparisons of pretrained CNN (limited to only **LeNet-5,ResNet -34 and ResNet -50**).

Case study review on to Convolutional Neural Networks (CNNs / ConvNets)and Biomedical Image applications

Practical Session: Introduction to Mathwork Matlab Deep Learning Toolbox/ Python coding

Unit – IV	Contact Hours = 8 Hours
Deep Learning Medical Image Segmentation 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 and V-net segmentation. **Practical Session: Introduction to Mathwork Matlab Deep Learning Toolbox/ Python coding** **Case study review on Biomedical Image Segmentation**	

Unit –V	Contact Hours = 8 Hours
Deep Learning Medical Image Classification, Analysis and Visualization 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. **Practical Session: Introduction to Mathwork Matlab Deep Learning Toolbox/ Python coding** **Case study review on Pre trained CNN Model**	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

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.	Semantic Segmentation and nnU-net
5.	Clustering algorithm for image classification in Biomedical Imagery applications

Books	
	Text Books:
1.	Geoff Dougherty, "Digital Image Processing for Medical Applications", Cambridge University Press, 2nd Edition, 2013.
2.	Kevin Zhou, Medical Image Recognition, Segmentation and Parsing: Machine Learning and Multiple Object Approaches, 1st Edition, Elsevier Science, 2015
	Reference Books:
1.	Kevin Zhou, Hayit Greenspan and Dinggang Shen, Deep Learning for Medical Image Analysis Elsevier Science, 2017
2.	Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989
	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/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project

3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	**Mini Project**		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Apply knowledge of deep learning algorithms to solve real life problems related to health care and radiology.	Ap	1,2,12	1,2
2.	Analyze the state of art techniques applied in deep learning research	An	1,2,12	1,2
3.	Evaluate the effectiveness of deep learning models in healthcare classification and identification using suitable datasets.	Ev	1,2,3,5,6,8,12	1,2,3
4.	Analyze different deep learning models for different applications of Diseases detection and identification using Computed tomography (CT) and Magnetic Resonance Imaging (MRI).	An	1,2,3,5,6,8,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓			✓							✓	✓	✓	
2	✓	✓			✓							✓	✓	✓	
3	✓	✓		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓
4	✓	✓		✓	✓	✓		✓				✓	✓	✓	✓

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Enhanced skills and competence in biomedical image understanding and analysis.	Applicable industry sectors and domains for biomedical image understanding and analysis include healthcare, medical imaging, diagnostic imaging, research institutions, pharmaceutical companies, and biotechnology.	After undergoing the course in biomedical image understanding and analysis, students can take up job roles such as biomedical imaging specialist, medical image analyst, research scientist in medical imaging, imaging software developer, and biomedical engineer in healthcare or academic institutions.

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

MODERN ELECTRIC, HYBRID ELECTRIC AND FUEL CELL BASED VEHICLES

Course Code	**21EC553**	Course type	**PEC**	Credits L-T-P	**3 – 0 – 0**
Hours/week: L - T- P	**3 – 0 – 0**			Credits	**3**
Total Contact Hours	**L = 40 Hrs; T=P=0 Hrs; Total = 40 Hrs.**			CIE Marks	**100**
Flipped Classes content	**00 Hours**			SEE Marks	**100**

Course Learning Objectives	
1.	Learning the basics related to vehicle dynamics, transmission characteristics and various transmission techniques for traditional and modern vehicles.
2.	Understanding functioning of various propulsion systems and energy sources for EV.
3.	Getting exposed to the field of electric vehicles, hybrid electric vehicles and fuel cell-based hybrid electric vehicles and knowing their performance and design parameters.
4.	Understanding the concept of regenerative braking and its significance in EV design.

Required Knowledge: Engineering mechanics, basic electrical and electronics engg, analog electronics, network theorems, signals &systems, control systems, automotive systems.

Unit – I Vehicle Propulsion, ICEVs, and Vehicle Transmission	**Contact Hrs = 8**
General descriptions of vehicle movements, vehicle dynamics, brake performance, fuel economy, basics of SI& CI engine, vehicle transmission characteristics, manual and automatic transmission, torque converter, planetary or epicyclic gear train, automated manual and dual clutch transmission, CVT, IVT, and DHT.	

Unit – II Electric Propulsion Systems and Energy Sources	**Contact Hrs = 8**
Propulsion Systems – Chopper controlled DC motor drives, volt/Hertz and FOC of induction motors, BLDC speed control &functioning of rotor position sensors, speed control of SRM; Energy Sources and Peaking Power Sources – batteries as energy storing devices, PEM fuel cell as energy source, ultracapacitors and ultra-high-speed flywheels as peaking power sources,	

Unit – III Electrical Vehicles & Regenerative Braking	**Contact Hrs = 8**
EV – Configuration, performance graph, tractive effort in normal driving, energy consumption; Regenerative Braking – Braking energy consumed in urban driving, braking energy and brake power comparison with various parameters, brake system for EV, HEV and FCV.	

Unit – IV Series, Parallel and Other Hybrid Electric Vehicles	**Contact Hrs = 8**
Concept and architecture of hybrid electric drivetrain, series hybrid (electrically coupled) drivetrain, parallel hybrid (mechanically coupled) drivetrain, max SoC of PPS and thermostat control for series and parallel hybrid drivetrains, series-parallel (torque-speed) control, plug-in hybrid electric vehicles, mild hybrid electric drivetrain.	

Unit V– Basics of H_2Fuel Cell and FCHEV Drivetrain Design	**Contact Hrs = 8**
Operation principles of H_2 driven PEM fuel cells, fuel cell characteristics, PEMFC sub-systems, configuration of fuel cell hybrid electric drivetrain design, control strategy, parametric design, motor power design, power design of fuel cell system, design of PPS power and energy capacity.	

	Text Books:
1.	Mehrdad Ehsani, Yimin Gao, Stefano Longo, and Kambiz Ebrahimi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles,”3rdEdition, CRC Press, Taylor & Francis Group, 2002, ISBN 13: 978-1-4987-6177-2 (Hardback).
2.	John G. Hayes, G. Abas Goodarzi, “Electric Powertrain – Energy Systems, Power Electronics and Drives for

	Hybrid, Electric and Fuel Cell Vehicle," 1st Edition, 2018.
3.	Iqbal Husain, "Electric and Hybrid Vehicles – Design Fundamentals," CRC Press, Taylor and Francis Group eBook Editions, ISBN 0-8493-1466-6, 2010.
	Reference Books:
4.	Chris Mi, Abul Masrus, "Hybrid Electric Vehicles – Principles and Applications with Practical Perspectives," 2nd Edition, Wiley, 2017.

	E-resourses (NPTEL link mentioned)
1	Fundamentals of Electric Vehicles – Technology and Economics - IITM NOC https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=1**by Prof. Ashok Jhunjhunwala, IIT Madras**

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Quizzes + OBA from NPTEL lectures
2.	PPT and Videos from YouTube	2.	IA tests
3.	Insudtry Expert lecture	3.	MATLAB On Ramp Course Certifications
4.	NPTEL – related course lectures audits	4.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply;An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	figure out the necessity of EV, HEV and FCV for a better world with far less pollution compared to current scenario.	Un	1,2	1
2.	understand the necessity of regenerative type of electrical braking for urban drive cycles.	Ap	1,2,3,4	1,2
3.	gather complete knowledge about the control and design parameters of EV, HEV and FCV.	An	1,2,3,5	1,3
4.	comprehend and justify the set up and upscaling of hydrogen generation and infrastructure development in India.	Ap	1,6,7,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment

Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓											✓		
2	✓	✓	✓	✓									✓	✓	
3	✓	✓	✓		✓								✓		✓
4	✓					✓	✓						✓	✓	
Tick mark the CO, PO and PSO mapping															

	Skill & competence enhanced after undergoing the course	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	**Design methods and development of EV**	**Automation** **Electric vehicle industry**	**Design and development engineer** **Manufacturing** **Electric vehicle maintainence**

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

EMBEDDED SYSTEMS WITH ARDUINO

Course Code	**21EC554**	**Course type**	**OEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Identify the embedded system devices from the real world.
2.	Make use of Arduino software/hardware platform and explain the basics of Arduino platform
3.	Define robotics, its terminologies and basic sensors used in robotics
4.	Build a simple robot using Arduino considering real world problems

Pre-requisites: Microcontroller

Unit – I	**Contact Hours = 8 Hours**
Embedded system: History, Block diagram, Comparison with general purpose computers, classification, applications. Case study: Washing Machine, traffic light controller and microwave oven (functional diagram level)	

Unit – II	**Contact Hours = 8 Hours**
Arduino: IDE, I/O Functions, Looping Techniques, Decision Making Techniques Designing of 1st sketch Programming of an Arduino (Arduino ISP), Arduino Boot loader, Serial Protocol (serial port Interfacing), Initialization of Serial Port using Functions, Basic Circuit for Arduino	

Unit – III	**Contact Hours = 8 Hours**
Basic Interfacing and I/O Concept Interfacing of: LED, Switch, keypad, LM35, Motor Driver L293D, IR Sensor, Interfacing L293D with Arduino with relevant program and connection diagram.	

Unit – IV	**Contact Hours = 8 Hours**
History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Specifications of robot. Definition of Forward and Reverse Kinematics	

Unit – V	**Contact Hours = 8 Hours**
Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors. Case Study: Implementation of small project demonstration of robot (line follower robot, robotic arm) using Arduino	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**2**	**2**	**2**	**2**	**2**

Books	
	Text Books:
1.	Introduction to Embedded Systems, Shibu K. V., Tata McGraw Hill Education Private Limited, 2009, ISBN: 10: 0070678790
2.	Rex Miller, Mark R. Miller - Robots and Robotics_ Principles, Systems, and Industrial Applications-McGraw-Hill Education (2017)
3.	Arduino-Based Embedded Systems: By Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury.
4.	Mike Cheich," Arduino book for beginners", Programming electronics academy, 2021
5.	Jeremy Blum, "Exploring Arduino: Tools and Techniques for Engineering, Wiley, 2013
	Reference Books:
1.	Neeparaj Rai, " arduino projects for beginners" ,BPB Publications
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.swayam2.ac.in/aic20_sp04/preview (Arduino, IIT Bombay)

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/Course Project
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain and distinguish the components of embedded system with the help of applications	Un	2,9,10,11,12	1
2.	Apply the concepts of software & hardware structure of the Arduino and interface peripherals	Ap	2,5,9,10,11,12	1
3.	Apply the knowledge of embedded concepts and Arduino to design embedded robotic systems.	An	5,9,10,11,12	2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25 = 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

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		✓							✓	✓	✓	✓	✓		
2		✓			✓				✓	✓	✓	✓	✓		
3					✓				✓	✓	✓	✓		✓	
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Real time systems design	Embedded systems	Embedded Systems Engineer
2	Embedded Robot design	Robotics	Robotics Engineer

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

RESEARCH METHODOLOGY & IPR

Course Code	21EC57	Course type	AEC	Credits L-T-P	1 – 0 – 0
Hours/week: L - T- P	1 – 0 – 0			Total credits	1
Total Contact Hours	L = 15 Hrs; T = 0 Hrs; P = 0 Hrs Total = 15 Hrs			CIE Marks	50
Flipped Classes content	3 Hours			SEE Marks	50

Course learning Objectives	
1.	Understand the basic concepts of research and its methodologies
2.	Identify and select the appropriate research/sampling design methods.
3.	CreatetheawarenessaboutIntellectualPropertyRightsfortheprotectionofinventions.

Required Knowledge of: Probability & Statistics.

Unit–I	5 Hours

Research Methodology: Introduction

Meaning, Objectives, types, Research Approaches. Significance of Research, Research Methods versus Methodology, Research and scientific method, research Process, Criteria of good research, Problems encountered by researchers.

Research Problem:

Defining a research problem, Selecting a research problem, necessity and techniques involved in defining the research problem.

Unit–II	5 Hours

Data Collection Methods:

Collection of Primary Data, Observation Method, Interview Method, Questionnaires, Schedules, Other Methods of Data Collection, Collection of Secondary Data, Case study method.

Processing and Analysis of Data

Processing operations, Elements/ types of analysis, Statistics in research- measures of central tendency or statistical averages, measures of dispersion, measures of asymmetry (skewness), measures of relationship, Simple regression analysis

Unit–III	5 Hours

Intellectual Property Rights – IPR- Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs)- A brief summary of: Patents, Copyrights, Trademarks, Industrial Designs- Integrated Circuits-Geographical Indications-Establishment of WIPO-Application and Procedures. Research ethics, Plagiarism, Prior art search.

Flipped Classroom Details

Unit No.	I	II	III
No. for Flipped Classroom Sessions	1	1	1

Self-Study Topics	
Unit No.	**Topic description**
I	Significance of Research Methodology.
II	Limitations of test of hypothesis.
III	Other measures-Index numbers, Time series analysis.

Books	
	Text Books:
1.	C R. Kothari, Research Methodology, New Age International Publishers, 2nd edition, 2007.
	Reference Books:
1.	Panneer Selvam, Research Methodology, PHI Learning Pvt. Ltd., 2007.
2.	Dr. B.L. Wadhera -Intellectual Property Rights, Universal Law Publishing Co. Ltd.. 2002
	William G Zikmund, Business Research Methods, Indian edition, South western Publishers, 8th Indian Reprint – 2009.
	E-resourses (NPTEL/SWAYAM. Any Other)- mention links
1.	https://onlinecourses.swayam2.ac.in/cec20_ge37 (Research Methodology)

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Research Activity
3.	Flipped Classes	3.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Identify and select an appropriate methodology for research.	Un	1,2,9,10	1
2.	Analyze and interpret data collected	Ap	1,2,9,10	1
3.	Discuss the significance of Intellectual Property Rights & report writing	Ap	1,2,3,9,10	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Research Activity	Total Marks
Marks	20+20=40	10	50

IAs and Assignments: Minimum score to be eligible for SEE: 20 OUT OF 50

The weightage of Continuous Internal Evaluation (CIE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50).

Scheme of Semester End Examination (SEE):	
1.	The pattern of the **question paper is MCQ** (multiple choice questions). The time allotted for SEE is **01 hour.**
2.	SEE paper shall be set for **50 questions, each of the 01 mark**.
3.	The weightage for Semester End Exam (SEE) is 50%. The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50).
4.	A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to the subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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	✓	✓							✓	✓			✓		
2	✓	✓							✓	✓			✓		
3	✓	✓	✓						✓	✓			✓	✓	✓
Tick mark the CO, PO and PSO mapping															

EMPLOYABILITY SKILLS - I

Course Code	**21EC58**	**Course type**	**AEC**	**Credits L-T-P**	1– 0 – 0
Hours/week: L - T- P	1 – 0 – 0			**Total credits**	1
Total Contact Hours	L = 20 Hrs; T = 0 Hrs; P = 0 Hrs Total = 20 Hrs			**CIE Marks**	100

Course learning objectives	
1.	Skill development is/are personal attributes that influence how well an individual works or interacts with others.
2.	Skill development is/are personal attributes that influence how well an individual works or interacts with others.
3.	In essence, they are essential for individual success in the workplace, their company's success, and their personal life also

Unit – I	**Contact Hours = 4 Hours**
General Aptitude 1.1: Understanding Quantitative Aptitude: Number System, Averages, Ratio and Proportion Partnership	

Unit – II	**Contact Hours = 4 Hours**
General Aptitude 1.2: Understanding Quantitative Aptitude: Percentages, Profit and Loss, Time and Work, Ages	

Unit – III	**Contact Hours = 4 Hours**
General Aptitude 1.3: Understanding Quantitative Aptitude: Number and Letter Series, Coding and Decoding and DST, Analogy and Blood Relations	

Unit – IV	**Contact Hours = 4 Hours**
General Aptitude 1.4: Understanding Quantitative Aptitude: Reading Comprehension, Sentence Correction, Ordering of Sentences	

Unit – V	**Contact Hours = 4 Hours**
Improve Sense of Belongingness: Body Language, Grooming and Etiquette, Group Discussions	

Books	
	Text Books:
1.	The Aptitude Triad, BIZOTIC
	Reference Books:

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

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
		3	Internal Assessments

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Clear the Aptitude round of recruiters during placements	L2	10	
2.	Perform confidently during the Interview process	L2	12	
3.	Develop Resumes that are grammatically correct	L2	10	
4.	Develop behaviors that are appropriate for a professional	L2	12	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25 = 50	10	15+15 =30	10	100
> Writing 2 IA tests is compulsory **> Minimum score to be eligible for SEE: 40 OUT OF 100**					

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										✓		✓			
2										✓		✓			
3										✓		✓			
4										✓		✓			
5										✓		✓			
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Logical Thinking	IT Industry	Software Engineer
2	Problem Solving	Automotive	Developer
3	Communication Skills	Education Sector	Project Manager

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

ENVIRONMENTAL STUDIES

Course Code	**21EC59A**	**Course type**	**HSMS**	**Credits L-T-P**	1– 0 – 0
Hours/week: L - T- P	1 – 0 – 0			**Total credits**	1
Total Contact Hours	L = 1Hrs; T = 0 Hrs; P =0 Hrs Total = 20 Hrs			**CIE Marks**	50
Flipped Classes content	**10 Hours**			**SEE Marks**	50

Course learning objectives	
1.	To understand the scope of Environmental Engineering.
2.	Identify the Environmental impact due to Human activities.
3.	To understand the concept of Disaster Management.
4.	Identify the renewable and non-renewable sources of energy.
5.	Identify the various Legal aspects in Environmental Protection.

Unit – I	**Contact Hours = 4 Hours**
Definition of Environment, Ecology and Ecosystem, Structure and functions of ecosystem, balanced ecosystem, Introduction to Environmental Impact Assessment Natural Resources: Material Cycles - Oxygen, Carbon, Nitrogen and Hydrological cycle. Importance of water quality, Water borne diseases, Water induced diseases, Significance of Fluoride in drinking water	

Unit – II	**Contact Hours = 4 Hours**
Energy - Different types of energy, Conventional and Non - Conventional sources – Advantages and Limitations of Wind Mills, Hydro Electric, Fossil fuel, Nuclear, Solar, Biomass and Biogas, Geothermal energy	

Unit – III	**Contact Hours =4 Hours**
Disasters - Natural Disasters: Meaning and nature of natural disasters, their types and effects (Floods, drought, cyclone, earthquakes, Tsunami). Man Made Disasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution and marine pollution	

Unit – IV	**Contact Hours = 4 Hours**
Disaster Management: International strategy for disaster reduction. Concept of disaster management and national disaster management framework	

Unit – V	**Contact Hours = 4 Hours**
Environmental Protection: Role of Government, Legal aspects, Initiatives by Non - Governmental Organizations (NGO), Environmental Education, Women Education. E waste and solid waste management rules	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Benny Joseph, **"Environmental Studies",** Tata McGraw - Hill Publishing Company Limited (2005).
2.	Ranjit Daniels R.J. and Jagdish Kirshnaswamy, **"Environmental Studies",** Wiley India Private Ltd., New Delhi (2009).
3.	Sanjay K. Sharma, **"Environment Engineering and Disaster Management",** USP (2011).
4.	Harsh K. Gupta, **"Disaster Management",** Universities Press (India) Pvt. Ltd (2003).
	Reference Books:
1.	Meenakshi P., **"Elements of Environmental Science and Engineering",** Prentice Hall of India Private Limited, New Delhi (2006).
2.	Tyler Miller Jr. G., **"Environmental Science – Working with the Earth",** Tenth Edition, Thomson Brooks/Cole (2004).
	E-resources (NPTEL/SWAYAM/Any Other)- mention links
1.	–

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 Outcomes (COs)				
At the end of the course, the student will be able to:		Learning Level	PO(s)	PSO(s)
1.	Explain the importance of the Environment	Un	1,6,7	
2.	Evaluate Environmental disasters caused by human activities	Un	1,6,7	
3.	Outline the water problems and energy crisis in the present era	Un	1,6,7	
4.	Explain and classify the Renewable and Non-Renewable sources of energy	Un	1,6,7	
5.	Summarize the various Legislations related to Environment	Un	1,6,7	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Addition of two Assignments	Total Marks

Marks	15+15 = 30	10+10 =20	50
Writing the IA test is Compulsory **Minimum marks required to be eligible for SEE: 20 out of 50**			

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 50 marks of 1 hour duration.
2.	**Minimum marks required in SEE to pass: 20 out of 50**
3.	Question paper contains multiple choice questions.

CO-PO Mapping (Planned) [tick mark relevant ones]													**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	✓					✓	✓								
2	✓					✓	✓								
3	✓					✓	✓								
4	✓					✓	✓								

COMMUNICATIVE ENGLISH

Course Code:	**21EC59B**	**Course type**	**HSMS MNC for Diploma**	**Credits L-T-P**	1– 0 - 0
Hours/week: L - T- P	1 – 0 – 0			**Total credits**	1
Total Contact Hours	L = 15 Hrs, T = 0 Hrs P = 0 Hrs Total = 15 Hrs			**CIE Marks**	100
Flipped Classes content	3 Hours			**SEE Marks**	Nil

Course learning objectives	
1.	Enhance pronunciation and fluency for better communication skills.
2.	Augment English vocabulary and grammar for better communication skills.
3.	Impart basic language skills [LSRW].
4.	Achieve better writing skills for employment.
5.	Understand the importance of Non-verbal communication

Pre-requisites: Conversant with basic English Grammar and able to understand spoken English.

Unit – I Introduction to Listening Skills	**Contact Hours = 2 Hours**
Content of the Unit: Introduction to Listening Comprehension, Hearing and Listening, Listening Process, Types of Listening, Barriers of Listening, Effective and Passive Listening, Reasons and Disadvantages of Poor Listening.	

Unit – II Introduction to Speaking Skills	**Contact Hours = 3 Hours**
Content of the Unit: Introduction to Phonetics of English Vowel and Consonant sounds, Phonetic Transcription [IPA/RP], English Syllables, Rules for Word Accent -Stress Shift, Intonation, Silent and Non-silent Letters.	

Unit – III Introduction to Reading Skills	**Contact Hours = 2 Hours**
Content of the Unit: Reading Meaning and Stages, Importance of Reading, Types of Reading, Characteristics of Reading, Process of Reading, Approaches and Factors Influencing Reading, Techniques or Strategies of Reading.	

Unit – IV Introduction to Writing Skills	**Contact Hours = 3 Hours**
Content of the Unit: Introduction Writing Paragraphs, Parts of the paragraph, Importance of Proper Punctuation, Creating Coherence and Cohesion in Writing, Precise writing, Importance of Summarizing and Paraphrasing. Types of Writing,	

Unit – V Introduction to Non- Verbal communication	Contact Hours = 2 Hours
Content of the Unit: Introduction to Nonverbal Communication, Importance of NVC, Types of NVC- Gestures, Postures, Haptics, Proxemics, Chronemics and Paralanguage.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	**	Grammar-I	**	Grammar-II	Grammar III

Books	
	Text Books:
1.	A Textbook of English Language Communication Skills, Infinite Learning Solutions–(Revised Edition) 2021.
	Reference Books:
1.	Communication Skills by Sanjay Kumar and Pushp Lata, Oxford University Press - 2019.
2.	English for Engineers by N.P.Sudharshana and C.Savitha, Cambridge University Press – 2018.
	E-resources (NPTEL/SWAYAM. Any Other)- mention links
1.	Technical English for Engineers course Swayam/ NPTEL https://onlinecourses.nptel.ac.in/noc22_hs34/preview
2.	ESOL Courses: Listening & Grammar free online video lesson https://www.esolcourses.com/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	CIE assignments
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Course seminar
4.	Online classes, if required.	4.	

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	To understand and identify the Common Errors in Writing and Speaking.	Re	10	
2.	2. To Achieve better technical writing and Presentation skills.	Un	10	
3.	3. To read technical proposals properly and make them Write good technical reports.	Ap	10	
4.	4. Acquire Employment and Workplace communication skills.	An	10	

Scheme of Continuous Internal Evaluation (CIE):

Components	Assignments	Course Seminar	Quizzes	Total Marks
Marks	20+20 = 40	20	10x4=40	100

Scheme of Semester End Examination (SEE): No SEE component	
1.	NA
2.	**Minimum marks required in SEE: NA**
3.	The weightage of Continuous Internal Evaluation (CIE) is 100%

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										✓					
2										✓					
3										✓					
4										✓					
5										✓					
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1			
2			
3			

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

MANAGEMENT FOR ELECTRONICS ENGINEERING

Course Code	**21EC61**	**Course type**	**HSMS**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand Characteristics and roles of management in an Electronics Industry.
2.	Understand the need of entrepreneur & characteristics of Entrepreneurship
3.	Understand the opportunities of MSME's and apply for various Central and State Institutional Supports.
4.	Analyze the need of Project report for Business Proposals.

Unit – I	**Contact Hours = 8 Hours**
Management: Introduction, nature and characteristics of Management, Scope and Functional areas of management, Management as a science, art of profession **Planning:** Nature, importance and purpose of planning process, Types of plans, Decision making, Importance of planning, steps in planning. **Organizing**: Nature and purpose of organization, Principles of organization, Types of organization (based on departments, based on commands), Span of control, MBO **Course Activity: Identify the roles of manager in an IT company.**	

Unit – II	**Contact Hours = 8 Hours**
Staffing, Directing & Controlling: Nature and importance of staffing, Process of Selection & Recruitment, Training Methods **Directing**: Meaning and nature of directing, Leadership styles, Motivation Theories (McGregor's Theory of X and Y, Maslow's Hierarchy of needs theory, Herzberg's Motivation-Hygiene Theory), Communication- Meaning and importance **Controlling:** Meaning and steps in controlling, Essentials of a sound control system, Methods of establishing control. **Course Activity: Identify the roles of HR Department in different department of the industry.**	

Unit – III	**Contact Hours = 8 Hours**
Entrepreneur: Meaning of entrepreneur: Evolution of the concept: Functions of an Entrepreneur, Types of Entrepreneur, Concept of Entrepreneurship, Evolution of Entrepreneurship, The Entrepreneurial Culture and Stages in entrepreneurial process. **Creativity and Innovation**: Creativity, Source of New Idea, Ideas into Opportunities, Creative Problem Solving: Heuristics, Brainstorming, Synectics, Significance of Intellectual Property Rights. **Course Activity**: **Identify the innovative start-ups recently launched**	

Unit – IV	Contact Hours = 8 Hours
Micro, Small and Medium Enterprises [MSMEs] and Institutional Support: Business environment in India**,** Role of MSMEs**,** Government policies towards MSMEs, Impact of Liberalization, Privatization and Globalization on MSMEs. **Institutional support**: NSIC, TECKSOK, KIADB, KSSIDC, SIDBI; KSFC **Course Activity: Identify the nearby MSMEs funded through various institutional support**	

Unit – V	Contact Hours = 8 Hours
Preparation of Project report and Business Plan: Meaning of Project, Project Identification, Project Selection, Project Report, Need and Significance of Report, Contents. **Business Plan**: Need of business plan, anatomy of business plan, executive summary, business description, Business environment analysis, background information. **Venture Capital:** Meaning, Need, Types and Venture capital in India **Course Activity**: **Identify the roles of Angel Investors to support financial needs of start-ups**	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Henry Koontz, "Essentials of Management", McGraw Hill, 10th Edition 2017 onwards
2.	Poornima M. Charantimath, "Entrepreneurship Development", Pearson Education, 2014 Edition onwards
	Reference Books:
1.	P. C. Tripathi, P. N. Reddy "Principles of Management" — Tata McGraw Hill.
2.	Dr. M. M. Munshi, Prakash Pinto and Ramesh Katri "Entrepreneurial Development" Himalaya Publishing House, 2016.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/110107150 - (Principles of Management, IIT Roorkee)

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 Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand** the Functions of management, Characteristics of Management, and Purpose of Planning.	Un	8,9,10,11,12	2
2.	**Understand** the need and role of entrepreneur in the development of the industry.	Un	7,8,9,10,11,12	2,3
3.	**Understand** different Schemes and support for MSME's. and **applying** for the Start Up concepts.	Ap	6,7,8,9,10,11,12	2,3
4.	Analyze a business plan and its report to the support organizations.	An	6,7,8,9,10,11,12	3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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								✓	✓	✓	✓	✓		✓	
2							✓	✓	✓	✓	✓	✓		✓	✓
3						✓	✓	✓	✓	✓	✓	✓		✓	✓
4						✓	✓	✓	✓	✓	✓				✓
Tick mark ✓ the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Manager in various sectors	MSME and Large-scale industries	Manager in an organization

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

MACHINE LEARNING AND APPLICATIONS

Course Code	**21EC62**	**Course type**	**PCC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To study and apply machine learning algorithms for accurate data analysis and problem-solving.
2.	To grasp the fundamentals of machine learning and effectively apply supervised and unsupervised classification techniques to real-world problems.
3.	To critically analyze and evaluate machine learning models for optimal performance.
4.	To apply machine learning algorithms and techniques to real-world datasets for practical problem-solving.

Pre-requisites: Fundamental statistics

Unit – I	**Contact Hours = 8 Hours**

Introduction to Machine Learning

Machine learning: what and why? Supervised learning, Unsupervised learning, Some basic concepts in machine learning.

Applications of Machine Learning:

Image Recognition, Natural Language Processing, Recommender Systems, Fraud Detection, Healthcare Diagnosis, Autonomous Vehicles, Financial Forecasting, Social Media Analysis, Predictive Maintenance, Energy Consumption Optimization.

Case study on Classifying customer reviews as positive or negative using machine learning techniques.

Practical Session of Machine Learning and Applications: Introduction to Python, PyTorch, MathWorks Matlab.

Unit – II	**Contact Hours = 8 Hours**

Probability Distributions

Introduction, **A brief review of probability theory** - Discrete random variables, Fundamental rules, Bayes rule, Independence and conditional independence, Continuous random variables, Quantiles, Mean and variance. **Some common discrete distributions** - The binomial and Bernoulli distributions, The multinomial and multinoulli distributions, The Poisson distribution, The empirical distribution.

Case study on machine learning models to diagnose diseases based on medical images.

Practical Session of Machine Learning and Applications: Implementation of examples using Python, PyTorch, MathWorks Matlab.

Unit – III	Contact Hours = 8 Hours
Linear Models for Regression **Linear Basis Function Models** – Introduction, Model specification, Maximum likelihood estimation (MLE), Maximum likelihood and least squares, Geometry of least squares, Sequential learning, Regularized least squares, Multiple outputs. **The Bias**-Variance Decomposition, **Bayesian Linear Regression** - Parameter distribution, Predictive distribution, Equivalent kernel. Bayesian Model Comparison, **The Evidence Approximation**- Evaluation of the evidence function, Maximizing the evidence function, Effective number of parameters, Limitations of Fixed Basis Functions. **Case study on detecting fraudulent activities in financial transactions using machine learning algorithms.** **Practical Session of Machine Learning and Applications: Implementation of examples using Python, PyTorch, MathWorks Matlab.**	

.

Unit – IV	Contact Hours = 8 Hours
Logistic regression Introduction, Model specification, **Model fitting** – MLE, Steepest descent, Newton's method , Iteratively reweighted least squares (IRLS), Quasi-Newton (variable metric) methods, ℓ_2 regularization, Multi-class logistic regression, **Bayesian logistic regression** - Laplace approximation, Derivation of the BIC, Gaussian approximation for logistic regression, Approximating the posterior predictive, Residual analysis (outlier detection), **Online learning and stochastic optimization** - Online learning and regret minimization , Stochastic optimization and risk minimization, The Least Mean Squares (LMS) algorithm, The perceptron algorithm, A Bayesian view, **Generative vs discriminative classifiers** - Pros and cons of each approach, Dealing with missing data, Fisher's linear discriminant analysis (FLDA). **Case study on pproviding personalized content recommendations to users based on their preferences.** **Practical Session of Machine Learning and Applications: Implementation of examples using Python, PyTorch, MathWorks Matlab.**	

Unit – V	Contact Hours = 8 Hours
Classification and clustering using Machine learning Introduction to Classification and Clustering, Supervised Learning for Classification, Unsupervised Learning for Clustering, **advanced Classification Techniques** - Ensemble methods (Bagging, Boosting), Deep learning approaches for classification (Neural Networks, Convolutional Neural Networks), Handling imbalanced data sets, Handling missing data and outliers, **Advanced Clustering Techniques**-Density-based clustering methods (Mean Shift, OPTICS), Spectral clustering, Fuzzy clustering, Semi-supervised and constrained clustering. Evaluation and Validation, Applications of Classification and Clustering. **Case study on predicting equipment failure and maintenance needs in industrial settings using machine learning.** **Practical Session of Machine Learning and Applications: Implementation of examples using Python, PyTorch, MathWorks Matlab.** **Intro to DL**	

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	4	Exploratory Analysis of Data

		Compare Grouped Data Using Box Plots Create Scatter Plots Using Grouped Data Curve Fitting and Distribution Fitting
2	4	Simulating Dependent Random Variables Using Copulas Fitting a Univariate Distribution Using Cumulative Probabilities Fit Custom Distributions Multinomial Probability Distribution Objects
3	3	Bayesian Analysis for a Logistic Regression Model Fitting Data with Generalized Linear Models Weighted Nonlinear Regression
4	4	Linear Regression with Interaction Effects Train Linear Regression Model Analyze Time Series Data Train Linear Regression Model
5	4	Cluster Analysis Cluster Gaussian Mixture Data Using Hard Clustering Classification with Imbalanced Data Assess Neural Network Classifier Performance

Unit No.	Self-Study Topics
1	Exponential models, Time series models.
2	Multiple linear regression, Multivariate linear regression, Generalized linear models.
3	Machine learning and compressed sensing.
5	Sparse signal representation, kernel and sparse kernel

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Christopher M. Bishop - "Pattern Recognition and Machine Learning" - Springer, 1st Edition, 2006.
2.	Kevin P. Murphy - "Machine Learning: A Probabilistic Perspective" - MIT Press, 2012.
	Reference Books:
1.	Richard O. Duda, Peter E. Hart, and David G. Stork - "Pattern Classification" - Wiley, 2nd Edition, 2000.
2.	Trevor Hastie, Robert Tibshirani, and Jerome Friedman - "Elements of Statistical Learning: Data Mining, Inference, and Prediction" - Springer, 2nd Edition, 2009.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Introduction To Machine Learning, By Prof. Sudeshna Sarkar, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_cs97/preview
2.	Machine Learning And Deep Learning - Fundamentals And Applications, By Prof. Manas Kamal Bhuyan, IIT Guwahati. https://onlinecourses.nptel.ac.in/noc23_ee87/preview

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.	**Mini Project**	5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand** machine learning concepts and their applications.	Un	1,2,12	1,2
2.	**Apply** supervised learning algorithms for classification and regression tasks.	Ap	1,2,12	1,2
3.	**Analyze** and implement deep learning techniques for complex pattern recognition and image analysis tasks.	An	1,2,12	1,2,3
4.	**Evaluate** and compare machine learning models, addressing overfitting challenges.	Ev	1,2,6,7,9,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓			✓							✓	✓	✓	
2	✓	✓			✓							✓	✓	✓	
3	✓	✓			✓		✓	✓	✓	✓		✓	✓		
4	✓	✓			✓							✓	✓	✓	✓

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	The course in Machine Learning and Applications enhances students' skills and competence in applying machine learning algorithms to solve real-world problems and analyze data effectively	The knowledge gained in Machine Learning and Applications is applicable to various industry sectors and domains, including healthcare, finance, e-commerce, marketing, and artificial intelligence.	After completing the Machine Learning and Applications course, students can pursue job roles such as machine learning engineer, data scientist, AI researcher, predictive analyst, and data engineer.

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

DATA COMMUNICATION AND NETWORKS

Course Code	**21EC63**	**Course Type**	**IPCC**	**Credits L-T-P**	3 – 0 – 1
Hours/week: L-T-P	3 – 0 – 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

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

Required Knowledge of : Principles of Communication system (21EC44)

Unit – I	**Contact Hours = 8 Hours**
Data Communications: Components, Representations, Data Flow, Networks: Physical Structures, Network Types: Switching, Transmission time, Latency, throughput, delay bandwidth product, Jitter. TCP/IP Protocol Suite: Layered Architecture, Description of layers, Addressing. The OSI Model: OSI Versus TCP/IP. **Case Study:** Protocols and Standards.	

Unit – II	**Contact Hours = 8 Hours**
Data Link Control: LLC layer: Framing, Flow and Error Control, Noiseless Channels and Noisy Channels, HDLC. Data Link Layer Protocols: Reliable Transmission, Simplex Protocol, Stop and Wait protocol, Sliding Window, selective repeat, Piggybacking. **Case Study:** Different error control implementation schemes in LLC layer.	

Unit – III	**Contact Hours = 8 Hours**
Media Access Control: Random Access, ALOHA, slotted aloha, CSMA, CSMA/CD, CSMA/CA. Controlled Access: Reservation, Polling, Token Passing. ATM networks, BISDN reference model, ATM layer. Virtual LANs: Membership, Configuration, Communication between Switches, Advantages. **Case Study:** Demonstration of LAN configuration and it's working	

Unit – IV	**Contact Hours = 8 Hours**
Network Layer services: Packetizing, Switching and forwarding, Datagram, Virtual Circuit Switching, Source Routing. IPV4 Addresses: Classful Addressing, classless addressing, DHCP, Network Address Resolution and Border Gateway Protocols (BGP), Embedding IPv4 Addresses in IPv6 For Transition. **Case Study**: Simulating of LAN and study of packet transfer using packet tracer tool.	

Unit –V	Contact Hours = 8 Hours
Transport Layer: Introduction, Transport Layer Services, Connectionless and Connection oriented Protocols. User Datagram Protocol: User Datagram, UDP Services, UDP Applications, TCP congestion control. Digital subscriber line: ADSL, HDSL, SDSL, VDSL, Cable TV Networks. Applications of blockchain in computer networks. **Case Study:** With help of research papers document the various network working scenarios in which TCP/UDP are preferable.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. of Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	Number of Experiments	Topic(s) related to Experiment
1	1	Study of networking devices, NIC card and cable crimping process needed for network deployment.
1	1	Design a local area network, configure the nodes, switches and illustrate the data flow using packet tracer tool.
2	1	Simulate the different network topologies using CISCO packet tracer.
2	1	Simulate Routing Information Protocol (RIP) algorithm using CISCO packet tracer.
3	1	Configure the server to implement DHCP and ARP services.
3	1	Configure and simulate the network to implement SMTP services
4	1	Design and implement smart garden system using remote terminal and wireless links.
4	1	Design and implement virtual LAN
5	1	Configure and simulate to study the functionality and working of a Border Gateway Protocol and virtual LAN.
5	1	Simulation of Wi-Fi using virtual Lab.

Unit No.	Self-Study Topics
1	Numerical on Performance parameters.
2	Numerical on LLC layer protocols.
4	Numerical on IP addressing

Books	
	Text Books:
1.	Behrouz A Forouzan, “Data Communication and Networking”, Tata McGraw-Hill publishing Company Limited, Indian Edition, 2006 and onwards.

2.	Alberto Leon Garcia, “Communication Networks”, McGraw-Hill, 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-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Course Title: Computer Communications Specialization https://www.coursera.org/specializations/computer-communications#courses
2.	

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Compare the various data flow control methods with respect to general data network communication. Compare and contrast the OSI model and TCP/IP architecture suite.	Understand	1,2	1
2.	Analyse the relevance of networking components and methods of channel access techniques.	Apply	2,3,5	1
3.	Compare and analyse the relevance of Transport Control Protocol and User datagram protocol to design congestion free network.	Analysis	1,2,5,10,12	1
4.	Design and analyse the network addresses using the knowledge of data switching and IPV4 addressing.	Evaluate	2,3,5,12	1

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)/ Course project	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive					
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks					

2. Calculations, results, graph, conclusion and Outcome: 5 marks 3. Viva voce: 5 marks
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 10 marks 5. Viva voce: 10 marks
Eligibility for SEE: 1. 40% and above (24 marks and above) in theory component 2. 40% and above (16 marks and above) in lab component 3. **Lab test is COMPULSORY** 4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO1 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
Un	✓	✓	✓										✓		
Ap			✓										✓		
An	✓	✓	✓			✓			✓				✓		
Ev										✓	✓	✓	✓		
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Developing networks	IT industry	System administrator
2	Debugging network issues	Telecommunication industry	Network Designer
3	Data connectivity and supporter	Hardware industries	Network Manager

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

MICROWAVE AND RADAR

Course Code	21EC64	**Course type**	IPCC	**Credits L-T-P**	3 – 0 – 1
Hours/week: L - T- P	3 – 0 – 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To study the fundamental concepts of microwave and RADAR based communication systems.
2.	To determine various parameters to evaluate the performance for microwave and RADAR circuits/systems.
3.	To develop microwave/RADAR circuits/systems for various applications.

Required Knowledge of: Engineering Mathematics; Engineering Electromagnetics;

Unit – I	**Contact Hours = 8 Hours**
Microwave Transmission Lines: Microwave Frequencies and band designations (IEEE microwave frequency bands), Microwave devices, Microwave Systems, Transmission Line equations (derivation) and solutions (no derivation), Reflection Coefficient and Transmission Coefficient (no derivation), Standing Wave and Standing Wave Ratio, Smith Chart, Single Stub matching, double stub matching.	

Unit – II	**Contact Hours = 8 Hours**
Microwave Network theory: S matrix representation of Multi-Port Networks, Properties of S matrix, S parameters of a two- port network with mismatched load. Microwave Passive Devices: Coaxial Connectors and Adapters, Attenuators, Phase Shifters, Waveguide Tees: E-plane, H-plane and Magic Tee, Isolators, Circulators, and Directional couplers.	

Unit – III	**Contact Hours = 8 Hours**
Microwave Active Devices: Transferred Electron Device (TED), Gunn Diode, RWH Theory, Modes of Operation; Avalanche Transit Time Devices (ATTD): READ, IMPATT, TAPPAT, BARITT	

Unit – IV	**Contact Hours = 8 Hours**
Nature of RADAR: Introduction, Simple form of RADAR equation, RADAR block diagram and operation, RADAR frequencies; RADAR equation: Prediction of range performance, minimum detectable signal, receiver noise, probability density function, signal to noise ratio, integration of radar pulse, radar cross section targets, cross section fluctuations, pulse repetition frequencies (PRF).	

Unit – V	**Contact Hours = 8 Hours**
CW, Frequency modulated RADAR: Doppler effect, CW radar, frequency modulated CW radar, airborne Doppler navigation, multiple frequency CW radar. MTI and Pulse Doppler Radar: Introduction, Delay line canceler, multiple or staggered PRF, range gated Doppler filter, other MTI delay lines, example of MTI Delay lines, example of MTI, limitation to MTI Performance,	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	3	Impedance matching for lumped parameters (software based)
		Impedance matching for distributed parameters (software based)
		Impedance matching for lumped parameters (hardware based).
2	3	E, H plane tee: S-matrix and characteristics
		Magic-Tee: S-matrix and characteristics
		Directional Coupler, Isolator, Circulator: S-matrix and characteristics
3	1	Gunn diode characteristics
4	1	RADAR Equation, RADAR Cross Section
5	2	RADAR detection and waveform analysis

Unit No.	Self-Study Topics
1	Smith Chart applications.
2	Applications of microwave passive devices.
3	Material properties of devices.
4	RADAR performance parameters.
5	RADAR applications.

Books	
	Text Books:
1.	Samuel Liao, "Microwave Devices and circuits", Pearson Education.
2.	Merrill Skolnik, Introduction to RADAR Systems, McGraw Hill Book Company.
	Reference Books:
1.	Annapurna Das and Sisir K Das, "Microwave Engineering", TMH Publication, 2nd Edition, 2010 and onwards.
2.	D. Pozar, Microwave Engineering, J. Wiley and Sons, 3rd Edition, 2004
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Microwave Engineering : https://nptel.ac.in/courses/108103141
2.	Principles and Techniques of Modern Radar Systems: https://nptel.ac.in/courses/108105154

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination

Course Outcome (COs)
Learning Levels:
Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	To understand the fundamental concepts of	Un	1,2,10,12	1,2

	microwave and RADAR based communication systems.			
2.	To analyze the performance of microwave and RADAR circuits/systems.	Ap	1,2,3,4,5,9,10,11,12	1,2
3.	To evaluate microwave/RADAR circuits/systems for various applications.	Ev	1,2,3,4,5,9,10,11,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)/ Course project	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive					
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks 3. Viva voce: 5 marks					
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 10 marks 5. Viva voce: 10 marks					
Eligibility for SEE: 1. 40% and above (24 marks and above) in theory component 2. 40% and above (16 marks and above) in lab component 3. **Lab test is COMPULSORY** 4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓								✓		✓	✓	✓	

2	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Microwave circuits and systems modeling, characterization, analysis. RADAR systems operations	5G Communications technology	Product designer, researcher

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

MODERN ELECTRIC, HYBRID ELECTRIC AND FUEL CELL BASED VEHICLES

Course Code	**21EC6501**	Course type	**PEC**	Credits L-T-P	**3 – 0 – 0**
Hours/week: L - T- P	**3 – 0 – 0**			Credits	**3**
Total Contact Hours	**L = 40 Hrs; T=P=0 Hrs; Total = 40 Hrs.**			CIE Marks	**100**
Flipped Classes content	**00 Hours**			SEE Marks	**100**

Course Learning Objectives	
1.	Learning the basics related to vehicle dynamics, transmission characteristics and various transmission techniques for traditional and modern vehicles.
2.	Understanding functioning of various propulsion systems and energy sources for EV.
3.	Getting exposed to the field of electric vehicles, hybrid electric vehicles and fuel cell based hybrid electric vehicles and knowing their performance and design parameters.
4.	Understanding the concept of regenerative braking and its significance in EV design.

Required Knowledge: Engineering mechanics, basic electrical and electronics engg, analog electronics, network theorems, signals &systems, control systems, automotive systems.

Unit – I Vehicle Propulsion, ICEVs, and Vehicle Transmission	**Contact Hrs = 8**
General descriptions of vehicle movements, vehicle dynamics, brake performance, fuel economy, basics of SI& CI engine, vehicle transmission characteristics, manual and automatic transmission, torque converter, planetary or epicyclic gear train, automated manual and dual clutch transmission, CVT, IVT, and DHT.	

Unit – II Electric Propulsion Systems and Energy Sources	**Contact Hrs = 8**
Propulsion Systems – Chopper controlled DC motor drives, volt/Hertz and FOC of induction motors, BLDC speed control &functioning of rotor position sensors, speed control of SRM; Energy Sources and Peaking Power Sources – batteries as energy storing devices, PEM fuel cell as energy source, ultracapacitors and ultra-high-speed flywheels as peaking power sources,	

Unit – III Electrical Vehicles & Regenerative Braking	**Contact Hrs = 8**
EV – Configuration, performance graph, tractive effort in normal driving, energy consumption; Regenerative Braking – Braking energy consumed in urban driving, braking energy and brake power comparison with various parameters, brake system for EV, HEV and FCV.	

Unit – IV Series, Parallel and Other Hybrid Electric Vehicles	**Contact Hrs = 8**
Concept and architecture of hybrid electric drivetrain, series hybrid (electrically coupled) drivetrain, parallel hybrid (mechanically coupled) drivetrain, max SoC of PPS and thermostat control for series and parallel hybrid drivetrains, series-parallel (torque-speed) control, plug-in hybrid electric vehicles, mild hybrid electric drivetrain.	

Unit V– Basics of H_2Fuel Cell and FCHEV Drivetrain Design	Contact Hrs = 8
Operation principles of H_2 driven PEM fuel cells, fuel cell characteristics, PEMFC sub-systems, configuration of fuel cell hybrid electric drivetrain design, control strategy, parametric design, motor power design, power design of fuel cell system, design of PPS power and energy capacity.	

	Text Books:
1.	Mehrdad Ehsani, Yimin Gao, Stefano Longo, and Kambiz Ebrahimi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles,"3rdEdition, CRC Press, Taylor & Francis Group, 2002, ISBN 13: 978-1-4987-6177-2 (Hardback).
2.	John G. Hayes, G. Abas Goodarzi, "Electric Powertrain – Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicle," 1st Edition, 2018.
3.	Iqbal Husain, "Electric and Hybrid Vehicles – Design Fundamentals," CRC Press, Taylor and Francis Group eBook Editions, ISBN 0-8493-1466-6, 2010.
	Reference Books:
4.	Chris Mi, Abul Masrus, "Hybrid Electric Vehicles – Principles and Applications with Practical Perspectives," 2nd Edition, Wiley, 2017.

	E-resourses (NPTEL link mentioned)
1	Fundamentals of Electric Vehicles – Technology and Economics - IITM NOC https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=1**by Prof. Ashok Jhunjhunwala, IIT Madras**

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Quizzes + OBA from NPTEL lectures
2.	PPT and Videos from YouTube	2.	IA tests
3.	Insudtry Expert lecture	3.	MATLAB On Ramp Course Certifications
4.	NPTEL – related course lectures audits	4.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply;An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	figure out the necessity of EV, HEV and FCV for a better world with far less pollution compared to current scenario.	Un	1,2	1
2.	understand the necessity of regenerative type of electrical braking for urban drive cycles.	Ap	1,2,3,4	1,2
3.	gather complete knowledge about the control and design parameters of EV, HEV and FCV.	An	1,2,3,5	1,3
4.	comprehend and justify the set up and upscaling of hydrogen generation and infrastructure development in India.	Ap	1,6,7,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓											✓		
2	✓	✓	✓	✓									✓	✓	
3	✓	✓	✓		✓								✓		✓
4	✓					✓	✓						✓	✓	
Tick mark the CO, PO and PSO mapping															

	Skill & competence enhanced after undergoing the course	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	**Design methods and development of EV**	**Automation Electric vehicle industry**	**Design and development engineer Manufacturing Electric vehicle maintainence**

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

LOW POWER ARCHITECTURE

Course Code	**21EC6502**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand the fundamentals of low-power VLSI design:
2.	Familiarity with low-power design techniques and methodologies
3.	Analyze power consumption in CMOS circuits.
4.	Apply low-power techniques in system-level design.

Pre-requisites: Digital System Design, Analog Electronics

Unit – I	**Contact Hours = 8 Hours**
Introduction, Technology and circuit design levels: Device and Technology impact on low power electronics, introduction, dynamic dissipation in CMOS, effects of UN on speed, constraints on reduction, transistor sizing and optimal Gate oxide thickness, impact of technology scaling, technology and device innovations.	

Unit – II	**Contact Hours = 8 Hours**
Low power circuit techniques: Introduction, power consumption in circuits, flip flops and latches, logic, high capacitance notes Low power clock distribution: Power distribution in clock distribution, driver vs distributed buffers, buffer and device sizing under process variation.	

Unit – III	**Contact Hours = 8 Hours**
Logic synthesis for low power: Introduction, power estimation techniques, power minimization techniques, Low power memory design: Introduction, sources and reductions of power dissipation in memory subsystem.	

Unit – IV	**Contact Hours = 8 Hours**
Low power microprocessor design: System Power management support, architectural tradeoff for power, choosing the supply voltage, low-power clocking, implementation options for low power, Power and performance, Comparing microprocessors. **Case Study:** Low power architecture design and compilation techniques for high-performance processors.	

Unit –V	Contact Hours = 8 Hours
Architectural level methodology: Introduction, design floor, algorithm level, Analysis and Optimization, architectural level, Estimation and synthesis. **Case Study:** Study of QAM block in communication systems.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Jan M. Rabaey and Massoud Pedram, "Low-power-design-Methodology", The Springer International Series in Engineering and Computer Science, 1995 and onwards.
2.	Kaushik Roy and Sharat C Prasad, “Low-Power CMOS VLSI Circuit Design”, John Wiley Pvt. Ltd., 2008 and onwards.
	Reference Books:
1.	Gary Yeap and Kluwer, “Practical Low Power Digital VLSI Design”, Academic Publications, 1998 and onwards.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	
2.	

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 (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Understand the fundamentals of low-power VLSI design.	L2	1	1
2.	Evaluate power-performance trade-offs and understand their impact on circuit design.	L3	2,3	1
3.	Evaluate the suitability of advanced low-power techniques for different design scenarios.	L4	3,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓												✓		
2		✓	✓										✓		
3			✓									✓	✓		
4															
5															
Use tick mark(✓)															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	VLSI Design, Low Power Techniques	VLSI Design, Embedded Systems	Engineer, Verification Engineer

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

DIGITAL SYSTEM DESIGN ON FPGA

Course Code	21EC6503	**Course type**	**PEC**	**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**	100
Flipped Classes content	3 Hours			**SEE Marks**	100

Course learning objectives	
1.	Explain ASIC methodologies, data path elements, logical effort.
2.	Understand and implementing programmable IP flow and also customize the IP.
3.	Analyze back-end physical design flow, including partitioning, floor-planning, placement and routing for area power and timing optimization.
4.	Validate the designs for specific timing and power constraints.

Required Knowledge of: Digital System Design, CMOS VLSI Design, HDL

Unit – I	**Contact Hours = 8 Hours**
State-of-the-Art Programmable Logic: Introduction, The Evolution of Programmable Logic, Current Applications for FPGAs, Application-Level System Architectures, FPGA Architecture, System on Chip, System Level Functions	

Unit – II	**Contact Hours = 8 Hours**
IP Flows: Overviews, IP Catalog, IP Customization, IP Constraints, IP-Upgrade Decisions, IP Simulation **Processor Options:** Introduction, Computing on FPGAs, Processors on FPGAs, Tool Chains, Beyond Traditional System Design	

Unit – III	**Contact Hours = 8 Hours**
Synthesis: Introduction, Designs Migrating from ASIC, Getting the Most of Device Primitives, Attributes / Directives to Control Synthesis Behavior, Synthesis vs. Simulation Mismatch: Common Cases, Guidelines to Get Best Results Out of Synthesis. **C-Based Design:** C Simulation, Arbitrary Precision Data Types, High-Level Synthesis, Interface Synthesis, Measuring Performance, Optimization Methodology	

Unit – IV	**Contact Hours = 8 Hours**
Simulation: Introduction, Setting Up Design for Simulation, Simulation and Observing Results. **Clocking:** Clocking in FPGA Designs, Choice of Clock Frequency, Number of Clocks, Optimizing Clock Networks to Improve Internal Timing, Optimizing Clock Networks for Interfaces. **Stacked Silicon Interconnect (SSI)**: SSI Terminology, Design Partitioning, Pinout Considerations for SSI Designs	

Unit –V	Contact Hours = 8 Hours
Timing Closure: Introduction to Timing Concepts, Generating Timing Reports, Timing Paths and Constraint Correctness, Timing Closure Techniques. **Power Analysis and Optimization:** Introduction, Xilinx Power Estimator (XPE), Vivado Report Power, Vivado Power Optimization, **Emulation Using FPGAs:** Introduction to Emulation, Emulation Using FPGAs, Challenges in Emulation Using FPGAs.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions		**2**	**1**	**-**	**-**

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	**2**	Types of Vivado Programmable Logic, HDL/IP based programs
2	**2**	IP Customization blocks.
3	**1**	RTL design and analysis
4	**1**	Synthesizing the code, Simulation and adding constraints
5	**1**	Generating timing reports
5	**1**	Generating power reports
	2	Power Analysis and Power estimation

Unit No.	Self-Study Topics
1	Introductions to EDA tools
2	(Vivado) IP Integrator , Verification of System Generator Design ,
3	RTL Integration

Books	
	Text Books:
1.	Sanjay Churiwala (eds.) - Designing with Xilinx® FPGAs_ Using Vivado-Springer International Publishing (2017)
2.	KhosrowGolshan - Physical design essentials_ an ASIC design implementation perspective-Springer (2007)
	Reference Books:
1.	Pong P. Chu - FPGA Prototyping by VHDL Examples_ Xilinx MicroBlaze MCS SoC-Wiley-Blackwell (2017)
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://archive.nptel.ac.in/courses/117/108/117108040/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Understanding FPGA architecture and components.	Un	1,2	1
2.	Optimizing FPGA designs for performance and area.	Ap	4,5	1
3.	Developing a complete FPGA-based system from concept to realization.	An,Ev	3,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓											✓		
2				✓	✓								✓		
3			✓									✓	✓		
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	FPGA/ASIC design	VLSI Design	Front end developer,

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

ROBOTICS & AUTOMATION

Course Code	21EC6504	Course type	PEC	Credits L-T-P	3 – 0 – 0
Hours/week: L-T-P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	3 Hours			SEE Marks	100

Course learning objectives	
1.	To understand fundamentals of industrial automation and robotics
2.	To understand different types of actuators, motors, grippers used in robot drive system and control systems
3.	To identify the faults in the system and troubleshoot thus learning the complete cycle of building a robot

Pre-requisites: Digital Electronics, Microcontrollers.

Unit – I	Contact Hours = 8 Hours
Fundamentals of Robot: Introduction, industrial robot, robot, laws of robotics, types of robots, 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	Contact Hours = 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	Contact Hours = 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	Contact Hours = 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:** Development of robotic arm control system.

Unit –V	**Contact Hours = 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 newforms. **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.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**-**	**2**	**1**	**-**	**-**

Books	
	Text Books:
1.	Ramachandran S., “Robotics”, AIRWALK PUBLICATIONS (2017), ISBN: 978-9384893-69-9
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)
	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)
2.	John J. Craig - Introduction to Robotics Mechanics and Control 3rd edition-Pearson Education, Inc. (2005)
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/108/105/108105063/

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/Project
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the fundamentals of Robotics.	Un	1,9,10,11,12	1
2.	Compare and identify the appropriate proper actuators and sensor required for the robotic application.	Ap	2,3,9,10,11,12	1
3.	Program a controller to sense from sensors and control the actuators.	An	5,9,10,11,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓								✓	✓	✓	✓	**1**		
2		✓	✓						✓	✓	✓	✓	**1**		
3					✓				✓	✓	✓	✓		**1**	
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	**Robotics**	**Automation**	**Process Automation Engineer/Tester**

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

BIO MEDICAL IMAGE UNDERSTANDING AND ANALYSIS

Course Code	**21EC6505**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

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.	Appreciate the evolution of Deep Neural Network from ANN
4.	Design and deploy simple Convolution Neural Network (CNN) model for Biomedical Image classification and identification for specific Radiological Modalities.

Required Knowledge of: Linear Algebra, Statistics and Probability

Unit – I	**Contact Hours = 8 Hours**

Introduction to Biomedical Image Processing

Digital Image Processing, Biomedical 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.

Privacy and Ethics in Handling Clinical Data for Experiments: Ensuring privacy and ethics in handling clinical data for experiments is essential to protect patient confidentiality and uphold ethical standards.

Practical Session : Introduction to Mathwork Matlab and Image Processing Toolbox / Python coding

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

Over view 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 Mathwork Matlab Deep Learning Toolbox/ Python coding

Case study review on Artificial Neural Networks and Biomedical Image applications

Unit – III	Contact Hours = 8 Hours
Convolution Neural Networks and Applications Introduction to Convolutional Neural Networks (CNNs / ConvNets), architecture overview and terminologies of CNN, motivation behind CNN, study of architecture and comparisons of pretrained CNN (limited to only **LeNet-5,ResNet -34 and ResNet -50**). **Case study review on to Convolutional Neural Networks (CNNs / ConvNets)and Biomedical Image applications** **Practical Session: Introduction to Mathwork Matlab Deep Learning Toolbox/ Python coding**	

Unit – IV	Contact Hours = 8 Hours
Deep Learning Medical Image Segmentation 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 and V-net segmentation. **Practical Session: Introduction to Mathwork Matlab Deep Learning Toolbox/ Python coding** **Case study review on Biomedical Image Segmentation**	

Unit –V	Contact Hours = 8 Hours
Deep Learning Medical Image Classification, Analysis and Visualization 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. **Practical Session: Introduction to Mathwork Matlab Deep Learning Toolbox/ Python coding** **Case study review on Pre trained CNN Model**	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

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.	Semantic Segmentation and nnU-net
5.	Clustering algorithm for image classification in Biomedical Imagery applications

Books	
	Text Books:
1.	Geoff Dougherty, "Digital Image Processing for Medical Applications", Cambridge University

	Press, 2nd Edition, 2013.
2.	Kevin Zhou, Medical Image Recognition, Segmentation and Parsing: Machine Learning and Multiple Object Approaches, 1st Edition, Elsevier Science, 2015
	Reference Books:
1.	Kevin Zhou, Hayit Greenspan and Dinggang Shen, Deep Learning for Medical Image Analysis Elsevier Science, 2017
2.	Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989
	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/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	**Mini Project**		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Apply knowledge of deep learning algorithms to solve real life problems related to health care and radiology.	Ap	1,2,12	1,2
2.	Analyze the state of art techniques applied in deep learning research	An	1,2,12	1,2
3.	Evaluate the effectiveness of deep learning models in healthcare classification and identification using suitable datasets.	Ev	1,2,3,5,6,8,12	1,2,3
4.	Analyze different deep learning models for different applications of Diseases detection and identification using Computed tomography (CT) and Magnetic Resonance Imaging (MRI).	An	1,2,3,5,6,8,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓			✓							✓	✓	✓	
2	✓	✓			✓							✓	✓	✓	
3	✓	✓		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓
4	✓	✓		✓	✓	✓		✓				✓	✓	✓	✓

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Enhanced skills and competence in biomedical image understanding and analysis.	Applicable industry sectors and domains for biomedical image understanding and analysis include healthcare, medical imaging, diagnostic imaging, research institutions, pharmaceutical companies, and biotechnology.	After undergoing the course in biomedical image understanding and analysis, students can take up job roles such as biomedical imaging specialist, medical image analyst, research scientist in medical imaging, imaging software developer, and biomedical engineer in healthcare or academic institutions.

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

ADAPTIVE SIGNAL PROCESSING

Course Code	**21EC6506**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand meaning of "adaption" in terms of signal processing and geometrical terms.
2.	Analyze basic non-recursive adaptive filter, that is, the adaptive linear combiner.
3.	Understand performance or error surface under stationary and non-stationary conditions.
4.	Understand LMS algorithms and other types of adaptive algorithms.
5.	Understand adaptive modelling and system identification; inverse adaptive modelling, deconvolution and equalization.

Pre-requisites: Signals and Systems, Digital Signal Processing,

Unit - I	**8 Hours**
Adaptive systems: Definitions and characteristics - applications - properties-examples - adaptive linear combiner input signal and weight vectors - performance function-gradient and minimum mean square error - introduction to filtering-smoothing and prediction – linear optimum filtering-orthogonality – WienerHopf equation- Performance Surface. (Text 1)	

Unit - II	**8 Hours**
Searching performance surface-stability and rate of convergence: learning curve-gradient search - Newton's method - method of steepest descent - comparison - gradient estimation - performance penalty - variance - excess MSE and time constants – misadjustments. (Text 1)	

Unit - III	**8 Hours**
LMS algorithm convergence of weight vector: LMS/Newton algorithm - properties - sequential regression algorithm – adaptive recursive filters - random-search algorithms - lattice structure - adaptive filters with orthogonal signals. (Text 1)	

Unit - IV	**8 Hours**
Applications-adaptive modelling: Multipath communication channel, geophysical exploration, FIR digital filter synthesis. (Text 2)	

Unit - V	**8 Hours**
System identification-adaptive modelling: Inverse adaptive modelling, equalization, and deconvolution adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis. (Text 2)	

Books	
	Text Books:
1.	Simon Haykin, **"Adaptive Filter Theory"**, Pearson Education, 2003.
2.	Bernard Widrow and Samuel D. Stearns, **"Adaptive Signal Processing"**, Person Education, 2005.
	Reference Books:
1.	John R.Treichler, C.Richard Johnson, Michael G.Larimore, **"Theory and Design of Adaptive Filters"**, Prentice-Hall of India,2002
2.	S.Thomas Alexander, "Adaptive Signal Processing-Theory and Application", Springer-Verlag.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	
2.	

Course delivery methods

1. Blackboard Teaching
2. Presentations

Assessment methods

1. Internal Assessment
2. Assignment
3. Activity

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 (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Design optimal minimum mean square estimators and in particular linear estimators.	L3	1, 3	1
2.	Implement adaptive filters (FIR, IIR, non-causal, causal) and evaluate their performance.	L3	1,3	1
3.	Identify applications in which it would be possible to use the different adaptive filtering approaches.	L4	1,2,3	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓		✓										✓		
2	✓		✓										✓		
3	✓	✓	✓										✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	**Adaptive filter design for communication application**	**Core Signal Processing and Communication Industry**	**Signal Processing Engineer Communication Engineer**

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

INTERNET OF THINGS & CYBER-PHYSICAL SYSTEMS

Course Code	21EC6507	**Course type**	**PE**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Introduce modeling of CPS & IoT
2.	Introducing the benefits of CPS and ability to analyze smart grid and smart city infrastructure as per new grid code.
3.	Explore different applications.

Pre-requisites: Embedded System

Unit – I	**Contact Hours = 8 Hours**
Motivation and examples of CPS e.g. Energy, Medical and Transportation cyber physical systems; Key design drivers and quality attributes of CPS. Attributes of high confidence CPS. **Case Study:** Identify an application and analyze its performance using any two network models.	

Unit – II	**Contact Hours = 8 Hours**
Continuous systems modeling; Discrete time system modeling; Introduction to IoT: Sensing, Actuation, Basics of IoT Networking, IoT Architecture, Communication Protocols for IoT. **Case Study:** Linear separability, Perceptron convergence theorem.	

Unit – III	**Contact Hours = 8 Hours**
Machine to machine Communication: Introduction, Node types and M2M Applications, Integration of Sensors and Actuators for Implementation of IoT. **Case Study:** Review a research paper on CNN application and analyze the architecture.	

Unit – IV	**Contact Hours = 8 Hours**
Basic concepts of embedded systems; Embedded Processors; Input-outputs; Invariants and Temporal Logic; Linear Temporal Logic **Case Study:** Compare the different parameters of feedback neural networks with each other.	

Unit –V	**Contact Hours = 8 Hours**
Equivalence and Refinement; Development of models from specifications; RSmart cities and Smart homes, Industrial IoT. **Case Study:** Compare RBF with MLP networks.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	R. Rajkumar, D. de. Niz and M. Klein, (2017), Cyber Physical Systems, addisionwesely onwards.
2.	Kamal, R., (2017), Internet of Things - Architecture and Design Principles, 1st Edition, Mcgraw Hill onwards.
	Reference Books:
1.	E.A.Lee and S A Shesia, (2018), Embedded system Design: A Cyber-Physical Approach, Second Edition, MIT Press onwards.
2.	A.Platzer, (2017), Logical Foundations of Cyber Physical Systems, Springer.
3.	Misra, S., Introduction to Internet of Things, NPTEL Course Material, Department of Computer Science and Engineering, Indian Institute of Technology Kharagpur, https://nptel.ac.in/courses/106105166/. Onwards.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links

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 (Highlight the **action verb** representing the learning level.)

	Learning Levels: Re – Remember; Un – Understand; Ap – Apply; An – Analysis; Ev – Evaluate; Cr – Create	**Learning Level**	**PO(s)**	**PSO(s)**
1.	Know various modeling formalisms for CPS.	Un	1,2,4,5	1
2.	Identify safety specifications and critical properties.	Un	1,2,4,5	1
3.	Understand CPS security and safety aspects & abstraction in system designs.	Ap	1,2,4,5	1
4.	Realize the basics of CPS implementation	Ap	1,2,4,5	1
5.	value professional and ethical responsibility	An	1,2,4,5	1

Scheme of Continuous Internal Evaluation (CIE):

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

Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓		✓	✓	✓								✓		
2	✓		✓	✓	✓								✓		
3	✓		✓	✓	✓								✓		
4	✓		✓	✓	✓								✓		
5	✓		✓	✓	✓								✓		
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Cyber security and sensors.	Crime prevention, analysis	Data Analytics, information security, network security analyst, sensor & actuator professional.
2	Cyber security and sensors.	Crime prevention, analysis	Data Analytics, information security, network security analyst, sensor & actuator professional.
3	Cyber security and sensors.	Crime prevention, analysis	Data Analytics, information security, network security analyst, sensor & actuator professional.

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

COMPUTATIONAL INTELLIGENCE

Course Code	**21EC6508**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Develop a comprehensive understanding of computational intelligence, fuzzy logic, and neural networks.
2.	Explore and analyze various neural network architectures and their applications.
3.	Acquire in-depth knowledge of the fundamental principles, concepts, and operations of fuzzy logic.
4.	Design and implement effective fuzzy logic systems, including creating rule bases, defining membership functions, and implementing fuzzy inference mechanisms.

Pre-requisites : Mathematical fundaments and set theory, fundamentals of Linear Algebra

Unit – I	**Contact Hours = 8 Hours**

Introduction to Computational Intelligence

Overview of computational intelligence and its applications, Introduction to neural networks, fuzzy logic, evolutionary computation, swarm intelligence, and machine learning.

Case study on Energy Management in Smart Grids using computational intelligence.

Unit – II	**Contact Hours = 8 Hours**

Fundamentals of Artificial Neural Network

Perceptron, artificial neuron, artificial neuron implementation, different activation functions for binary and multilabelled classification. Logic development using simple perceptron, single layer perceptron, multilayer perceptron, artificial neural learning, forward propagation and back propagation algorithm and application.

Applications of Artificial Neural Networks (ANNs)

Image and Speech Recognition, Natural Language Processing, Time Series Prediction, Pattern Recognition and Classification.

Case study on Fraud Detection in Financial Transactions using computational intelligence.

Unit – III	**Contact Hours = 8 Hours**

Fuzzy Set theory and Fuzzy System

Fuzzy set theory: Introduction to Fuzzy Set, Membership, Operations, Properties, Fuzzy Relation.

Fuzzy system: Introduction, FL, Fuzzification, Fuzzy Inference, F Rule Based System, Defuzzification.

Applications of fuzzy system:

Fuzzy rule-based traffic signal optimization, Fuzzy logic-based medical diagnosis systems, Fuzzy logic-

based power system stability analysis, Fuzzy rule-based decision support systems for financial risk assessment.

Case study on Medical Diagnosis and Treatment using computational intelligence.

Unit – IV	**Contact Hours = 8 Hours**

Associative Memory

Fuzzy Associative Memory, - Fuzzy associative memories (FAMs) pattern recognition and retrieval in fuzzy logic systems and Associative Neural Memory.

Applications of Associative Memory: Efficient data storage and retrieval in large-scale databases, Image and video processing for object recognition and tracking, Speech recognition and natural language processing, financial forecasting and time series analysis, Fault diagnosis and anomaly detection in complex systems.

Case study on Autonomous Vehicle Navigation using computational intelligence.

Unit – V	**Contact Hours = 8 Hours**

Applications of Neuo-Fuzzy

Neuro-Fuzzy System Fundamentals, Neuro-Fuzzy Modeling, Neuro-Fuzzy Pattern Recognition application, Neuro-Fuzzy Time Series Prediction and analysis, Neuro-Fuzzy Fault Diagnosis and Neuro-Fuzzy Applications in Healthcare.

Case study on Predictive Maintenance in Manufacturing using computational intelligence.

Unit No.	**Self-Study Topics**
1	Exponential models, Time series models.
2	Multiple linear regression, Multivariate linear regression, Generalized linear models.
3	Machine learning and compressed sensing.
5	Sparse signal representation, kernel and sparse kernel

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions **Mini -Project and Case Study in each Unit**	**2**	**2**	**2**	**2**	**2**

Books	
	Text Books:
1.	Andries P. Engelbrecht, "Computational Intelligence: An Introduction, Second Edition", Wiley, 2007.
2.	Simon Haykin, "Neural Networks and Learning Machines", 3rd Edition, Pearson, 2008.
	Reference Books:
1.	Nikola K. Kasabov, "Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering", MIT Press, 1996.

2.	Bart Kosko, "Neural Networks and Fuzzy Systems", Prentice Hall, 1992.
3.	Bart Kosko, "Fuzzy Engineering", Prentice Hall, 1997.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Approximate Reasoning Using Fuzzy Set Theory, By Prof. Balasubramaniam Jayaram, IIT Hyderabad https://onlinecourses.nptel.ac.in/noc23_ma60/preview
2.	Introduction To Fuzzy Set Theory, Arithmetic And Logic, By Prof. Niladri Chatterjee, IIT Delhi https://onlinecourses.nptel.ac.in/noc23_ma73/preview
3.	Deep Learning for Computer Vision, By Prof. Vineeth N Balasubramanian, IIT Hyderabad https://onlinecourses.nptel.ac.in/noc21_cs93/preview

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.	**Mini Project and Casestudy**	5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the foundational principles and concepts of computational intelligence, including neural networks and fuzzy logic.	**Re**	1,2, 12	1,2
2.	Apply computational intelligence techniques effectively to solve complex problems.	**Ap**	1,2, 12	1,2
3.	Analyze and evaluate computational intelligence algorithms and models critically.	**An**	1,2,12	1,2,3
4.	Design and implement innovative computational intelligence solutions for real time application.	**An**	1,2,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):

1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓										✓	✓		
2	✓	✓										✓	✓		
3	✓	✓					✓					✓	✓	✓	✓
4	✓	✓										✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Enhanced skills and competence in computational intelligence techniques, including neural networks, fuzzy logic, and evolutionary computation, for solving real-world problems in diverse domains.	Applicable industry sectors and domains include artificial intelligence, data science, robotics, finance, healthcare, manufacturing, and engineering, among others.	Various job roles that students can take up after undergoing the course include data scientist, machine learning engineer, AI researcher, and robotics engineer.

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

DATABASE MANAGEMENT SYSTEMS

Course Code	**21EC6509**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the fundamental concepts of database management systems, including data models, schema design, and relational algebra.
2.	To develop proficiency in querying databases using Structured Query Language (SQL) and understanding the principles of database optimization.
3.	To study the concept of database normalization, transactions, concurrency control and recovery techniques

Pre-requisites : Any Programming experience

Unit – I	**Contact Hours = 8 Hours**
Introduction: Characteristics of database, Advantages of using DBMS approach, when not to use a DBMS, Types of databases, Actors/Roles involved in using database, A brief history of database applications, Data models, Schemas and instances, Three-schema architecture and data independence	

Unit – II	**Contact Hours = 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. Develop a ER model for COMPANY database	

Unit – III	**Contact Hours = 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.	

Unit – IV	**Contact Hours = 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.	

Unit – V	Contact Hours = 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 and recovery techniques.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Elmasri and Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2007and onwards
	Reference Books:
1.	Silberschatz, Korth and Sudharshan, "Data base System Concepts", 6th Edition, Mc-GrawHill, 2010and onwards.
2.	C. J. Date, A. Kannan and S. Swamynatham, "An Introduction to Database Systems", 8th Edition,Pearson Education, 2006and onwards.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	**https://onlinecourses.nptel.ac.in/noc22_cs91/preview** (Data Base Management System)
2.	https://nptel.ac.in/courses/106104135 (Data Base Management System)

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 (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Explain the fundamental concepts and components of database management systems.	Un	2,3,5	1
2.	Design and implement a relational database schema for a given problem domain, including tables, primary keys, foreign keys, and	Ap	2,3,5	1

	relationships.			
3.	Analyze the performance of database queries and propose optimization strategies	An	2,3,5	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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		✓	✓		✓								✓		
2		✓	✓		✓								✓		
3		✓	✓		✓								✓		
4															
5															
Use tick mark(✓)															

DIGITAL FORENSICS

Course Code	21EC6510	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
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	**Contact Hours = 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	**Contact Hours = 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	**Contact Hours = 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:

1. Understanding bootstrap loader sequence in a computer.
2. Identify the applications of RSA in public key cryptosystems.
3. Develop a code for implementing simple hash function.

Unit – IV	Contact Hours = 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 Face book by Afentis Software) to discover friends and other information of a public profile.	

Unit –V	Contact Hours = 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.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

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.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/

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 (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the basic concepts of digital forensics and study the forensic tools.	Un	1,3,4,5,6,8	1
2.	Analyze the forensic data acquired from an electronic system.	An	1,3,4,5,6,8	1
3.	Analyze the e-mail and social media digital forensics and document.	Ev	1,3,4,5,6,8	1
4.	Understand the digital forensics applied to mobile and cloud scenario.	Ap	1,3,4,5,6,8	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓		✓	✓	✓	✓		✓				✓	✓		
2	✓		✓	✓	✓	✓		✓				✓	✓		
3	✓		✓	✓	✓	✓		✓				✓	✓		
4	✓		✓	✓	✓	✓		✓				✓	✓		
5	✓		✓	✓	✓	✓		✓				✓	✓		
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Analytical, understanding of cyber security.	Crime detection, prevention, analysis	Computer Forensics investigator, information security, network security analyst
2	Analytical, understanding of cyber security.	Crime detection, prevention, analysis	Computer Forensics investigator, information security, network security analyst
3	Analytical, understanding of cyber security.	Crime detection, prevention, analysis	Computer Forensics investigator, information security, network security analyst

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

NANO ELECTRONICS

Course Code	**21EC661**	**Course type**	OEC	**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**	100
Flipped Classes content	4 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the principles of nano-science engineering, carbon nanotubes and their applications.
2.	To understand the effects of size of nano-materials on various applications.
3.	To study the fabrication techniques of nano particles.
4.	To identify the properties of nanoparticles and their usage in various applications.

Pre-requisites: Basic physics and chemistry

Unit – I	**Contact Hours = 8 Hours**
Introduction: Overview of nano-science and engineering, Development milestones in micro-fabrication 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. Case Study: Effects of nano-meter length scale	

Unit – II	**Contact Hours = 8 Hours**
Characterization: Classification, 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. Case Study: Electronic density of states	

Unit – III	**Contact Hours = 8 Hours**
Fabrication methods: Top-down processes, bottom-up processes methods for templating the growth of nano-materials, Ordering of nano systems **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.	

Case Study: Fabrication of Semiconductor Nanocrystals

Unit – IV	**Contact Hours = 8 Hours**
Characterization of semiconductor nanostructures: Optical, electrical and structural **Carbon Nanostructures:** Carbon molecules, Carbon clusters, Carbon nanotubes, Applications of carbon nanotubes. **Case Study:** Fabrication of carbon nanotubes	

Unit – V	**Contact Hours = 8 Hours**
Nano sensors: Introduction, Sensors and nano-sensors, 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: Applications of Nano sensors	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**0**	**0**	**2**	**2**	**0**

Books	
	Text Books:
1.	Robert Kelsall, Ian Hamley, Mark Geoghegan, —Nanoscale Science and Technology, John Wiley, 2007. (Unit 1, 2, 3 and 4)
2.	Charles P Poole, Jr, Frank J Owens, —Introduction to Nanotechnology, John Wiley, Copyright 2006, Reprint 2011. (Unit 4)
3.	T Pradeep, —Nano: The Essentials-Understanding Nanoscience and Nanotechnology, TMH. (Unit 5)
	Reference Books:
1.	William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, —Hand Book of Nanoscience Engineering and Technology‖, CRC press, 2003.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Fundamentals of micro and nanofabrication By Prof. Shankar Selvaraja, Prof. Sushobhan Avasthi, IISc Bangalore https://onlinecourses.nptel.ac.in/noc20_bt37/preview

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.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the principles of Nano-electronics, properties of Nano-particles and carbon nanotubes	Un	1,9,10,12	1
2.	Apply concepts of nano-electronics in various fields	Ap	1,2,9,10,12	1,2
3.	Understand the fabrication techniques and Analyze the process flow for sensor design.	Un, An	1,2,3,8,9,10,12	1,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓								✓	✓		✓	✓		
2	✓	✓							✓	✓		✓	✓	✓	
3	✓	✓	✓					✓	✓	✓		✓	✓		✓
Use tick mark(✓)															

HUMAN COMPUTER INTERACTION

Course Code	21EC662	**Course type**	OE	**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**	100
Flipped Classes content	2 Hours			**SEE Marks**	100

Course learning objectives	
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.	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.
4.	Study the implementation and applications of groupware, ubiquitous computing and augmented realities applied to interactive systems.

Pre-requisites: Nil

Unit – I	**Contact Hours = 8 Hours**

Foundation:

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

Case Study: Paradigms for interaction

Unit – II	**Contact Hours = 8 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.

Case Study: Designing for diversity

Unit – III	**Contact Hours = 8 Hours**

Models of Interactive Systems:

Standard formalism, Cognitive models: Goal and task hierarchies, Linguistic models, challenge of display-based systems, Physical and device models, and Cognitive architectures. Interaction models, modeling rich interaction.

Case Study: Socio-organizational issues and stakeholder requirements

Unit – IV	**Contact Hours = 8 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. **Case Study**: Evaluation through user participation	

Unit – V	**Contact Hours = 8 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. **Case Study**: Hypertext, Multimedia and the World Wide Web	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**0**	**0**	**1**	**1**	**0**

Books	
	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.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.hcibook.com/e3/online/

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.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the basic elements of human-computer interaction.	Un	1,6,8,9,10,11,12	1,3
2.	Analyze different models of interactive systems and their implementation and evaluation.	An	1,2,6,8,9,10,11,12	2,3
3.	Apply groupware, ubiquitous computing and augmented reality technologies in an interactive system.	Ap	1,2,6,8,9,10,11,12	1,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓					✓		✓	✓	✓	✓	✓	✓		✓
2	✓	✓				✓		✓	✓	✓	✓	✓		✓	✓
3	✓	✓				✓		✓	✓	✓	✓	✓	✓		✓
Use tick mark(✓)															

DIGITAL IMAGE PROCESSING

Course Code	**21EC663**	**Course type**	**OEC**	**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 = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the basics of digital image processing techniques and its applications.
2.	To introduce the different mathematical transforms required in various image enhancement operations.
3.	To understand the image processing techniques in spatial and frequency domains.
4.	To study and analyze image restoration techniques, morphological operations.

Required Knowledge of: Basics of Matrices and Vectors, Basics of computer programming.

Unit – I	**Contact Hours = 8 Hours**
Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition.	

Unit – II	**Contact Hours = 8 Hours**
Image Enhancement in the Spatial Domain: Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations. Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.	

Unit – III	**Contact Hours = 8 Hours**
Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-DDFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.	

Unit – IV	**Contact Hours = 8 Hours**
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.	

Unit – V	Contact Hours = 8 Hours
Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing. **Color Image Processing:** Color Fundamentals, Color Models, Pseudo color Image Processing.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Unit No.	Self-Study Topics
1	Structure of human eye and image formation in the eye
2	Relationship between sampling and frequency intervals
4	Linear position invariant degradations.
5	Applications of color image processing.

Books	
	Text Books:
1.	Rafael C. Gonzalez and Richard E. Woods: Digital Image Processing PHI 2nd Edition 2005.
2.	S. Jayaraman S. Esakkirajan, T.Veerakumar: Digital Image Processing, McGraw Hill Ed. (India) Pvt. Ltd. 2013.
	Reference Books:
1.	A.K.Jain: Fundamentals of Digital Image Processing Pearson, 2004.
2.	Scott E. Umbaugh: Digital Image Processing and Analysis, CRC Press, 2014.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Describe the fundamentals of digital image processing.	Un	1	1
2.	Understand image formation and the role human visual system plays in perception of gray and color image data.	Un	1, 2, 5, 12	1
3.	Apply image processing techniques in both the spatial and	Ap	1, 3,	1

	frequency (Fourier) domains.		4, 5	
4.	Conduct independent study and analysis of image enhancement and restoration techniques.	An	1, 4, 5, 12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓												✓		
2	✓	✓			✓							✓	✓		
3	✓		✓	✓	✓								✓		
4	✓			✓	✓							✓	✓		
5															
6															
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Image and Signal Processing, MATLAB, Image classifications, Image Restorations	Medical, Defense and Security, Food industry, and Robotics	Signal & Image Processing Engineer, Computer Vision Engineer, Image Processing ML/AI Engineer

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

REQUIREMENTS ENGINEERING

Course Code	**21EC664**	**Course type**	OEC	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the significance of Requirements Engineering and the impact of Requirements Engineering in business development
2.	To comprehend the types of requirements and stakeholders involved
3.	To apprehend requirements elicitation, documentation and validation techniques

Unit – I	**Contact Hours = 8 Hours**
Introduction: Definition of Requirements, Why do I need Requirements, Requirements Engineering, problems with requirements, Product/System Development Life Cycle and various approaches, Project management, The business case, Terms of Reference / Project Initiation Document / Project Charter – business objectives, project objectives, scope, constraints (budget, timescale, standards), sponsor (authority), Framework for Requirements Engineering, Actors/ Roles during requirements work Activity: Study the PID for any project and write a summary of the same. Develop an alternate PID for the same and justify why/how the new document is better than the studied one.	

Unit – II	**Contact Hours = 8 Hours**
Types of requirements and Stakeholders : Building the hierarchy through decomposition of requirements, Categories of requirements within the hierarchy, General business requirements, including legal and business policy, Technical policy requirements, Functional requirements, Non-functional requirements, including performance, usability, access, security, archiving, backup and recovery, availability, robustness, Stakeholders, Types of stakeholders and their role and contribution to the requirements engineering process, The Requirements Process . **Case Study**: Study the Ice Breaker Project (text 2). Activity: 1. Identify the stakeholders of the project. Develop the list of stakeholders for any project you identify. Identify their roles and contributions. 2. Build the list of functional and non-functional requirements for any project you identify.	

Unit – III	**Contact Hours = 8 Hours**
Requirements Elicitation: Knowledge types – tacit and non-tacit (explicit), Elements of tacit knowledge that cause problems, Elicitation techniques: Interviews, Workshops, Observation: Formal/informal, Shadowing, Focus groups, Prototyping, Scenarios, Document Analysis **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. Activity: 1. Conduct interviews/workshops on the requirements identified for a idea/project. Summarize the outcomes. 2. Develop Prototypes, Scenarios, documents and conduct document analysis for the requirements listed in the above idea/project

Unit – IV	**Contact Hours = 8 Hours**
Requirements Analysis: Organizing requirements, requirements Filters for ensuring well-formed requirements **Requirements Documentation**: The importance of Documentation, Structure of Requirements Document, Requirements catalogue, hierarchy of requirements, Documenting a Requirement-Characteristics of an individual requirement Activity: 1. Prepare a requirements document for any identified idea/project.	

Unit – V	**Contact Hours = 8 Hours**
Requirements validation: Agreeing the requirements document, Representatives of the review group, Outcomes of a review **Requirements management:** Dealing with changing requirements, the importance of traceability, Traceability and ownership, Elements of Requirements management, Requirements Engineering support tools Activity: 1.Trace the changes of a requirement identified based on the reviews.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**2**	**2**	**2**	**2**	**2**

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.

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 (Highlight the **action verb** representing the learning level.)

	Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the relevance of requirements engineering in business development	Un	2, 6,10,11,12	2,3
2.	Develop a model and analyze the use of a range of requirements elicitation and documentation techniques and the relevance of the techniques to business situations	An	2, 6,10,11,12	2,3
3.	Analyze the performance of requirements management process and apply them to manage a business requirements.	An	2, 6,10,11,12	2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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						✓				✓	✓	✓		✓	✓

2		✓				✓				✓	✓	✓		✓	✓
3		✓				✓				✓	✓	✓		✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1			
2			
3			

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

EMPLOYABILITY SKILLS – II

Course Code	**21EC68**	**Course type**	**AEC**	**Credits L-T-P**	1 – 0 – 0
Hours/week: L - T- P	1 – 0 – 0			**Total credits**	1
Total Contact Hours	L = 20 Hrs; T = 0 Hrs; P = 0 Hrs Total = 20 Hrs			**CIE Marks**	100

Course learning objectives	
1.	Skill development is/are personal attributes that influence how well an individual works or interacts with others.
2.	These skills make it easier to form relationships with people, create trust and dependability, and lead teams.
3.	In essence, they are essential for individual success in the workplace, their company's success, and their personal life also

Unit – I	**Contact Hours = 4 Hours**
General Aptitude 1.1: **Understanding Quantitative Aptitude:** Time, Speed, and Distance, Trains, Boats, and Streams	

Unit – II	**Contact Hours = 4 Hours**
General Aptitude 1.2: **Understanding Quantitative Aptitude:** Permutation and Combination, Probability, Data Interpretation, and Simple and Compound Interest	

Unit – III	**Contact Hours = 4 Hours**
General Aptitude 1.3: **Understanding Quantitative Aptitude:** Change of Speech & Voice, Sentence Completion, and Critical Reasoning	

Unit – IV	**Contact Hours = 4 Hours**
General Aptitude 1.4: **Understanding Quantitative Aptitude:** Allegation and Mixtures, Syllogisms, Seating Arrangement, Data Arrangement, Clocks & Calendars, and Data Sufficiency	

Unit – V	**Contact Hours = 4 Hours**
Improve Sense of Belongingness: Interview Skills and Resume Writing	

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

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
		3.	Internal Assessments

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Clear the Aptitude round of recruiters during placements	L2	10	
2.	Perform confidently during the Interview process	L2	12	
3.	Develop Resumes that are grammatically correct	L2	10	
4.	Develop behaviors that are appropriate for a professional	L2	12	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Assignment	Class Performance	Total Marks
Marks	25+25 = 50	10	15+15 =30	10	100
> Writing 2 IA tests is compulsory **> Minimum score to be eligible for SEE: 40 OUT OF 100**					

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										✓		✓			
2										✓		✓			

3										✓		✓			
4										✓		✓			
5										✓		✓			
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Logical Thinking	IT Industry	Software Engineer
2	Problem Solving	Automotive	Developer
3	Communication Skills	Education Sector	Project Manager

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

WIRELESS COMMUNICATION TECHNIQUES

Course Code	**21EC71**	**Course type**	**PCC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course Learning Objectives	
1.	To enable the student to understand cellular system components, various modulation and multiple-access techniques used in wireless communication and solve related problems.
2.	To enable the student to apply the knowledge of wireless channel characteristics in the design of channel propagation models and select a suitable model.
3.	To enable the student to understand various emerging wireless technologies and experiment with their functionalities.

Pre-requisites: Knowledge of Analog and Digital Communication is required.

Unit – I	**Contact Hours = 8 Hours**
Teletraffic Engineering Fundamentals: Introduction, Service level, Traffic usage, Traffic measurement units, Call Capacity, Traffic types, Blocking formulas- Erlang B, Erlang C, Poison's, Binomial formula.	

Unit – II	**Contact Hours = 8 Hours**
Fundamentals of cellular communications: Introduction, Cellular systems, Hexagonal cell geometry, Co-channel interference ratio and its reduction, Seven cell reuse pattern – three sector case, six-sector case, Cell splitting, Adjacent channel interference, Segmentation, typical wireless cellular network components, numbering schemes, mobility and handoff management.	

Unit – III	**Contact Hours = 8 Hours**
Transmission techniques: **Modulation techniques:** Introduction, QPSK, OQPSK, M-PSK, π/4-DQPSK MSK and GMSK, QAM, M-ary FSK, Synchronization, Equalization. **Spread spectrum:** DS-SS, FH-SS **Multiple Access Techniques:** TDMA, FDMA, CDMA, CSMA, MIMO, OFDM.	

Unit – IV	**Contact Hours = 8 Hours**
Radio Propagation Path-Loss Models: Introduction, Free-space attenuation, Attenuation over reflecting surface, Effect of Earth's curvature, Radio wave propagation, Wireless channel characteristics, Signal fading statistics, Level crossing rate and average fade duration, Fade margin, Link margin, Outdoor and indoor propagation models.	

Unit – V	Contact Hours = 8 Hours
Applications of wireless technologies: Bluetooth, RFID, Zigbee, Near Field Communication (NFC), Wi-Fi, Wi-MAX, Wireless Access Point (WAP), Software Defined Radio/Cognitive Radio.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Vijay K. Garg, Wireless Communications and Networking, Elsevier, 2nd Edition, 2018.
2.	Gary J. Mullet, Introduction to wireless telecommunications systems and networks, Cengage Learning, 2016.
	Reference Books:
1.	Jochen Schiller, Mobile Communications, Pearson Education, 2nd Ed, 2014.
2.	Theodore S. Rappaport, Wireless Communications- Principles and Practice, Pearson, 2nd Ed, 2016.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/117102062 (Wireless Communication, IIT Delhi)
2.	https://nptel.ac.in/courses/117105132 (Fundamentals of MIMO, IIT Kharagpur)

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 Assignments (OBA)
		4.	Course Activity
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Understand and solve the problems related to cellular system components, various modulation and multiple access techniques used in wireless communication.	Un	1, 2, 6	1
2.	Apply the knowledge of wireless channel characteristics in the	Ap	1, 2, 5	1, 2

	design of channel propagation models and select a suitable model.			
3.	Understand various emerging wireless technologies and their applications.	Un	1, 5	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓				✓							✓	✓	✓
2	✓	✓			✓								✓	✓	
3	✓				✓								✓		
Use tick mark(✓)															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Apply the concepts of wireless communication in practical applications, design and analyze the wireless systems.	Wireless and Mobile Communication industries	Field engineers, Design engineers

ADVANCED VLSI DESIGN

Course Code	**21EC721**	**Course type**	**PEC**	**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**	100
Flipped Classes content	07 Hours			**SEE Marks**	100

Course learning objectives	
1.	To introduce integrated circuits manufacturing techniques and design methods.
2.	To comprehend and apply VLSI design techniques to data path subsystems and memory units.
3.	To understand the performance parameters design strategies and factors considered minimize the implementation cost.

Pre-requisites: CMOS VLSI Design, MOSFET ideal and non-ideal characteristics

Unit – I	**Contact Hours = 8 Hours**
Digital Systems and VLSI: Why Design Integrated Circuits? Integrated Circuit, Manufacturing, CMOS Technology, Integrated Circuit Design Techniques, Hierarchical design, Design abstraction, IP-Based Design. **Case study:** IP Components	

Unit – II	**Contact Hours = 8 Hours**
Datapath Subsystems: Introduction, Addition/Subtraction, Single-Bit Addition, Carry-Propagate Addition, Subtraction, Multiple-Input Addition, Flagged Prefix Adders, Counters, Binary Counters, Linear-Feedback Shift Registers Shifters, Barrel Shifter, Multiplication, Unsigned Array Multiplication. **Case study:** Implementation of Column Addition, Fused Multiply-Add using cadence tool	

Unit – III	**Contact Hours = 8 Hours**
Array subsystems: introduction, SRAM cell, 6T SRAM cell, Area, Delay, and Power of RAMs and Register Files, DRAM *Dynamic RAMs* (DRAMs), Subarray Architectures, Column Circuitry, 3T, 4T DRAM cell, Read Only Memory, Flash memory. **Case study:** Simulation of memory cells using cadence tool	

Unit – IV	**Contact Hours = 8 Hours**
Design and Economics: Introduction, Structured Design Strategies, A Software Radio—A System Example, Hierarchy, Regularity, Modularity Locality, economics, Design reuse, Data sheets and documentation.	

Unit –V	Contact Hours = 8 Hours
DESIGN FOR MANUFACTURABILITY: Introduction, Process Variations, Basic Concepts and Definitions Design of Experiments and Performance Modeling, Parametric Yield Estimation, Parametric Yield Maximization, Worst-Case Analysis, Performance Variability Minimization.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	2	2	1	1

Books	
	Text Books:
1.	Wayne Wolfe, "Modern VLSI Design, System-On-Chip Design", Prentice Hall, 2002 Onwards
2.	Neil Weste, and David Harris, "CMOS VLSI Design, A Circuits and System Perspective", 4th Edition; Pearson Education, India.
3.	Sung-Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits, Analysis and Design", McGraw Hill Publications.
	Reference Books:
1.	Douglas Pucknell, and Kamran Eshraghian, "Basic VLSI Design", PHI Publications IndiPvt. Ltd.

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 Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Understand integrated circuits manufacturing techniques and design methods	Un	1,2,12	1
2.	Apply VLSI design techniques to design data path subsystems and analyze the speed of memory units.	An	1,2,5,11,12	1
3.	Apply modeling methods to understand the performance parameters of integrated circuits.	Ap	1,2,11,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO1 0**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓										✓	✓		
2	✓	✓			✓						✓	✓	✓		
3	✓	✓									✓	✓	✓		
Use tick mark(✓)															

RF AND MICROWAVE INTEGRATED CIRCUITS

Course Code	21EC722	**Course type**	PEC	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To study the theoretical foundations, concepts and properties of RF microwave circuits/components.
2.	To determine various parameters for evaluating the performance for RF/microwave circuits/components..
3.	To learn the development of RF/microwave circuits/component frontend functional blocks.

Pre-requisites: Engineering Mathematics; Electromagnetic Theory and Antenna Engineering; Microwave and Radar Engineering

Unit – I	**Contact Hours = 8 Hours**
Wave propagation in networks: Introduction, Reasons for using RF/Microwaves, Applications, RF waves, RF and Microwave circuit design, Introduction to components basics, Analysis of simple circuit phasor domain, RF impedance matching, Properties of waves, transmission media, Micro strip lines, High frequency parameters, Formulation of S-parameters, Properties, transmission matrix, Generalized S-parameters.	

Unit – II	**Contact Hours = 8 Hours**
Passive circuit design: Introduction, Design of matching networks, Matching using lumped and distributed elements	

Unit – III	**Contact Hours = 8 Hours**
Basic consideration in active networks and design of amplifiers, oscillators and detector: Stability consideration, gain consideration, Noise consideration. Linear and nonlinear design: Introduction, Types of amplifier, Design of different types of amplifiers, Multistage small signal amplifiers, Design of transistor oscillators, Detector losses, detector design	

Unit – IV	**Contact Hours = 8 Hours**
Mixers, Phase shifters and RF and Microwave Control Circuit design: Mixer types, Conversion loss for SSB mixers, One diode mixer, Phase shifters, Digital phase shifters, Semiconductor phase shifters.	

Unit – V	**Contact Hours = 8 Hours**
RF and microwave IC design: MICs, MIC materials, Types of MICs, Hybrid verses monolithic ICs, Chip materials.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Unit No.	Self-Study Topics
1	Generalized S-parameters
2	ZY chart applications
3	Losses in detector
4	Microwave control circuits
5	Monolithic ICs'

Books	
	Text Books:
1.	Matthew M. Radmanesh, "RF and Microwave Electronics Illustrated", Pearson Education edition, 2004.
2.	Reinhold Ludwig, and Pavel Bretchko, "RF circuit design theory and applications", Pearson Education edition, 2004
	Reference Books:
1.	D. Pozar, Microwave Engineering, J. Wiley and Sons, 3rd Edition, 2004
2.	K. Chang, I. Bahl, and V. Nair, RF and Microwave Circuit and Component Design for Wireless Systems, J. Wiley & Sons, 2002
3.	G. Gonzalez, Microwave Transistor Amplifiers, 2nd Edition, Prentice Hall, 1997.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	RF and Microwave Networks: https://nptel.ac.in/courses/108105189
2.	Design Principles of RF and Microwave Filters and Amplifiers: https://nptel.ac.in/courses/117105138

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
		4.	Semester End Examination

Course Outcome (COs)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Understand the requirement of RF circuit for various applications.	**Un**	1,2,10,12	1,2
2.	Analyze various components for the given criteria.	**An**	1,2,3,4,5,9, 10,11,12	1,2
3.	Develop circuits for the required RF applications.	**Ev**	1,2,3,4,5,9, 10,11,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25 = 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment Minimum score to be eligible for SEE: 40 OUT OF 100					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	Minimum marks required in SEE to pass: Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts A,B and C. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓								✓		✓	✓	✓	
2	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	RF Microwave circuits systems modeling, characterization, analysis.	RF Communications technology, RFIC Design	IC designer, researcher

BIOMEDICAL SYSTEM DESIGN

Course Code	**21EC723**	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand basic concepts of semiconductor physics relevant to building circuit and device models.
2.	Understand the process of modelling a Human Physiological System.
3.	Describe and use physics-based devices and circuit models for biomedical applications.

Pre-requisites: Engineering Mathematics, Applied Electronic Circuits(21EC32), Embedded system design.

Unit – I	**Contact Hours = 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	**Contact Hours = 8 Hours**
Anatomy and Physiology: Introduction-Cellular organization – Tissues - Major organs and systems – Homeostasis, Bioelectric phenomena - Origin of bio-potentials - Notion of Hodgkin-Huxley and Soliton models - Biopotential measurements – ECG, EEG, EMG. **Case Study:** GE health care case study on a) GE Mac 2000 ECG Machine, 12-lead Resting ECG System b) GE Healthcare – Vscan Air CL Ultrasound System – H8031VA	

Unit – III	**Contact Hours = 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: Biosensors for Personal Mobile Health: A System Architecture Perspective. (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7546526/)

Unit – IV	**Contact Hours = 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	**Contact Hours = 8 Hours**
Biomedical embedded systems and computational intelligence techniques: 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 and neurological diseases. **Case Study:** Memory management issues for diagnostic processing - Power reduction techniques in diagnostic systems.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**2**	**2**	**2**	**2**	**2**

Books	
	Text Books:
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.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/108108180

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 (Highlight the **action verb** representing the learning level.)

	Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the biomedical system design and apply for designing system model.	Un	1,2,4,8,12	1
	Understand and apply engineering concepts to describe many types of systems in biology and medicine. Systems include physiological systems (organs and systems level), bioelectronics systems, sensing and transducing systems, computational systems, etc	Ap	1,2,4,5,8,12	1
2.	Analyze physiological systems and design engineering systems to measure various pathophysiological parameters	An	1,2,4,5,8,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓		✓				✓				✓	✓		
2	✓	✓		✓	✓			✓				✓	✓		
3	✓	✓		✓	✓			✓				✓	✓		

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Academic competence	GE Healthcare	Sales Executive/Engineer
2	ability to work as a part of a multidisciplinary team	Siemens	Research and development
3		Cardiac Labs	Service Engineer

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

SATELLITE COMMUNICATION TECHNIQUE

Course Code	**21EC724**	**Course type**	**PEC**	**Credits L-T-P**	3 – 0 – 0
Hours/week: L-T-P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40Hrs; T = 0Hrs;P = 0Hrs Total = 40Hrs			**CIE Marks**	100
Flipped Classes content	8 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand the fundamental concepts and principles of satellite communication systems, and analyze satellite communication links.
2.	Gain knowledge of different satellite communication techniques, to effectively design and optimize satellite communication systems.
3.	Develop skills in the analysis and design of satellite communication link budgets to ensure reliable and efficient satellite communication links.
4.	Acquire knowledge of satellite communication system components and understand their roles and characteristics, challenges and limitations in practical application.

Pre-requisites: Basic Electronics, Elements of Electrical Engineering, Principles of Communication Systems, Electromagnetic Theory and Antenna Engineering, Microwave and Radar.

Unit – I Introduction to Satellite Communication Systems	**Contact Hours = 8 Hours**
Overview of satellite communication systems, Historical development and milestones, Satellite orbits and constellations, Satellite link budget analysis, Satellite subsystems and components.	

Unit – II Satellite Communication Link Analysis	**Contact Hours = 8 Hours**
Satellite link design and parameters, Modulation techniques for satellite communication, Error control coding and decoding, Multiple access techniques in satellite communication, Satellite antenna systems and beamforming.	

Unit – III Satellite System Architecture and Protocols	**Contact Hours = 8 Hours**
Satellite system architecture and network topology, Satellite access protocols (TDMA,FDMA, CDMA), Routing and congestion control in satellite networks, Satellite networksynchronization and timing, Quality of Service (QoS) considerations in satellite communication.	

Unit – IV Satellite Link Design and Performance Evaluation	**Contact Hours = 8 Hours**
Link budget calculation and analysis, Rain fade and atmospheric effects on satellite links, Link availability and outage prediction, Interference analysis and mitigation techniques, Satellite system performance evaluation and optimization.	

Unit –V Emerging Trends and Applications in Satellite Communication	**Contact Hours = 8 Hours**

Advanced satellite communication systems (LEO, MEO, HEO), Satellite constellations for global coverage, Satellite-based navigation and positioning systems (GPS, GNSS), Satellite broadcasting and multimedia services, Future directions and emerging technologies in satellite communication.

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	1	1

Books	
	Text Books:
1.	"Satellite Communications" by Dennis Roddy, McGraw-Hill Education, 2015.
2.	"Satellite Communications Systems: Systems, Techniques and Technology" by Gerard Maral and Michel Bousquet, Wiley, 2013.
3.	"Introduction to Satellite Communication" by Bruce R. Elbert, Artech House, 2017.
4.	"Satellite Communication Engineering" by Michael OlorunfunmiKolawole, Springer, 2017.
	Reference Books:
1.	"Satellite Communications and Navigation Systems" by Enrico Re, Artech House, 2008.
2.	"Satellite Communications: Payload and System" by Teresa M. Braun, Wiley, 2012.
3	"Satellite Communications: System and Its Design Technology" by Yoshio Inasawa, Peter Elby and Makoto Noda, John Wiley & Sons, 2011.
4	"Satellite Communication Systems Design" by SM Moghaddam, TMH, 2019.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Satellite Communication Systems, Prof. Kalyan Kumar Bandyopadhyay, Department of Electronics and Electrical Communication Engineering, Indian Institute of Technology, Kharagpur https://archive.nptel.ac.in/courses/117/105/117105131/

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(Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Recall and recognize the key concepts and principles of satellite communication systems in all aspects.	Un	1, 2, 3, 6, 10	1
2.	Comprehend the different satellite communication techniques, multiple access schemes, modulation and coding techniques, and error control mechanisms.	Ap	1, 2, 3, 6,	1

			9, 10	
3.	Apply the knowledge and skills in the analysis and design of satellite communication link budgets system performance parameters.	Ap	1, 2, 3, 6, 9, 10	1, 2
4.	Analyze the various components of satellite communication systems, their roles and characteristics in the system architecture and operation, and the challenges and limitations in practical application.	An	1, 2, 3, 6, 9, 10	1, 2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓	✓			✓				✓			✓		
2	✓	✓	✓			✓			✓	✓			✓		
3	✓	✓	✓			✓			✓	✓			✓	✓	
4	✓	✓	✓			✓			✓	✓			✓	✓	

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Analytical Thinking	IT, Core, Electronics	Engineering and Administrative
2	Team Building	IT, Core	Team Lead, Project Manager
3	Satellite Design and entricacies	Electronics, Communication	Team Lead, Program Manager

DATA SCIENCE

Course Code	21EC725	**Course type**	**PEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To provide the students with the basic knowledge of Data Science
2.	To make the students develop solutions using Data Science tools
3.	To introduce them to Python packages and their usability.

Pre-requisites: Knowledge of Statistics, Data Structures and Algorithms.

Unit – I	**Contact Hours = 8 Hours**
Data Science and Its Scope: What Is Data Science, Data Science and Statistics, Role of Statistics in Data Science, A Brief History, Difference between Data Science and Data Analytics, Knowledge and Skills for Data Science Professionals, Some Technologies used in Data Science, Benefits and uses of data science, Facets of data. **Case Study:** Data analysis using excel.	

Unit – II	**Contact Hours = 8 Hours**
The data science process: Overview, defining research goals and creating a project charter, retrieving data, Cleansing, integrating, and transforming data, Exploratory data analysis, Build the models, presenting findings and building applications on top of them. **Case Study:** Implementation of data manipulation using Excel	

Unit – III	**Contact Hours = 8 Hours**
Introduction to NumPy: Creating Arrays from Scratch, NumPy Standard Data Types, The Basics of NumPy Arrays, Array Indexing, slicing, reshaping, Concatenation, splitting, Computation on NumPy Arrays: Universal Functions, Aggregations: Min, Max, Comparison operator, Boolean arrays. **Case Study:** Implementation of Array operations using Numpy.	

Unit – IV	**Contact Hours = 8 Hours**
Data Manipulation with Pandas: Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing. Combining Datasets: Concat and Append, Combining Datasets: Merge and Join, Aggregation and Grouping, Pivot Tables **Case Study:** Introduction on Kaggle.	

Unit –V	Contact Hours = 8 Hours
Visualization with Matplotlib: General Matplotlib Tips, Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Bindings, and Density. **Case Study:** Implementations of Histogram in Matplotlib	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications.[Unit 1 and 2]
2.	Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'REILLY Publication.[Unit 3,4,5]
	Reference Books:
1.	Data Science from Scratch: First Principles with Python, O"Reilly Media, 2015.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/

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 (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Summarize the basics of data science and its process	**Understand**	1,2,3,10,12	1
2.	Construct solution to a given problem using knowledge of tools for Data Science.	**Understand**	1,2,3,10,12	1
3.	Build a solution to a given problem using NumPy package	**Apply**	1,2,3,5,10,12	1
4.	Explain functions of Python libraries.	**Analysis**	1,2,3,5,10,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO1 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓	✓							✓		✓	✓		
2	✓	✓	✓		✓					✓		✓	✓		
3	✓	✓	✓		✓					✓		✓	✓		
4	✓	✓	✓		✓					✓		✓	✓		
Use tick mark(✓)															

NATURAL LANGUAGE PROCESSING

Course Code	**21EC726**	**Course type**	**PEC**	**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 = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand foundational concepts and techniques of Natural Language Processing (NLP) including text preprocessing, word embeddings, and deep learning models, and apply them to real-world problems.
2.	To gain proficiency in implementing and utilizing advanced NLP models such as recurrent neural networks (RNNs), transformer networks, and attention mechanisms.
3.	To develop skills in performing syntactic analysis and parsing tasks including dependency parsing and constituency parsing.
4.	To explore emerging trends and applications in NLP such as machine translation, question-answering systems, and language generation.

Required Knowledge of: fundamentals Deep Learning and artificial neural network

Unit – I	**Contact Hours = 8 Hours**
Introduction to NLP and Deep Learning Introduction to Natural Language Processing, Applications of Natural Language Processing, Introduction to Word2Vec, Word2Vec objective function and gradients **Case study on Analyzing customer reviews using NLP techniques to determine their sentiment.** **Practical Session of NLP: Introduction to Python, PyTorch, Natural Language Toolkit, Spacy and NLP**	

Unit – II	**Contact Hours = 8 Hours**
Dependency Parsing and Recurrent Neural Networks Dependency Grammar, Neural dependency parsing, Introduction to Recurrent Neural Networks, (RNNs), Language models with RNNs, Vanishing Gradients problem, Fancy RNNs (e.g., LSTM, GRU). **Case study on Identifying and classifying named entities in text data for efficient information retrieval.** **Practical Session of NLP: NLP applications examples Natural Language Toolkit and Spacy**	

Unit – III	**Contact Hours = 8 Hours**
Machine Translation and Attention Mechanism Machine Translation, Sequence-to-Sequence (Seq2Seq) models, Introduction to Attention mechanism, Advanced concepts in Attention mechanism. **Case study on Developing a system for automatic translation of text between different languages.**	

Practical Session of NLP: NLP applications examples Natural Language Toolkit and Spacy

Unit – IV	Contact Hours = 8 Hours
Transformer Networks and Advanced NLP Tasks Transformer Networks for NLP, Coreference Resolution, Memory Networks for NLP, Tree Recursive Neural Networks and Constituency Parsing, Advanced architectures in NLP. **Case study on Building an intelligent system that can accurately answer user questions based on textual information.** **Practical Session of NLP: NLP applications examples Natural Language Toolkit and Spacy**	

Unit – V	Contact Hours = 8 Hours
Reinforcement Learning and Future of NLP Reinforcement Learning for NLP, Semi-supervised Learning for NLP, Future directions of NLP models, Multi-task Learning in NLP, Question-Answering (QA) Systems. **Case study on Categorizing documents or text data into specific classes or categories using NLP algorithms.** **Practical Session of NLP: NLP applications examples Natural Language Toolkit and Spacy**	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Unit No.	Self-Study Topics
1	Introduction to NLP: Study the fundamentals of NLP, including text processing, tokenization, and language modeling.
2	NLP Algorithms and Models: Explore various NLP algorithms and models such as sentiment analysis, named entity recognition, and machine translation.
3	Deep Learning for NLP: Dive into deep learning techniques for NLP, including recurrent neural networks (RNNs), convolutional neural networks (CNNs), and transformer models.
4	NLP Applications: Explore real-world applications of NLP, such as chatbots, question-answering systems, and information retrieval.
5	NLP Libraries and Tools: Familiarize yourself with popular NLP libraries and tools like NLTK, spaCy, and TensorFlow, and learn how to use them for NLP tasks.

Books	
	Text Books:
1.	Goldberg, Y, A Primer on Neural Network Models for Natural Language Processing. Morgan & Claypool Publishers, 2016
2.	Bird, S., Klein, E., & Loper, E, Natural Language Processing with Python. O'Reilly Media. 2009
3.	L. Ashok Kumar, D. Karthika Renuka, Deep Learning Approach for Natural Language Processing, Speech, and Computer Vision, CRC Press, 2023

	Reference Books:
1.	Palash Goyal, Sumit Pandey, Karan Jain, and Karan Nagpal, Deep Learning for Natural Language Processing: Creating Neural Networks with Python, 2020
2.	Paul Azunre, Transfer Learning for Natural Language Processing, Manning Publications, 2021.
3.	Jacob Eisenstein, Natural Language Processing, MIT Press, 2019
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	"Natural Language Processing", By Prof. Pawan Goyal, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc23_cs80/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	**Mini Project**		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Apply various NLP techniques and algorithms to process and analyze natural language data.	Ap	1,2,12	1,2
2.	Evaluate and select appropriate NLP models and algorithms for specific language processing tasks.	Ev	1,2,3,5, 7,8,12	1,2,3
3.	Critically analyze and interpret the results of NLP experiments and research studies.	An	1,2,3,5, 7,8,12	1,2,3
4.	Design and develop NLP systems and applications using relevant tools and technologies.	Ap	1,2,5,7,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA - Open Book Assignment

Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer

	1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓	✓			✓							✓	✓	✓	
2	✓	✓	✓		✓		✓	✓				✓	✓	✓	✓
3	✓	✓	✓		✓		✓	✓				✓	✓	✓	✓
4	✓	✓			✓							✓	✓	✓	
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Students' skills and competence are significantly enhanced in Natural Language Processing (NLP) after completing the course.	The knowledge gained from the course in Natural Language Processing (NLP) is applicable across various industry sectors and domains.	After completing the course in Natural Language Processing (NLP), students can pursue job roles such as NLP Engineer, Data Scientist, or Language Technology Specialist.

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

HUMAN COMPUTER INTERACTION

Course Code	21EC727	**Course type**	PEC	**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**	100
Flipped Classes content	2 Hours			**SEE Marks**	100

Course learning objectives	
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.	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.
4.	Study the implementation and applications of groupware, ubiquitous computing and augmented realities applied to interactive systems.

Pre-requisites: Nil

Unit – I	**Contact Hours = 8 Hours**
Foundation: Introduction to human and computer, The Interaction: Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of WIMP interface, Interactivity. **Case Study**: Paradigms for interaction	

Unit – II	**Contact Hours = 8 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. **Case Study**: Designing for diversity	

Unit – III	**Contact Hours = 8 Hours**
Models of Interactive Systems: Standard formalism, Cognitive models: Goal and task hierarchies, Linguistic models, challenge of display-based systems, Physical and device models, and Cognitive architectures. Interaction models, modeling rich interaction.	

Case Study: Socio-organizational issues and stakeholder requirements

Unit – IV	**Contact Hours = 8 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. **Case Study**: Evaluation through user participation	

Unit – V	**Contact Hours = 8 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. **Case Study**: Hypertext, Multimedia and the World Wide Web	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**0**	**0**	**1**	**1**	**0**

Books	
	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.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.hcibook.com/e3/online/

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.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the basic elements of human-computer interaction.	Un	1,6,8,9,10,11,12	1,3
2.	Analyze different models of interactive systems and their implementation and evaluation.	An	1,2,6,8,9,10,11,12	2,3
3.	Apply groupware, ubiquitous computing and augmented reality technologies in an interactive system.	Ap	1,2,6,8,9,10,11,12	1,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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	✓					✓		✓	✓	✓	✓	✓	✓		✓
2	✓	✓				✓		✓	✓	✓	✓	✓		✓	✓
3	✓	✓				✓		✓	✓	✓	✓	✓	✓		✓
Use tick mark(✓)															

CYBER SECURITY – A PRACTICAL APPROACH

Course Code	**21EC728**	**Course type**	**Integrated Project based**	**Credits L-T-P**	2 – 0 – 1
Hours/week: L - T- P	2 – 0 – 2			**Total credits**	3
Total Contact Hours	L = 20 Hrs, T = 0 Hrs, P = 20 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	NIL			**SEE Marks**	100

Course learning objectives	
1.	To understand the basics of cybersecurity and get familiar with cybersecurity analysis tools
2.	To acquire knowledge regarding types of security threats, attacks and countermeasures
3.	To explore secure coding practices

Required Knowledge of : Basic understanding of internet

Unit – I	**Contact Hours = 4 Hours**

Cybersecurity System Fundamentals

Introduction to Digital data, its types and information, Introduction to information system, Introduction to management information systems (MIS) and its functions. Introduction to Data Centre and its infrastructure

Introduction to virtualization, its benefits and virtual machines

Components of Virtual Machines, its hardware and its benefits, Application and Desktop Virtualization and their techniques

Introduction to Cyber Security

CIA Triad-3 pillars of information security architecture, CIA components and its importance, Cyber security threats and best practices, Access controls and its types, Types of Reconnaissance, Types of Cyber Attack, Vulnerability Assessment and its features, Concept and types of Scanning Methodology, Penetration Tests

Unit – II	**Contact Hours = 4 Hours**

Network Security Threats and countermeasures

Network Security Devices, Types of Network Securities, Network Access Control, Characteristics of Network Access Control, Application Security, Application Security Tools, Firewalls and its types, virtual private network, Tunnelling protocol and types IDS, IPS and their Types, Introduction to Web Application Vulnerabilities

Basic Practices of Web Application Security

Common Cyberattacks on Web Applications, Mobile Application Vulnerabilities, Mobile Security Threats, Mobile Application Security, Fundamentals of Mobile Device Management, Overview of Mobile Device Management

Cloud Computing Threats and Solutions

Clouds Computing – Threats and Vulnerabilities, Cloud Computing Risks and Threats, Introduction to Cloud Security, Cloud Security and its Practices

Unit – III	Contact Hours = 4 Hours

Firewall and its types

Types of Firewalls and its benefits, Packet Filtering Firewall, Application Firewall, Inspection Techniques, Stateful and Stateless Application, Internet protocol, TCP Header, Well-known UDP and TCP Ports, Client Server Model, DNS and DHCP, SSL and TSL, VPN and how it protects your IP address and privacy

Network Analysis

Information and view specific packets being sent and received on the network, Security Configuration Checklist, Monitoring Network Bandwidth, Network Analyzers, Wireshark and its use cases

Case Study: NMAP tool

Unit – IV	Contact Hours = 4 Hours

Cryptography

Cryptography and Cryptanalysis, Types of cryptography, Symmetric encryption, Asymmetric encryption, Understanding digital certificates and signatures, introduction to signatures, introduction to digital certificates, introduction to cryptographic attacks, types of cryptographic attacks, Traditional cryptographic attacks, Counter measures to cryptographic attacks

Case Study: Cryptool

Unit – V	Contact Hours = 4 Hours

Web Server & Application Security

Concept and overview of 3 tier Architecture, Web Application Basics, Working of Domain Name System (DNS), Working of DNS and its vulnerabilities, Web Server Vulnerabilities, Web Application Security, Web Application Attacks, Working of HTTP, Configuring Chrome to work with Burp, HTTP Request Methods, HTTP Status Messages, HTTP – Responses.

Secure Coding Techniques

OWASP Secure Coding Practices, Quick Reference Guide, , Nikto and its features, CMSeek, its features and detection tools, WPScan and its uses

Case Study: Burp Suite and its tools

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	**2**	1. Virtual lab environment setup for cybersecurity 2. Introduction to Kali Linux and its significance in cybersecurity
2	**2**	1. Fundamentals of Network Security protocols, firewalls, and encryption 2. Introduction to Penetration Testing: Conducting a basic penetration test on a vulnerable system
3	**2**	1. Conduction of network scanning and host enumeration using tools like Nmap 2. Network Scanning and Host Discovery with Nmap
4	**2**	1. Data Encryption and decryption the data using RSA and secure key exchange using Diffie-Hellman Key exchange protocol. 2. Securing email communication with GnuPG
5	**2**	1. Creating strong passwords and managing them 2. Testing Password Strength with John-the-riper and Hashcat

Unit No.	Self-Study Topics
1	Case study: Green Data Centre
2	Case study: Google Data Centre
3	Internet Control Message Protocol
4	Hash Cryptography
5	Case study: Web Application Vulnerability Scanning Tools

Books	
	Text Books:
1.	William Stallings, Cryptography and Network Security, Pearson 6th edition, 2005 onwards
2.	Michael E. and Herbart J.: Principles of Information Security, 2nd Edition 2005 onwards
3.	Michael Gregg, Omar Santos, Certified Ethical Hacker (CEH) Version 10 Cert Guide,Pearson IT Certification, 3rd Edition, 2019 onwards
4.	Shankar Kambhampaty, Infrastructure Architecture Essentials for Data Center and Cloud, 2022 onwards (ISBN 979-8786300469)
	Reference Books:
1.	Matt Walker, CEH Certified Ethical Hacker All-in-One Exam Guide, Fourth Edition,McGraw-Hill, 4th Edition, 2019 onwards
2.	Wes Noonan , Firewall-Fundamentals, Cisco-Press, 1 st Edition, 2006 onwards
3.	Angela Orebaugh, Nmap in the Enterprise: Your Guide to Network Scanning, Syngress, 2008 onwards
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	
2.	

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests- Theory & Lab based
2.	PPT and Videos	2.	Project phase 1 & 2
3.	Practice session/Demonstrations in Labs	3.	SEE- Project evaluation
		4.	SEE- Solving an Open ended problem

Course Outcome (COs)

Learning Levels:

Re - Remember, Un - Understand, Ap - Apply, An - Analysis, Ev - Evaluate, Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Examine the vulnerabilities at different parts of the networks and deign secured services	L3	1,2,3, 4, 5, 8,9,10,11,12	2,3
2.	Analyze various types of attacks and compare the performance of various countermeasure tools.	L4	2, 3, 4, 5, 6,8,9,10,11,12	2,3
3.	To evaluate the secure systems in various web applications	L5	2, 4, 5, 6,8,9,10,11,12	2,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (40 marks)		**PROJECT (60 marks)**			Total
IA test (Theory)	IA test (Lab)	Project Phase 1	Project Phase 2	Project report	
25 marks	15 marks	25 marks	25 marks	10 marks	100 marks
Theory IA test should be of one-hour duration. Lab IA test should be of two/three-hour duration. Project batch will ideally consist of 2 students (maximum of 3). Project Phase 1 presentation will be conducted after 6 weeks and Project Phase 2 presentation will be conducted after 13 weeks from the start of the semester. Submitting Project report is compulsory.					
Eligibility for SEE: 1. 40% and above (16 marks and above) in theory component 2. 40% and above (24 marks and above) in project component 3. Not eligible in any one of the two components will make the student **Not Eligible** for SEE					

Semester End Examination (SEE):

1.	It will be conducted for 100 marks having 3 hours duration.		
2.	**Lab Open ended program/problem/experiment** Write-up & execution (1 open ended expt)- (20 marks write-up + 20 marks algorithm/flowchart + 10 marks execution)	50 marks	100 marks
	Project evaluation a. Initial write up stating the objectives, methodology and the outcome b. Hardware project: Exhibiting and demonstration of working of project. Software project: Demonstration of the programming capabilities by writing flowchart, algorithm and codes related to a section of the project. c. Viva-voce	10 marks 30 marks 10 marks	
3.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.		
4.	SEE will be conducted in project batches by **Internal & External examiners** together.		

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	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓		✓	✓
2		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓
3		✓		✓	✓	✓		✓	✓	✓	✓	✓		✓	✓
Tick mark the CO, PO and PSO mapping 2, 4, 5, 6,8,9,10,11,12															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Critical understanding of cyber security	Cybersecurity , information security, system security	information security, network security analyst

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

ARTIFICIAL NEURAL NETWORKS

Course Code	21EC731	**Course type**	OEC	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand different neural network models.
2.	Explore the hard problems and apply multilayer neural networks solve the same.
3.	Understand and interpret the energy analysis applied to Regression neural networks.
4.	Explore different architectures of neural networks for different set tasks.

Unit – I	**Contact Hours = 8 Hours**
Fundamentals of ANN – Biological Neurons and Their Artificial Models – Types of ANN – Properties – Different Learning Rules – Types of Activation Functions – Training of ANN – Perceptron Model (Both Single &Multi-Layer) – Training Algorithm – Problems Solving Using Learning Rules and Algorithms – Linear Separability Limitation and Its Over Comings **Case Study:** Identify an application and analyze its performance using any two network models.	

Unit – II	**Contact Hours = 8 Hours**
Back Propagation Networks (BPN) - Training - Architecture-Algorithm, Counter Propagation Network (CPN) - Training - Architecture, Bi-Directional Associative Memory (BAM) - Training-stability analysis, Adaptive Resonance Theory – Adaptive Resonance Theory (ART) - ART1- ART2 – Architecture - Training, Hop Field Network - Energy Function - Discrete - Continuous - Algorithm - Application – Travelling Sales Man Problem TSP. **Case Study:** Linear separability, Perceptron convergence theorem.	

Unit – III	**Contact Hours = 8 Hours**
Self organizing networks-Introduction - Kohonan SOM - Linear vector quantization, Probabilistic neural network, Cascade correlation, General Regression neural network, Cognitron - Application of ANN - Texture classification - Character recognition. **Case Study:** Review a research paper on CNN application and analyze the architecture.	

Unit – IV	**Contact Hours = 8 Hours**
Classical set - Operations and properties - Fuzzy Set - Operations and properties - Problems, Classical Relations - Operations and Properties, Fuzzy Relations - Operations and Properties - Compositions Membership function -FLCS - Need for FLC-Fuzzification - Defuzzification. **Case Study:** Compare the different parameters of feedback neural networks with each other	

Unit –V	Contact Hours = 8 Hours
Fuzzy decision making -Types, Fuzzy Rule Based System, Knowledge Based System, Nonlinear Fuzzy Control system - Fuzzy Classification - Hard C Means - Fuzzy C Means. Applications of fuzzy - Water level controller, Fuzzy image Classification, Speed control of motor. **Case Study:** Compare RBF with MLP networks.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	B. Yegnanarayana, Artificial neural networks", PHI, 2010 onwards.
2.	Robert J. Schalkoff, "Neural Networks for Pattern Recognition", Mcgraw-Hill Inc.
	Reference Books:
1.	Simon Haykin, "Neural Networks and Learning Machines", Pearson Education, 3rd edition, 2008 onwards.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/

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 (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Analyze performance of different neuron models with reference to identified application.	Ap	1,2,4,5	1
2.	Apply multilayer neural networks to solve hard problems.	Ap	1,2,4,5	1
3.	Compare different neural network architectures applied to complex pattern recognition tasks.	An	1,2,4,5	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓		✓	✓								✓		
2	✓	✓		✓	✓								✓		
3	✓	✓		✓	✓								✓		
Use tick mark(✓)															

FUNDAMENTALS OF ROBOTICS

Course Code	**21EC732**	**Course type**	OE	**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**	100
Flipped Classes content	3 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand fundamentals of industrial automation and robotics
2.	Understand different types of actuators, motors, grippers used in robot drive system
3.	Apply the knowledge of Sensors and actuators in building robotic systems
4.	Understand the applications of robots in various fields

Pre-requisites: Fundamentals of Electronics, Fundamental of Physics

Unit – I	**Contact Hours = 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	**Contact Hours = 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. **Case Study:** Study the control of a two-wheeled robot	

Unit – III	**Contact Hours = 8 Hours**
Sensors: Sensors, requirements and classification of sensors, position sensors, force sensors, external sensors: Electro-mechanical sensors. **Case Study:** Identify an application that uses machine vision for obstruction detection.	

Unit – IV	**Contact Hours = 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. **Case Study:** Understand the working principles of a robotic arm control system.	

Unit –V	Contact Hours = 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. **Case Study:** Design a simple automation system that employs the knowledge of sensors and actuators.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	-	2	1	-	-

Books	
	Text Books:
1.	Ramachandran S., "Robotics", AIRWALK PUBLICATIONS (2017), ISBN: 978-9384893-69-9
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-ButterworthHeinemann (2014)
	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)
2.	John J. Craig - Introduction to Robotics Mechanics and Control 3rd edition-Pearson Education, Inc. (2005)
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/108/105/108105063/
2.	

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 (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr – Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the fundamentals of Robotics.	Un	1,12	1
2.	Compare and identify the appropriate proper actuators and sensor required for the robotic application.	Ap	2,3,9,10,11,12	1
3.	Analyze the performance of various applications and compare different programming aspects in these applications.	An	5,9,10,11,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries 20 Marks.

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**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓											✓	**1**		
2		✓	✓						✓	✓	✓	✓	**1**		
3					✓				✓	✓	✓	✓		**1**	
Use tick mark(✓)															

DIGITAL FORENSICS

Course Code	21EC733	**Course type**	**OEC**	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
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	**Contact Hours = 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	**Contact Hours = 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	**Contact Hours = 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.	

Case Study:

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

Unit – IV	**Contact Hours = 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 Face book by Afentis Software) to discover friends and other information of a public profile.

Unit –V	**Contact Hours = 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.

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**2**	**2**	**2**	**2**	**2**

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.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/

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 (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the basic concepts of digital forensics and study the forensic tools.	Ap	1,3,4,5,6,8	1
2.	Analyze the forensic data acquired from an electronic system.	An	1,3,4,5,6,8	1
3.	Analyze the e-mail and social media digital forensics and document.	Ev	1,3,4,5,6,8	1
4.	Understand the digital forensics applied to mobile and cloud scenario.	Ap	1,3,4,5,6,8	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
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CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO1**	**PO**	**PO**	**PSO**	**PSO**	**PSO**

	1	2	3	4	5	6	7	8	9	0	11	12	1	2	3
1	✓		✓	✓	✓	✓		✓					✓		
2	✓		✓	✓	✓	✓		✓					✓		
3	✓		✓	✓	✓	✓		✓					✓		
4	✓		✓	✓	✓	✓		✓					✓		
Use tick mark(✓)															

COMPUTATIONAL INTELLIGENCE

Course Code	**21EC734**	**Course type**	OEC	**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**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Develop a comprehensive understanding of computational intelligence, fuzzy logic, and neural networks.
2.	Explore and analyse various neural network architectures and their applications.
3.	Acquire in-depth knowledge of the fundamental principles, concepts, and operations of fuzzy logic.
4.	Design and implement effective fuzzy logic systems, including creating rule bases, defining membership functions, and implementing fuzzy inference mechanisms.

Pre-requisites: Mathematical fundaments and set theory, fundamentals of Linear Algebra

Unit – I	**Contact Hours = 8 Hours**
Introduction to Computational Intelligence Overview of computational intelligence and its applications, Introduction to neural networks, fuzzy logic, evolutionary computation, swarm intelligence, and machine learning. **Case study on Energy Management in Smart Grids using computational intelligence.**	

Unit – II	**Contact Hours = 8 Hours**
Fundamentals of Artificial Neural Network Perceptron, artificial neuron, artificial neuron implementation, different activation functions for binary and multilabelled classification. Logic development using simple perceptron, single layer perceptron, multilayer perceptron, artificial neural learning, forward propagation and back propagation algorithm and application. **Applications of Artificial Neural Networks (ANNs)** Image and Speech Recognition, Natural Language Processing, Time Series Prediction, Pattern Recognition and Classification. **Case study on Fraud Detection in Financial Transactions using computational intelligence.**	

Unit – III	**Contact Hours = 8 Hours**
Fuzzy Set theory and Fuzzy System **Fuzzy set theory:** Introduction to Fuzzy Set, Membership, Operations, Properties, Fuzzy Relation. **Fuzzy system:** Introduction, FL, Fuzzification, Fuzzy Inference, F Rule Based System, Defuzzification. **Applications of fuzzy system:** Fuzzy rule-based traffic signal optimization, Fuzzy logic-based medical diagnosis systems, Fuzzy logic-	

based power system stability analysis, Fuzzy rule-based decision support systems for financial risk assessment.

Case study on Medical Diagnosis and Treatment using computational intelligence.

Unit – IV	**Contact Hours = 8 Hours**

Associative Memory

Fuzzy Associative Memory, - Fuzzy associative memories (FAMs) pattern recognition and retrieval in fuzzy logic systems and Associative Neural Memory.

Applications of Associative Memory: Efficient data storage and retrieval in large-scale databases, Image and video processing for object recognition and tracking, Speech recognition and natural language processing, financial forecasting and time series analysis, Fault diagnosis and anomaly detection in complex systems.

Case study on Autonomous Vehicle Navigation using computational intelligence.

Unit – V	**Contact Hours = 8 Hours**

Applications of Neuro-Fuzzy

Neuro-Fuzzy System Fundamentals, Neuro-Fuzzy Modeling, Neuro-Fuzzy Pattern Recognition application, Neuro-Fuzzy Time Series Prediction and analysis, Neuro-Fuzzy Fault Diagnosis and Neuro-Fuzzy Applications in Healthcare.

Case study on Predictive Maintenance in Manufacturing using computational intelligence.

Unit No.	**Self-Study Topics**
1	Exponential models, Time series models.
2	Multiple linear regression, Multivariate linear regression, Generalized linear models.
3	Machine learning and compressed sensing.
5	Sparse signal representation, kernel and sparse kernel

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions **Mini -Project and Case Study in each Unit**	**2**	**2**	**2**	**2**	**2**

Books	
	Text Books:
1.	Andries P. Engelbrecht, "Computational Intelligence: An Introduction, Second Edition", Wiley, 2007.
2.	Simon Haykin, "Neural Networks and Learning Machines", 3rd Edition, Pearson, 2008.
	Reference Books:
1.	Nikola K. Kasabov, "Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering", MIT Press, 1996.

2.	Bart Kosko, "Neural Networks and Fuzzy Systems", Prentice Hall, 1992.
3.	Bart Kosko, "Fuzzy Engineering", Prentice Hall, 1997.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Approximate Reasoning Using Fuzzy Set Theory, By Prof. Balasubramaniam Jayaram, IIT Hyderabad https://onlinecourses.nptel.ac.in/noc23_ma60/preview
2.	Introduction To Fuzzy Set Theory, Arithmetic And Logic, By Prof. Niladri Chatterjee, IIT Delhi https://onlinecourses.nptel.ac.in/noc23_ma73/preview
3.	Deep Learning for Computer Vision, By Prof. Vineeth N Balasubramanian, IIT Hyderabad https://onlinecourses.nptel.ac.in/noc21_cs93/preview

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.	**Mini Project and Casestudy**	5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the foundational principles and concepts of computational intelligence, including neural networks and fuzzy logic.	**Re**	1,2, 12	1,2
2.	Apply computational intelligence techniques effectively to solve complex problems.	**Ap**	1,2, 12	1,2
3.	Analyze and evaluate computational intelligence algorithms and models critically.	**An**	1,2,12	1,2,3
4.	Design and implement innovative computational intelligence solutions for real time application.	**An**	1,2,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

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CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
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1	✓	✓										✓	✓		
2	✓	✓										✓	✓		
3	✓	✓					✓					✓	✓	✓	✓
4	✓	✓										✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Enhanced skills and competence in computational intelligence techniques, including neural networks, fuzzy logic, and evolutionary computation, for solving real-world problems in diverse domains.	Applicable industry sectors and domains include artificial intelligence, data science, robotics, finance, healthcare, manufacturing, and engineering, among others.	Various job roles that students can take up after undergoing the course include data scientist, machine learning engineer, AI researcher, and robotics engineer.

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus