M Sc ELECTRONICS

LOCF SYLLABUS 2025

Department of Electronics

School of Physical Sciences

St. Joseph's College (Autonomous)

Tiruchirappalli - 620002, Tamil Nadu, India

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS) POSTGRADUATE COURSES

St. Joseph's College (Autonomous), an esteemed institution in the realm of higher education in India, has embarked on a journey to uphold and perpetuate academic excellence. One of the pivotal initiatives in this pursuit is the establishment of five Schools of Excellence commencing from the academic year 2014-15. These schools are strategically designed to confront and surpass the challenges of the 21st century.

Each School amalgamates correlated disciplines under a unified umbrella, fostering synergy and coherence. This integrated approach fosters the optimal utilization of both human expertise and infrastructure. Moreover, it facilitates academic fluidity and augments employability by nurturing a dynamic environment conducive to learning and innovation. Importantly, while promoting collaboration and interdisciplinary study, the Schools of Excellence also uphold the individual identity, autonomy, and distinctiveness of every department within.

The overarching objectives of these five schools are as follows:

1. Optimal Resource Utilization: Ensuring the efficient use of both human and material resources to foster academic flexibility and attain excellence across disciplines.

2. Horizontal Mobility for Students: Providing students with the freedom to choose courses aligning with their interests and facilitating credit transfers, thereby enhancing their academic mobility and enriching their learning experience.

3. Credit-Transfer Across Disciplines (CTAD): The existing curricular structure, compliant with regulations from entities such as TANSCHE and other higher educational institutions, facilitates seamless credit transfers across diverse disciplines. This underscores the adaptability and uniqueness of the choice-based credit system.

4. Promotion of Human Excellence: Nurturing excellence in specialized areas through focused attention and resources, thus empowering individuals to excel in their respective fields.

5. Emphasis on Internships and Projects: Encouraging students to engage in internships and projects, serving as stepping stones toward research endeavors, thereby fostering a culture of inquiry and innovation.

6. Addressing Stakeholder Needs: The multi-disciplinary nature of the School System is tailored to meet the requirements of various stakeholders, particularly employers, by equipping students with versatile skills and competencies essential for success in the contemporary professional landscape.

In essence, the Schools of Excellence at St. Joseph's College (Autonomous) epitomize a holistic approach towards education, aiming not only to impart knowledge but also to cultivate critical thinking, creativity, and adaptability – qualities indispensable for thriving in the dynamic global arena of the 21st century.

Credit system

The credit system at St. Joseph's College (Autonomous) assigns weightage to courses based on the hours allocated to each course. Typically, one credit is equivalent to one hour of instruction per week. However, credits are awarded regardless of actual teaching hours to ensure consistency and adherence to guidelines.

The credits and hours allotted to each course within a programme are detailed in the Programme Pattern table. While the table provides a framework, there may be some flexibility due to practical sessions, field visits, tutorials, and the nature of project work.

For postgraduate (PG) courses, students are required to accumulate a minimum of 92 credits, as stipulated in the programme pattern table. The total minimum number of courses offered by the department is outlined in the Programme Structure.

OUTCOME-BASED EDUCATION (OBE)

OBE is an educational approach that revolves around clearly defined goals or outcomes for every aspect of the educational system. The primary aim is for each student to successfully achieve these predetermined outcomes by the culmination of their educational journey. Unlike traditional methods, OBE does not

prescribe a singular teaching style or assessment format. Instead, classes, activities, and evaluations are structured to support students in attaining the specified outcomes effectively.

In OBE, the emphasis lies on measurable outcomes, allowing educational institutions to establish their own set of objectives tailored to their unique context and priorities. The overarching objective of OBE is to establish a direct link between education and employability, ensuring that students acquire the necessary skills and competencies sought after by employers.

OBE fosters a student-centric approach to teaching and learning, where the delivery of courses and assessments are meticulously planned to align with the predetermined objectives and outcomes. It places significant emphasis on evaluating student performance at various levels to gauge their progress and proficiency in meeting the desired outcomes.

Here are some key aspects of Outcome-Based Education:

Course: A course refers to a theory, practical, or a combination of both that is done within a semester.

Course Outcomes (COs): These are statements that delineate the significant and essential learning outcomes that learners should have achieved and can reliably demonstrate by the conclusion of a course. Typically, three or more course outcomes are specified for each course, depending on its importance.

Programme: This term pertains to the specialization or discipline of a degree programme.

Programme Outcomes (POs): POs are statements that articulate what students are expected to be capable of by the time they graduate. These outcomes are closely aligned with Graduate Attributes.

Programme Specific Outcomes (PSOs): PSOs outline the specific skills and abilities that students should possess upon graduation within a particular discipline or specialization.

Programme Educational Objectives (PEOs): PEOs encapsulate the expected accomplishments of graduates in their careers, particularly highlighting what they are expected to achieve and perform during the initial years postgraduation.

LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The Learning Outcomes-Centric Framework (LOCF) places the learning outcomes at the forefront of curriculum design and execution. It underscores the importance of ensuring that these outcomes are clear, measurable, and relevant. LOCF orchestrates teaching methodologies, evaluations, and activities in direct correlation with these outcomes. Furthermore, LOCF adopts a backward design approach, focusing on defining precise and attainable learning objectives. The goal is to create a cohesive framework where every educational element is in harmony with these outcomes.

Assessment practices within LOCF are intricately linked to the established learning objectives. Evaluations are crafted to gauge students' achievement of these outcomes accurately. Emphasis is often placed on employing authentic assessment methods, allowing students to showcase their learning in real-life scenarios. Additionally, LOCF frameworks emphasize flexibility and adaptability, enabling educators to tailor curriculum and instructional approaches to suit the diverse needs of students while ensuring alignment with the defined learning outcomes.

Some important terminologies

Core Courses (CC): *These are compulsory courses that students must undertake as essential components of their curriculum, providing fundamental knowledge within their primary discipline. Including core courses is essential to maintain a standardized academic programme, ensuring recognition and consistency across institutions.*

Discipline Specific Elective Courses (ES): *Elective courses are offered within the main discipline or subject of study. They allow students to select specialized or advanced options from a range of courses, offering in-depth exposure to their chosen area of study. Typically, ES are more applied in nature and provide a deeper understanding of specific topics.*

Research Methodology/IPR(RM)*: It is a two-credit course offered in the third semester as a common program across disciplines within the school. It is designed to acquaint postgraduate learners with the research foundations and legal frameworks vital for innovation and entrepreneurship in technology and business.*

Open Elective Courses (OE): *These elective courses are chosen from disciplines unrelated to the student's main area of study, aiming to broaden their exposure and knowledge base. As per the Choice Based Credit System (CBCS) policy, students may opt for open elective courses offered by other disciplines within the college, enhancing the diversity of their learning experience.*

Ability Enhancement Course (AEC): *AE is designed to enhance skills and proficiencies related to the student's main discipline. It aims to provide practical training and hands-on experience, contributing to the overall development of students pursuing academic programmes.*

Skill Enhancement Course (SEC): *SE focus on developing specific skills or proficiencies relevant to students' academic pursuits. While it is open to students from any discipline, SE is particularly beneficial for those within the related academic programme.*

Self-Learning (SL): *A two-credit course designed to foster students' ability for independent and self-directed learning. There are* Three Self-Learning Courses:

- 'Global Citizenship Education' *a common online course offered to all PG students in Semester I on JosTEL.*
- *Compulsory MOOC on NPTEL-SWAYAM in Semester I or II*
- *A Department-Specific Self-Learning Course in Semester III on JosTEL*

Comprehensive Examination (CE): *These examinations cover detailed syllabi comprising select units from courses offered throughout the programme. They are designed to assess crucial knowledge and content that may not have been covered extensively in regular coursework.*

Extra Credit Courses: *To support students in acquiring knowledge and skills through online platforms such as Massive Open Online Courses (MOOCs), additional credits are granted upon verification of course completion. These extra credits can be availed across three semesters (2 - 4). In line with UGC guidelines, students are encouraged to enhance their learning by enrolling in MOOCs offered by portals like SWAYAM, NPTEL, and others. Additionally, certificate courses provided by the college are also considered for these extra credits.*

Outreach Programme (OR): *It is a compulsory course to create a sense of social concern among all the students and to inspire them to dedicated service to the needy.*

Course Coding

The following code system (10 alphanumeric characters) is adopted for Postgraduate courses:

25	**UXX**	**0**	**XX**	**00/X**
Year of Revision	PG Department Code	Semester Number	Course Specific Initials	Running Number/with Choice

Course Specific Initials

CC - Core Course

CP - Core Practical

ES - Discipline Specific Elective

AE - Ability Enhancement Course

SL - Self-Learning

OE – Open Elective

PW - Project and Viva Voce

CE - Comprehensive Examination

OR - Outreach Programme

IS – Internship

RM – Research Methodology

EVALUATION PATTERN (PG)

Continuous Internal Assessment

Sl No	Component	Marks Allotted
1	Mid Semester Test	30
2	End Semester Test	30
3	*Two Components (15 + 20)	35
4	Library Referencing	5
	Total	**100**

Passing minimum: 50 marks

* *The first component is a compulsory online test (JosTEL platform) for 15 marks comprising 7 questions (1 mark) at K1 level and 4 questions (2 marks) at K2 level;* The second component is decided by the course in-charge in accordance with the prescribed K levels.

Question Paper Blueprint for Mid and End Semester Tests

Duration: 2 Hours								**Maximum Marks: 60**
Section		**K levels**						**Marks**
		K1	**K2**	**K3**	**K4**	**K5**	**K6**	
A *(compulsory)*		7						7 × 1 = 7
B *(compulsory)*			5					5 × 3 = 15
C *(either…or type)*				3				3 × 6 = 18
D *(2 out of 3)*	Mid Sem				1(2)	1*		2 × 10 = 20
	End Sem					1(2)	1*	
							Total	**60**

***** *Compulsory*

Question Paper Blueprint for Semester Examination

Duration: 3 Hours							**Maximum Marks: 100**
Section	**K levels**						**Marks**
	K1	**K2**	**K3**	**K4**	**K5**	**K6**	
A *(compulsory)*	10						10 × 1 = 10
B *(compulsory)*		10					10 × 3 = 30
C *(either…or type)*			5				5 × 6 = 30
D *(3 out of 5)*				1(2)	1(2)	1*	3 × 10 = 30
						Total	**100**

***** *Compulsory*

Evaluation Pattern for One/Two-credit Courses

Title of the Course	CIA	Semester Examination	Final
• Ability Enhancement Course	20 + 10 + 20 = 50	50 *(Department)*	100
• Self - Learning Course (Dept. Specific) • Comprehensive Examination	25 + 25 = 50	50 *(CoE)*	100
• Internship • Self - Learning Course (Common) • Self - Learning Online Course (NPTEL / SWAYAM)	100	-	100
• Skill Enhancement Course: Soft Skills	100	-	100
• Project Work and Viva Voce	100	100	100

Grading System

The marks obtained in the CIA and semester for each course will be graded as per the scheme provided in Table - 1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA), respectively. These two are calculated by the following formulae:

$$SGPA \ and \ CGPA = \frac{\sum_{i=1}^{n} C_i Gp_i}{\sum_{i=1}^{n} C_i}$$

$$WAM = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$$

Where,

Ci - credit earned for the Course i

Gpi - Grade Point obtained for the Course i

Mi - Marks obtained for the Course i

*n - Number of Courses **passed** in that semester*

WAM - Weighted Average Marks

Table - 1: Grading of the Courses for PG

Mark Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above and below 90	9	A+
70 and above and below 80	8	A
60 and above and below 70	7	B+
50 and above and below 60	6	B
Below 50	0	RA

Table - 2: Grading of the Final Performance for PG

CGPA	Grade	Performance
9.00 and above	O	Outstanding*
8.00 to 8.99	A+	Excellent*
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
Below 5.00	RA	Re-appear

**The Candidates who have passed in the first appearance and within the prescribed duration of the PG programme are eligible. If the Candidates Grade is O/A+ with more than one attempt, the performance is considered "Very Good".*

Vision

Forming globally competent, committed, compassionate and holistic persons, to be men and women for others, promoting a just society.

Mission

- Fostering learning environment to students of diverse background, developing their inherent skills and competencies through reflection, creation of knowledge and service.
- Nurturing comprehensive learning and best practices through innovative and value- driven pedagogy.
- Contributing significantly to Higher Education through Teaching, Learning, Research and Extension.

Programme Educational Objectives (PEOs)

1. Graduates will be able to accomplish professional standards in the global environment.
2. Graduates will be able to uphold integrity and human values.
3. Graduates will be able to appreciate and promote pluralism and multiculturalism in working environment.

Programme Outcomes (POs)

1. Graduates will be able to apply assimilated knowledge to evolve tangible solution to emerging problems.
2. Graduates will be able to analyze and interpret data to create and design new knowledge.
3. Graduates will be able to engage in innovative and socially relevant research and effectively communicate the findings.
4. Graduates will become ethically committed professional and entrepreneurs upholding human values.
5. Graduates imbibed with ethical values and social concern will be able to understand and appreciate cultural diversity, social harmony and ensure sustainable environment.

Programme Specific Outcomes (PSOs)

1. Critical and Analytical Thinking Skills
2. Focus on latest technology in Electronics
3. Hardware designing skills
4. Trouble shooting and programming skill
5. Digital design synthesis and simulation
6. Entrepreneurial Skills
7. Employability Enhancement
8. Research and industrial consultancy.

M. Sc. Electronics				
Programme Structure				
Semester	**Specification**	**No. of Courses**	**Hours**	**Credits**
1 – 4	Core Course	9	46	37
1 - 4	Core Practical	4	32	19
1, 3 & 4	Discipline Specific Elective	3	12	9
1 – 2	Open Elective	2	8	4
1	Ability Enhancement Course	1	2	1
1 – 3	Self-Learning	3	-	4
2	Skill Enhancement Course	1	4	2
3	Research Methodology	1	4	2
4	Project	1	12	8
4	Comprehensive Examination	1	-	2
2 – 4	Outreach Programme (SHEPHERD)	-	-	4
1 - 4	Extra Credit Course	4	-	12
	Total	**30**	**120**	**92 (12)**

M. Sc. ELECTRONICS PROGRAMME PATTERN								
Course Details						Scheme of Exams		
Sem.	**Course Code**	**Course Type**	**Title of the Course**	**Hours**	**Credits**	**CIA**	**SE**	**Final**
1	25PEL1CC01	**CC Major**	**Core Course – 1:** Design of Digital Circuits	6	5	100	100	100
	25PEL1CC02		**Core Course – 2:** Embedded Systems Design and Programming - 1	6	5	100	100	100
	25PEL1CP01		**Core Practical – 1:** Digital circuits, Embedded systems and DSP	8	5	100	100	100
	25PEL1ES01A	**DSE**	**Discipline Specific Elective – 1:** Digital Signal Processing	4	3	100	100	100
	25PEL1ES01B		**Discipline Specific Elective – 1:** Advanced Digital Communication Systems					
	25PEL1AE01	**AEC**	**Ability Enhancement Course:** Electronics Research and Entrepreneurship	2	1	100	-	100
	25PEL1OE01	**OE**	**Open Elective - 1 (WS):** Electronics Media	4	2	100	100	100
	25PGC1SL01	**SL**	Global Citizenship Education (Online)	0	1	100	-	100
			Extra Credit Course	0	(3)			
			Total	**30**	**22 (3)**			
2	25PEL2CC03	**CC Major**	**Core Course – 3:** Automotive Electronics	5	4	100	100	100
	25PEL2CC04		**Core Course - 4:** Embedded Systems Design and Programming – 2 (Internship Embedded Course)	5	4	100	100	100
	25PEL2CC05		**Core Course - 5:** Design of Analog Circuits	4	3	100	100	100
	25PEL2CP02		**Core Practical - 2:** Automotive Sensors and Embedded System	8	5	100	100	100
	25PEL2OE02	**OE**	**Open Elective – 2 (BS):** Computer Hardware and Networks	4	2	100	100	100
	25PSS2SE01	**SEC**	**Skill Enhancement Course:** Soft Skills	4	2	100	-	100
	25PEL2SL02	**SL**	Online Courses: NPTEL / SWAYAM	0	2	-	100	100
			Extra Credit Course	0	(3)			
			Total	**30**	**22 (3)**			
3	25PEL3CC06	**CC Major**	**Core Course - 6:** VLSI Design and VERILOG Programming	5	4	100	100	100
	25PEL3CC07		**Core Course - 7:** Electronic Instrumentation and Virtual Instrumentation	4	3	100	100	100
	25PEL3CC08		**Core Course - 8:** Internet of Things with Single Board Computer	5	4	100	100	100
	25PEL3CP03		**Core Practical - 3:** Single Board Computer and FPGA	8	5	100	100	100
	25PEL3ES02A	**DSE**	**Discipline Specific Elective – 2:** Electromagnetics and Antenna Design	4	3	100	100	100
	25PEL3ES02B		**Discipline Specific Elective – 2:** Power Electronics and Solar PV Systems					
	25SPS3RM01	**RM**	Research Methodology and IPR	4	2	100	100	100
	25PEL3SL03A	**SL**	**Self-Learning:** Programmable Logic Controller*	0	1	50	50	50
	25PEL3SL03B		**Self-Learning:** Nano electronics*					
	25PEL3SL03C		**Self-Learning:** Medical Electronics*					
			Extra Credit Course	0	(3)			
			Total	**30**	**22 (3)**			
4	25PEL4CC09	**CC Major**	**Core Course - 9:** Artificial Intelligence	6	5	100	100	100
	25PEL4CP04		**Core Practical - 4:** Internet of Things and Artificial Intelligence	8	4	100	100	100
	25PEL4ES03A	**DSE**	**Discipline Specific Elective – 3:** Control System and Industry 4.0	4	3	100	100	100
	25PEL4ES03B		**Discipline Specific Elective – 3:** Biomedical Signal and Image Processing					
	25PEL4PW01	**PW**	Project	12	8	100	100	100
	25PEL4CE01	**CE**	Comprehensive Examination*	0	2	50	50	50
			Extra Credit Course	0	(3)			
			Total	**30**	**22 (3)**			
	25PCW4OR01	**OR**	Outreach Programme	0	4			
1-4			**TOTAL**	**120**	**92 (12)**			

***For Grade Calculation:** Marks obtained out of 50 will be converted into 100 in the mark statements.

Open Elective - 1 (WS): 1st Semester

School	Course Code	Title of the Course
SPS		
Chemistry	25PCH1OE01	Advanced Materials and Nano Technology
Electronics	25PEL1OE01	Electronics Media
Physics	25PPH1OE01A	Solar Energy and Utilization
	25PPH1OE01B	Renewable Energy Resources

Open Elective – 2 (BS): 2nd Semester
Offered to students from other Schools

School	Course Code	Title of the Course
SBS		
Botany	25PBO2OE02	Sustainable Horticulture and Urban Landscaping
Biochemistry	25PBI2OE02	First Aid Management
Biotechnology	25PBT2OE02	Food Technology
SCS		
Artificial Intelligence and Machine Learning	25PAI2OE02	Cyber Security
Computer Science	25PCA2OE02A	Web Design
	25PCA2OE02B	Cyber Security
Information Technology	25PCS2OE02	Recent Trends in Computing
Data Science	25PDS2OE02	Discrete Mathematics
Mathematics	25PMA2OE02	Operations Research
Visual Communication	25PVC2OE02	Women and Media
SLAC		
English	25PEN2OE02	English for Digital Media
History	25PHS2OE02	Public Administration
Tamil	25PTA2OE02	விளம்பரக்கலை (Art of advertising)
SMS		
Commerce	25PCO2OE02	Basics of Tally Prime
Commerce Computer Application	25PCC2OE02	Behavioural Dynamics and Psychology
Counselling Psychology	25PCP2OE02	Artificial Intelligence in Psychology
Economics	25PEC2OE02	Managerial Economics
Human Resource Management	25PHR2OE02	Counselling and Guidance
SPS		
Chemistry	25PCH2OE02	Chemistry of Health and Nutrition
Electronics	25PEL2OE02	Computer Hardware and Networks
Physics	25PPH2OE02A	Physics for Competitive Exams
	25PPH2OE02B	Nanoscience

Semester	Course Code	Title of the Course	Hours / Week	Credits
1	25PEL1CC01	**Core Course - 1:** Design of Digital Circuits	6	5

Course Objectives
Analyze and design multi-level combinational logic circuits, including NAND, NOR, multiplexers, and decoders, while considering fan-in limitations.
Explore flip-flop triggering, state diagrams, and the Mealy and Moore models to design synchronous sequential circuits such as counters.
Gain knowledge of shift registers, ripple counters, and synchronous counters, along with their design methodologies and timing considerations.
Study state reduction techniques, flow tables, hazard detection, and the design of race-free asynchronous circuits.
Utilize LabVIEW tools, loops, structures, and timing control to simulate and implement digital circuit designs effectively

Unit-I: Combinational Logic Circuits and Design Principles (18 Hours)

Introduction to combinational logic circuits: Multi-Level Gate Networks – Other Types of Logic Gates – Design of Two-Level NAND and NOR-Gate Networks - Design of Multi-Level NAND and NOR Gate Networks – Design of Two-Level Multiple Output Networks – Multi -Output NAND and NOR Networks – Multiplexers – Decoders – Design of Networks with Limited Gate Fan -in

Unit-II: Clock-Driven Sequential Circuits (18 Hours)

Flip-Flops -Triggering of Flip-Flops – Analysis of clocked Sequential Circuits – Sequential -Circuit Example -State Table- State Diagram -Flip- Flop Input Functions -Analysis with JK and other Flip-Flops -Mealy and Moore Models - State Reduction and Assignment – Flip-Flops Excitation Table – Design Procedure -Design of counters

Unit-III: Registers and Counters (18 Hours)

Introduction - Clock signal - Registers – Shift Registers - Ripple Counters – Synchronous Counters - Timing Sequence – Design of synchronous Counter – RAM - DRAM

Unit-IV: Asynchronous Sequential Logic (18 Hours)

Analysis Procedure – Circuits and Latches - Design Procedure – Reduction of state and Flow Tables – Race Free State Assignment – Hazards – Design Example

Unit-V: LABVIEW For Digital Circuits (18 Hours)

Lab VIEW basics: The Lab VIEW Environment - Controls Palette - Functions Palette - Tools Palette - Menus and Toolbars – Building the Front Panel – Building the Block Diagram – Loops and Structures: For Loop and While Loop Structures – Controlling Timings – Auto-Indexing Loops – Using Loops to Build Arrays – Shift Registers and the Feedback Node in Loops – Case, Sequence and Event Structures

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Charles. H. Roth, Jr, *Fundamentals of Logic Design*, Cengage Learning, 2014.
2. M. Morris Mano, *Digital logic and Computer Design*, PHI, 2010.
3. National Instruments, *Lab VIEW: Lab VIEW Fundamentals*, August 2005.

Unit	Book	Chapter	Sections
I	1	7, 8, 9	7.1, 7.3 -7.7, 8.2, 9,2, 9.4
II	2	6	6.2 – 6.8
III	2	7	7.1 – 7.7
IV	2	9	9.1 – 9.8
V	3	1,3,4,5,8	1.1 – 1.4, 3.1 -3.5, 4,5,8

Books for Reference:

1. Donald P. Leach, Albert Paul Malvino, Goutam Saha, *Digital Principles and Applications*, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Thomas L. Floyd, *Digital Fundamentals*, Pearson Education, 2015.
3. National Instruments, Lab VIEW manual

Websites and eLearning Source:

1. https://www.watelectronics.com/sequential-circuits-types-its-applications/
2. https://www.brainkart.com/article/Design-Procedure-of-Asynchronous-Sequential-circuits_6766/
3. http://www.ee.ucl.ac.uk/~ademosth/E757/Topic4.pdf
4. https://www.geeksforgeeks.org/asynchronous-sequential-circuits/
5. http://ece-research.unm.edu/jimp/415/labview/LV_Intro_Six_Hours.pdf

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Define and recall fundamental concepts of combinational and sequential circuits, including logic gates, flip-flops, and counters.	**K1**
CO2	Explain the working principles of combinational logic circuits, sequential circuits, and LabVIEW components used in digital design.	**K2**
CO3	Construct and implement logic circuits using combinational and sequential design techniques, including multi-level logic networks and counters.	**K3**
CO4	Examine and differentiate between synchronous and asynchronous circuits, identify hazards, and optimize state assignments for efficient circuit design.	**K4**
CO5	Assess various digital design techniques, compare different state reduction methods, and validate the performance of designed circuits.	**K5**
CO6	Develop and simulate digital circuits using LabVIEW by designing interactive front panels, block diagrams, and implementing logic structures.	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
1	**25PEL1CC01**		**Core Course - 1:** Design of Digital Circuits							**6**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	3	3	2	3	3	2.7
CO2	3	2	3	2	2	3	2	3	2	3	2.5
CO3	3	2	2	2	3	3	3	2	3	2	2.5
CO4	3	3	2	3	3	3	3	2	2	3	2.7
CO5	3	2	3	3	2	3	2	2	3	3	2.6
CO6	3	2	2	3	3	3	3	2	3	3	2.7
										Mean Overall Score	**2.6 (High)**

Semester	Course Code	Title of the Course	Hours / Week	Credits
1	**25PEL1CC02**	**Core Course - 2:** Embedded Systems Design and Programming - 1	**6**	**5**

Course Objectives
To introduce the fundamental concepts of embedded systems, including characteristics, challenges, and design processes.
To familiarize students with CPU architecture, memory systems, and interrupt handling techniques in embedded computing.
To develop an understanding of program design, compilation techniques, and software performance optimization in embedded systems.
To explore real-time operating systems (RTOS), multitasking, scheduling techniques, and process management in embedded applications.
To examine communication protocols, multiprocessor architectures, and networking principles in distributed embedded systems.

Unit-I: EMBEDDED CONCEPTS (18 Hours)

Complex systems – Characteristics of embedded systems – Cyber - physical systems – Challenges – Performance – Design process – VLIW processors – ARM processor – Advanced ARM features

Unit-II: CPUs (18 Hours)

Programming input and output – Interrupts – Supervisor, exception and traps – Memory system – CPU performance – Architecture – CPU bus – Memory devices and systems.
Renesas RH850: overview of RH850/F1KH – Pin functions

Unit-III: PROGRAM DESIGN AND ANALYSIS (18 Hours)

Components for embedded programs – Models of programs – Assembly, linking and loading – Compilation techniques – Program-level performance analysis – Software performance optimization – Analysis and optimization of program size – Program validation and testing

Unit-IV: PROCESSES AND OPERATING SYSTEMS (18 Hours)

Multiple tasks and Multiple processes – Multirate systems – Preemptive real-time operating systems RTOS – Priority-based scheduling – Evaluating operating system performance – Example real-time operating systems - Renesas e^2 studio – simple programs

Unit-V: NETWORKS AND MULTIPROCESSORS (18 Hours)

Networks and multiprocessors – Categories of multiprocessors – Distributed embedded systems – CAN and CAN FD bus – I2C and I2S bus – Ethernet – Internet – MPSoCs and shared memory multiprocessors

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Marilyn Wolf, *Computers as Components Principles of Embedded Computing System Design*, 3rd edition, Elsevier, 2012.
2. RENESAS RH 850 Datasheet (2023), *r01ds0442ej0100-rh850f1kx*
3. Renesas e^2 studio manual

Unit	Book	Chapter	Sections
I	1	1, 2	1.2, 1.2.2, 1.2.4, 1.2.5, 1.2.6, 1.3-1.3.8, 2.2.3, 2.3-2.3.4
II	1	3, 4	3.2-3.2.4, 3.3-3.3.3, 3.4, 3.5, 3.5.2, 3.6-3.6.2, 4.2.1-4.2.2, 4.3-4.3.3, 4.4, 4.4.1
III	1	5	5.2-5.7, 5.9, 5.10
IV	1	6	6.2, 6.5, 6.7, 6.9
V	1	8	8.2-8.5

Books for Reference:

1. K. C. Wang, *Embedded and Real-Time Operating Systems*, Springer International Publishing AG, 2017.
2. Keith E. Curtis, *Embedded Multitasking*, Elsevier, 2006.
3. Peter Marwedel, *Embedded System Design*, 3rd Edition, Springer, 2006.
4. RENESAS RH 850 User manual (2023), *r01uh0607ej0120-rh850c1m-a1-rh850c1m-a2*

Websites and eLearning Sources:

1. https://resources.pcb.cadence.com/blog/2020-the-steps-for-embedded-systems-design
2. https://www.qt.io/embedded-development-talk/building-an-efficient-embedded-system-design-and-software-development-process
3. https://www.tutorialspoint.com/embedded_systems/es_overview.htm
4. https://www.digi.com/blog/post/examples-of-embedded-systems
5. https://www.javatpoint.com/embedded-system-tutorial

(* subject to availability - not to be used for exam purpose)

CO. No.	Course Outcomes	Cognitive Level (K- level)
	On successful completion of this course, students will be able to	
CO1	Define and recall fundamental concepts of embedded systems, including ARM processors, VLIW architectures, and memory systems.	**K1**
CO2	Explain the working principles of embedded CPUs, program design models, and the role of real-time operating systems (RTOS).	**K2**
CO3	Implement program design techniques, optimize software performance, and develop simple embedded programs using Renesas e2 studio	**K3**
CO4	Compare different CPU architectures, analyze memory system performance, and evaluate scheduling techniques in RTOS-based systems.	**K4**
CO5	Assess the performance of embedded systems, optimize program execution, and troubleshoot real-time operating system implementations.	**K5**
CO6	Design and integrate embedded systems using networking protocols like CAN, I2C, and Ethernet, and develop multiprocessor-based solutions.	**K6**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**								**Hours**	**Credits**
1	**25PEL1CC02**	**Core Course - 2:** Embedded Systems Design and Programming - 1								**6**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	3	2	3	3	3	3	2.5
CO2	2	3	2	3	3	2	2	2	2	3	2.4
CO3	2	2	3	3	2	2	3	2	2	3	2.4
CO4	2	2	2	2	3	2	3	2	3	2	2.3
CO5	2	2	2	3	2	2	2	3	3	3	2.4
CO6	2	2	2	2	3	2	3	3	3	3	2.5
										Mean Overall Score	**2.4 (High)**

Semester	Course Code	Title of the Course	Hours / Week	Credits
1	25PEL1CP01	**Core Practical - 1:** Digital circuits, Embedded systems and DSP	8	5

Any 16 Experiments

Digital Circuits:

1. DAC performance parameter study
2. Encoder and decoder study (Gray to binary and binary to gray, DTMF decoder, BCD to seven segments)
3. Design of 4-bit sequential counter
4. Design of 8-bit registers using flip-flop and gate ICs
5. Design of 2/4-bit Successive Approximation ADC
6. Design of ALU
7. Design of decimal to binary Encoder and binary to decimal Decoder
8. Study of Shift register (SISO, SIPO, PISO & PIPO) and Universal shift register IC
9. Applications of multiplexer and de-multiplexer
10. Design of 4-bit Synchronous counter and mod-n counter using flip-flops.
11. Design of 4-bit Asynchronous counter and mod-n counter using flip-flops
12. Design of Digital circuits using LabView
13. Basics of LabView
14. Design and study of Sequence Detector

Embedded Systems:

15. Interfacing LCD, Keypad, Relay and Buzzer - Renesas
16. ADC and DAC Programming in Renesas
17. RTOS - Interfacing DC motor and Stepper Motor to Renesas
18. RTOS - Interrupt, Timer and Event Counter Program - Renesas
19. Embedded Program Analysis – Static
20. Embedded Program Analysis – Dynamic
21. Multitasking algorithm - Application
22. Analysis and code optimization for an embedded system
23. CPU performance analysis

Digital Communications and Digital Signal Processing:

24. Design and Study of ASK modulation and Demodulation
25. Study of FSK, BPSK and DPCM modulation and Demodulation
26. Study of PAM, PWM, PCM
27. Study of DSP Toolbox in MATLAB.
28. Basic image processing using MATLAB
29. Generation of Basic Signals (unit impulse Signal, Step, Ramp, Exponential) Using Matlab
30. Generate Continuous Time and Discrete time sin/ cosine signal.
31. Compute Convolution, Correlation, Cross Correlation, Auto Correlation and Correlation Coefficient of a given Sequence data
32. DFT, IDFT and Inverse FFT of signal analysis
33. Find frequency response of a given system given in (Transfer Function/ Differential equation form).
34. Noise cancellation using adaptive filter

Semester	Course Code	Title of the Course	Hours / Week	Credits
1	25PEL1ES01A	**Discipline Specific Elective – 1:** Digital Signal Processing	4	3

Course Objectives
To introduce the fundamental concepts of discrete-time signals and systems, including sampling, classification, and operations on signals.
To familiarize students with Discrete Fourier Transform (DFT), its properties, and its application in frequency-domain analysis.
To develop an understanding of the Z-transform and its role in analyzing digital filters and system stability.
To explore the design and implementation of Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters.
To examine the principles of adaptive filters and their applications in system identification, noise cancellation, and prediction.

UNIT-I: Discrete Time Signals and Systems: (12 Hours)

Sampling Theorem- Sampling of Analog Signals – Various Types of Signals -Standard Discrete Time Signals – Classification of Discrete Time Signals – Basic Operations on DTS – Discrete Time Systems – LTI invariant System (Discrete Convolution) - Classification of DT LTI systems – DT Correlation.

UNIT-II: Discrete Fourier Transformation: (12 Hours)

Discrete Fourier Transform – Matrix Relation for Computing DFT and IDFT – Important Properties of DFT – Circular Convolution and its implementation – Linear Convolution from circular convolution –Decimation in Frequency FFT – Decimation in Time FFT – Radix -2 Inverse FFT – Frequency analysis of Known DT Signals.

UNIT-III: Z Transformation: (12 Hours)

The Z Transform – Properties of Z-Transform – The Inverse Z-Transform – Elements of a Digital Filters – Transfer Functions of a Difference Equation – The z-Plane Pole-Zero Plot.

UNIT-IV: Basics of Digital Filtering: (12 Hours)

FIR Filter Structure – Properties of Linear Phase FIR Filters –Window Design Techniques – Design of Linear Phase FIR Filter Using Window- Generic Equation for IIR Filter - Design of Low Pass IIR Butterworth Filter – Design of Low Pass Chebyshev Filter

UNIT-V: Adaptive Filters: (12 Hours)

Basic Adaptive Filter - System Identification - Noise Cancellation – Equalization - Adaptive Prediction - Computing the coefficients of an adaptive filter - The Steepest Decent Algorithm – LMS Adaptive Algorithm.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Alan V. Oppenheim and Ronald W. Schafer, *Digital Signal Processing*,
2. D.C. Reddy, (2009), *Biomedical Signal Processing Principles and Techniques*, The Tata-McGraw – Hill Publishing Company Ltd, New Delhi.
3. Dr. Shaila D. Apte, (2010), *Digital Signal Processing*, WILEY INDIA.
4. John G. Proakis, Dimitris G. Monolakis, (2011), *Digital Signal Processing Principals, Algorithms and Applications*, PEARSON.
5. K. Deergha Rao, M. N. S. Swamy, (2012), *Digital Signal Processing*, JAICO Publishing House.

Unit	Book	Chapter	Sections
I	1	2	Relevant sections
II	1	8	Relevant sections
III	1	3	Relevant sections
IV	1	7	Relevant sections
V	4	13	Relevant sections

Books for Reference:

1. Roberto Cristi, (2012), *Modern Digital Signal Processing*, CENGAGE Learning.
2. S. Salivhanan, *Digital Signal Processing,* IV Edition, McGraw-Hill
3. Vinay K. Ingle, John G. Proakis, (2012), *Essentials of Digital Signal Processing Using MATLAB,* CENGAGE Learning, Third Edition.
4. Willis J. Tompkins, (2000), *Biomedical Digital Signal Processing,* Prentice - Hall of India Pvt. Ltd.
5. Won Y. Yong, Tae G. Chang, IK H. Song, Yong S. Cho, J. Heo, Won G. Jeon, Jeong W. Lee, and Jae K. Kim, (2001), *Signals and Systems with MATLAB,* Springer International Edition.

Websites and eLearning Sources:

1. https://www.analog.com/en/design-center/landing-pages/001/beginners-guide-to-dsp.html
2. https://www.tutorialspoint.com/digital_signal_processing/index.htm
3. https://www.geeksforgeeks.org/what-is-z-transform/
4. https://web.ece.ucsb.edu/~yoga/courses/DSP/P9_Intro_Digital_Filters.pdf
5. https://www.mathworks.com/help/dsp/ug/overview-of-adaptive-filters-and-applications.html
   (* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Define and recall fundamental concepts of discrete-time signals, systems, Fourier transform, Z-transform, and filtering techniques.	**K1**
CO2	Explain the properties of DFT, Z-transform, and digital filters, and describe their significance in signal processing.	**K2**
CO3	Implement DFT, FFT, and Z-transform computations, and design FIR and IIR filters for specific applications.	**K3**
CO4	Compare and analyze different signal processing techniques, convolution methods, and adaptive filtering approaches.	**K4**
CO5	Assess system stability, evaluate digital filter performance, and determine the efficiency of adaptive filtering algorithms.	**K5**
CO6	Design and develop digital signal processing applications using FIR, IIR, and adaptive filtering techniques for real-world problems.	**K6**

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
1	**25PEL1ES01A**	**Discipline Specific Elective – 1:** Digital Signal Processing	**4**	**3**

Course Outcomes	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	3	2	2	2	3	3	2.3
CO2	2	3	2	2	3	2	2	2	2	3	2.3
CO3	2	2	2	2	2	2	3	2	3	3	2.3
CO4	2	2	2	2	3	2	3	2	3	2	2.3
CO5	2	2	2	3	2	2	2	2	3	3	2.3
CO6	2	2	2	3	2	2	3	2	3	3	2.4
										Mean Overall Score	**2.32 (High)**

Semester	Course Code	Title of the Course	Hours / Week	Credits
1	25PEL1ES01B	**Discipline Specific Elective – 1:** Advanced Digital Communication Systems	4	3

Course Objectives
To introduce the fundamental concepts of information theory, including entropy, channel capacity, and coding techniques.
To familiarize students with waveform coding techniques such as DPCM, Delta Modulation, and Line coding properties
To develop an understanding of baseband transmission techniques, ISI, Nyquist criterion, and receiver designs.
To explore digital modulation schemes like BPSK, BFSK, QPSK, and QAM, including their error performance
To analyze error control coding techniques, including block codes, convolutional codes, and the Viterbi decoding algorithm

UNIT-I: Information Theory: (12 Hours)

Digital Communication System - Discrete Memory less source, Information, Entropy – Discrete Memory less channels – Channel Capacity – Hartley – Shannon law – Source coding theorem – Shannon – Fano & Huffman codes.

UNIT-II: Waveform Coding & Representation: (12 Hours)

Prediction filtering and DPCM – Delta Modulation – ADPCM & ADM principles-Linear Predictive Coding-Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ

UNIT-III: Baseband Transmission & Reception: (12 Hours)

ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding – Eye pattern – Receiving Filters – Matched Filter, Correlation receiver, Adaptive Equalization.

UNIT-IV: Digital Modulation Scheme: (12 Hours)

Geometric Representation of signals – Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK – QAM – Carrier Synchronization – Structure of Non-coherent Receivers – Principle of DPSK.

UNIT-V: Error Control Coding: (12 Hours)

Channel coding theorem – Linear Block codes – Hamming codes – Cyclic codes – Convolutional codes – Viterbi Decoder.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. John G. Proakis, Masoud Salehi, (2014), *Digital Communication*, McGraw Hill Education Edition.
2. Amitabha Bhattacharya, (2006), *Digital Communication*, McGraw Hill Education (India) Pvt. Ltd.
3. Bernard Sklar, Pabitra Kumar Ray, (2014), *Digital Communications Fundamentals and Applications*, Pearson Education.
4. Simon Haykin, (2005), *Digital Communications*, John Wiley India.

Unit	Book	Chapter	Sections
I	1	1	Relevant sections
II	2	4	Relevant sections
III	2	4, 5	Relevant sections
IV	2	7	Relevant sections
V	1	7	Relevant sections

Books for Reference:

1. K. Sam Shanmugam, (2012), *Digital and Communication Systems*, Wiley-India.
2. Nishanth N, (2017), *Digital Communication*, Cengage Learning India.
3. Ramakrishna Rao, (2011), *Digital communication*, Tata McGraw Hill Education Pvt.
4. Simon Haykin, (2012) *Communication Systems*, 4/e Wiley India.
5. Sudakshina Kundu, (2010), *Analog and Digital Communications*, Pearson.

Websites and eLearning Sources:

1. https://www.sciencedirect.com/topics/engineering/digital-communication-system
2. https://www.tutorialspoint.com/digital_communication/digital_communication_quick_guide.htm
3. https://www.egr.msu.edu/~tongli/teaching/ece865/Introduction
4. https://www.electronicdesign.com/technologies/communications/article/21798737/electronic-design-understanding-modern-digital-modulation-techniques
5. https://www.site.uottawa.ca/~yongacog/courses/elg3175/Lecture18-19-AY-Coding.pdf

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Define key concepts in information theory, digital modulation, waveform coding, and error control techniques.	**K1**
CO2	Explain entropy, source coding, and modulation techniques, along with their impact on communication systems.	**K2**
CO3	Implement source coding algorithms, waveform coding techniques, and digital modulation schemes in communication systems.	**K3**
CO4	Compare and analyze the performance of different modulation schemes, channel coding techniques, and receiver designs.	**K4**
CO5	Assess the efficiency of various coding and modulation techniques in terms of bandwidth, power, and bit error rate (BER).	**K5**
CO6	Design and develop digital communication systems using suitable modulation, coding, and error correction techniques.	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
1	**25PEL1ES01B**		**Discipline Specific Elective – 1:** Advanced Digital Communication Systems							**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	3	2	3	2	3	3	2.4
CO2	2	3	2	2	3	2	2	2	2	3	2.3
CO3	2	2	3	3	2	2	3	2	2	3	2.4
CO4	2	2	2	2	1	2	3	2	3	2	2.2
CO5	2	2	2	3	2	2	2	3	1	1	2.2
CO6	2	2	2	3	2	2	3	2	3	2	2.3
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours / Week	Credits
1	25PEL1AE01	**Ability Enhancement Course:** Electronics Research and Entrepreneurship	2	1

Course Objectives
To learn the basic concept of Matrices and Vectors
To learn various industrial detection sensors and its interfacing
To learn to design data acquisition systems
To Acquire knowledge on business concept trend and economic analysis and develop idea generation, creative and innovative skill
To know industrial control techniques

UNIT-I: Mathematics I: (6 Hours)

Matrices and Vectors-Eigenvalues and eigenvectors-Gradient-divergence and curl-Line and surface integrals- Stroke's Theorem

UNIT-II: Mathematics II: (6 Hours)

Second order Ordinary Differential Equations with variable coefficients - Cauchy-Euler equation - Bessel functions and their properties- Introduction to Partial Differential Equations + Definition of Laplace transform and its electronics applications

UNIT-III: Logical Reasoning and Data Interpretation: (6 Hours)

Understanding the structure of arguments: Venn diagram: Analogies - Data Interpretation -Graphical representation

UNIT-IV: Foundation of ENTREPRENEUR Skills: (6 Hours)

Introduction importance and need for entrepreneurial skills, Innovation and Entrepreneurial Idea generation and Development, identifying business opportunities. Business Management Skills- Creative Thinking Skills: Creating and Sustaining Enterprising model- Strategic Thinking and Planning skills.

UNIT-V: Troubleshooting skills: (6 Hours)

Identification of problems – understanding the symptoms – causes for the problems – analysing the solutions – implementing the solutions – testing and validation – Troubleshooting by observing the signals (voltage measurement, current measurement, resistance measurement, waveform, …) – case study (troubleshooting an electronic device)

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Erwin Kreyszig, Tenth Edition (2011), *Advanced Engineering Mathematics*, Wiley Plus.
2. Nishit K. Sinha, Sixth Edition (2019), *Logical Reasoning and Data Interpretation for CAT*, Pearson Education
3. Christopher Warburton and Steven Bookman, (2007), *Basic college Research Skills*, University Press of America
4. Ramachandran, Entrepreneurship Development, Mc Graw Hill
5. Text prepared by the Department

Unit	Book	Chapter	Sections
I	1	7, 8	Relevant Sections
II	1	2	Relevant Sections
III	2	Part 1, 2	Relevant Sections
IV	4	1	Relevant Sections
V	5	1	All

Books for Reference:

1. John Bird, sixth edition (2010), *Higher Engineering mathematics*, Elsevier.
2. Daniel R. Tomal, Ph.D. Aram S. Agajanian, Ph.D., Fourth Edition (2014), *Electronic Troubleshooting*, Mc Graw Hill Education.
3. C.R. Kothari and Gaurav Garg, Fourth Edition (2019), *Research Methodology*, New Age International Publishers
4. Fayolle A (2007) Entrepreneurship and new value creation, Cambridge, Cambridge university Press www.icmai.in Entrepreneurial Skills Nieuwenhuizen https://www.google.co.in/.

Websites and eLearning Sources:

1. https://www.niti.gov.in/innovation-and-entrepreneurship-sustainable-growth
2. http://www.untag-smd.ac.id/files/Perpustakaan_Digital_1/ENTREPRENEURSHIP%20Innovation%20and%20entrepreneurship.PDF
3. https://www.globalknowledge.com/us-en/resources/resource-library/articles/4-tips-to-strengthen-your-troubleshooting-skills/
4. https://cleverism.com/skills-and-tools/troubleshooting/
5. https://www.universityofgalway.ie/academic-skills/readingandresearch/#:~:text=Research%20skills%20refer%20to%20the,relevant%20to%20a%20particular%20topic.

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Basic mathematics for electronics understanding	**K1**
CO2	Understand logical reasoning and research methods	**K2**
CO3	Apply the reasoning and research in electronics	**K3**
CO4	Understand the importance of entrepreneurial skills and values in life and society	**K4**
CO5	Evaluate the symptoms	**K5**
CO6	Trouble shoot the electronic circuits	**K6**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**							**Hours**	**Credits**	
1	**25PEL1AE01**	**Ability Enhancement Course:** Electronics Research and Entrepreneurship							**2**	**1**	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	3	2	3	3	3	3	2.5
CO2	2	3	2	3	3	2	2	3	3	3	2.6
CO3	2	2	3	3	2	2	3	2	2	3	2.4
CO4	2	2	2	3	3	2	3	2	3	2	2.4
CO5	2	2	2	3	2	2	2	3	3	3	2.4
CO6	2	2	3	3	3	2	3	2	3	2	2.5
Mean Overall Score											**2.46 (HIGH)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	25PEL1OE01	**Open Elective - 1 (WS):** Electronics Media	4	2

Course Objectives
To Provide an understanding of electronic media evolution, broadcasting technologies, and media management.
Introduce the fundamentals of broadcasting, including analog and digital transmission in radio and television.
Explain transmission standards and reception systems, emphasizing modern digital technologies.
Explore mobile and emerging technologies like streaming, peer-to-peer distribution, and geo-spatial technology.
Familiarize students with media input and output systems, including microphones, mixing consoles, and display devices.

UNIT-I: Introduction to Electronic in Media (12 Hours)

An overview of electronic media: management – Skills, roles, and functions-electronic media industries - Evolution of Applied Electronics in Media. Development of broadcasting - Rise of the internet and deployment of broadband services – Leading to dramatic changes in telecommunication industry – Developments and changes in new media – Telephony to radio Mobile radio to visual radio – Geo-stationary satellites – Direct broadcasting satellites, narrowcasting, cable television, DTH - Public addressing system.

UNIT-II: Broadcasting Basics (12 Hours)

Analog radio, Digital radio, satellite radio, Audio blogging – RSS – Pod safe music – Analog television – Digital television – Cable television – Working principle of video camera – Consoles, Video hosting / Download services – Internet radio and television – Digital media production – Sound and vision – Image capture techniques – Web-based social interaction.

UNIT-III: Transmission Standards and Systems (12 Hours)

NTSC, PAL, SECAM, IPTV, HDTV, ATSC Digital television – Transmission / Reception lines and other equipment – Various modes of receiving systems – FM and TV antenna towers – Translators and repeaters – Transmitter remote controls – Mobile phone media production: SMS, MMS, Mobile phone media delivery – Streaming and video on demand.

UNIT-IV: Mobile and Emergent Technologies (12 Hours)

Information technology: Computer storage, Computer networks, Internet streaming, Web Streaming, Audio and video streaming, Flash streaming, MP3 streaming (radio), Peer to Peer distribution – Digital video broadcasting via satellite services to handhelds (DVB-SH) Technology, Geo-spatial technology, Wi-fi and Wi-Max, podcasting, i-Pod, Information superhighways, Interactive portals.

UNIT-V: Media Input /Output Systems (12 Hours)

Microphones- types - Mixing console - special effects units – equalizers - compressors - output devices - The Sound Recording Room-Display: LCD, LED, Plasma screens, IPOD, PDAs, Multimedia projectors, - Speakers, Active and passive speakers - Home theater network - connection diagram - types of cables, DolBy, DTS, CUBE. - Mobile devices for e-portfolios - Mobile devices in the classroom

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Graham Jones (2005). *A Broadcast Engineering Tutorial for Non-Engineers*, Focal Press.
2. Study Material prepared by the department

Unit	Book	Chapter	Sections
I	2	1	all
II	1	2, 3	all
III	1	5, 12, 14, 15	all
IV	2	2	all
V	2	3	all

Books for Reference:

1. E.P.J. Tozer. (2004), *Broadcasting Engineering Reference Book*, Focal Press.
2. Borko Furht and Syed A. Ahson. (2008), *Handbook of Mobile Broadcasting*, Taylor & Francis.
3. Brian Winston. (2000), *Media Technology and Society: A History from the Telegraph to the Internet*, Rutledge.

Websites and eLearning Sources:

1. https://www.docsity.com/en/introduction-to-electronic-media-lecture-notes-jmc-
2. 1011/6267953/
3. https://www.tvwithoutborders.com/tutorials/dtv_intro/broadcast-engineering-basics/
4. https://www.eeeguide.com/television-systems-and-standards/
5. https://www.tutorialspoint.com/emerging-technologies-of-2017

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Recall the fundamental concepts of electronic media, broadcasting, and telecommunications evolution**.**	**K1**
CO2	Explain the working principles of broadcasting systems, including analog and digital radio and television.	**K2**
CO3	Apply transmission standards and reception techniques for digital communication and signal processing.	**K3**
CO4	Analyze emerging technologies such as web streaming, mobile media production, and geo-spatial applications.	**K4**
CO5	Evaluate the effectiveness of media input/output systems like microphones, display screens, and sound equipment	**K5**
CO6	Develop innovative broadcasting solutions and integrate new media **t**echnologie**s** in electronic communication.	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
1	**25PEL1OE01**		**Open Elective - 1 (WS):** Electronics Media							**4**	**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	3	3	2	2	2	3	3	2.4
CO2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2
CO4	2	2	3	3	3	2	2	2	3	3	2.5
CO5	2	2	3	3	3	2	2	3	3	3	2.6
CO6	2	2	2	2	2	2	2	3	2	2	2.1
										Mean Overall Score	**2.27 (High)**

Semester	Course Code	Title of the Course	Hours/ Weeks	Credits
1	25PGC1SL01	Global Citizenship Education	Online	1

Course Objectives
To develop an understanding of global governance structures, rights and responsibilities.
To recognize and respect differences, multiple identities and diversity.
To examine beliefs and perceptions about social justice, equality and civic engagement.
To develop attitudes of care and empathy for others and the environment.
To develop global competence and ethical considerations by enhancing communication and collaboration skills across cultures

UNIT I: Introduction to Global Citizenship

01. Historical and Philosophical Foundations of Global Citizenship
02 Rights and Responsibilities of Global Citizenship
03. Key Organizations and Movements Promoting Global Citizenship

UNIT II: Globalization and Its Impact on Society

04. Globalization and Its Key Drivers
05. Positive and Negative Impacts of Globalization
06. Role of Education in Fostering a Global Perspective

UNIT III: Human Rights, Social Justice, Equality and Diversity

07. Key Human Rights Treaties, Frameworks and Declarations
08. Advocacy, Activism, and Movements for Social Justice and Equality
09. Global Challenges to Human Rights, Equality and Diversity

UNIT IV: Sustainable Development and Environmental Responsibility

10. The Sustainable Development Goals and Their Relevance to Global Citizenship
11. Climate Change, Environmental Degradation and Sustainable Development
12. Strategies for Promoting Environmental Responsibility

UNIT V: Building Global Competence and Engagement

13. Effective Communication and Collaboration Across Cultures
14. Volunteering and Community Engagement in Global Initiatives
15. Ethical Considerations in Global Citizenship

Teaching Methodology	Recorded Lectures/Videos, Reading Materials, PPTs, Case Studies, Collaborative Projects, Quizzes and Polls
Assessment Methods	Seminars, Assignments, MCQs, Reflection Essays, Group Project Presentations, Problem-Solving Scenarios

Books for Study:

1. Clapham, A. (2007). *Human rights: A very short introduction.* Oxford University Press.
2. Desai, A. (2018). *Global citizenship and cultural diplomacy: India's role in a changing world*. Routledge India.
3. Gould, J. A. (2012). *The ethics of global citizenship*. Routledge.
4. Held, D., et al. (2022). *Globalization and its impact on the developing world*. Cambridge University Press.
5. Sen, A. (2009). *The idea of justice*. Penguin Books India.

Books for Reference:

1. Ghosh, A. (2007). *The global impact of Indian civilization*. HarperCollins India.
2. Krecker, E. (2008). *The global citizen: A guide to creating an international life and career*. Career Press.
3. Kumar, R. (2017). *Sustainable development and environmental justice in India*. Oxford University Press.
4. Nair, K. G. (2014). *Human rights: A socio-political perspective*. Orient Blackswan.

5. Patel, V. (2015). *Social justice and equality in India: Theories and practices*. Oxford University Press.
6. Pillai, V. (2016). *Globalization and its impact on Indian society*. SAGE Publications India.

Websites and eLearning Sources:

1. https://www.unesco.org/en/global-citizenship-peace-education/need-know
2. TEDxCincinnati: Global Citizenship in the Classroom: Jenny Buccos at TEDxCincinnati https://www.youtube.com/watch?v=6jjLHmyBs7o
3. Social justice -- is it still relevant in the 21st century? | Charles L. Robbins | TEDxSBU https://www.youtube.com/watch?v=Wtroop739uU
4. Are We the Last Generation — or the First Sustainable One? | Hannah Ritchie | TED https://www.youtube.com/watch?v=Kl3VVrggKz4
5. Diversity, Equity & Inclusion. Learning how to get it right | Asif Sadiq | TEDxCroydon https://www.youtube.com/watch?v=HR4wz1b54hw

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	Recall the historical, philosophical and practical foundations of global citizenship.	**K1**
CO2	Explain the key drivers of globalization and the role of education in fostering a global perspective.	**K2**
CO3	Apply human rights frameworks, social justice principles, and advocacy strategies to real-world challenges.	**K3**
CO4	Analyze the relevance of the Sustainable Development Goals in addressing climate change and environmental degradation.	**K4**
CO5	Develop strategies for fostering global competence by enhancing communication and collaboration skills across cultures.	**K5**
CO6	Critically evaluate the effectiveness of current global strategies and policies in addressing social justice and environmental sustainability.	**K6**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25PEL2CC03	**Core Course - 3:** Automotive Electronics	5	4

Course Objectives
To describe the fundamentals of electronic engine control and fuel management systems in automobiles
To explain the working principles of automotive sensors, actuators, and their role in vehicle control systems
To apply digital powertrain control strategies, including fuel control, EGR, and turbocharging for engine optimization
To analyze vehicle motion control systems, including cruise control, and electronic steering for improved performance
To evaluate in-vehicle communication protocols like CAN, LIN, and FlexRay for automotive networking and synthesize safety and communication systems, such as ADAS, GPS navigation, and autonomous driving technologies

UNIT-I: Basics of Automotive Electronics (15 Hours)

Introduction to Electronic systems in Automotives - The Basics of Electronic Engine Control Concept of an Electronic Engine Control System - Definition of Engine Performance Terms (Torque, Power, Fuel Consumption, Engine Overall Efficiency, Calibration, Engine Mapping)- Electronic Fuel Control System- Analysis of Intake Manifold Pressure- Idle Speed Control - Electronic Ignition - ECM

UNIT-II: Sensors and Actuators (15 Hours)

Automotive Control System Applications of Sensors and Actuators- Airflow Rate Sensor - Pressure Measurement -Throttle Angle Sensor- Temperature Sensors- Typical Coolant Sensor Sensors for Feedback Control- Knock Sensors- Angular Rate Sensor- LIDAR- Digital Video Camera- Flex-Fuel Sensor- Automotive Engine Control Actuators- Variable Valve Timing Electric Motor Actuators- Stepper Motors- Ignition System.

UNIT-III: Digital Powertrain Control Systems (15 Hours)

Control Modes for Fuel Control- Discrete Time Idle Speed Control- EGR Control Turbocharging- Integrated Engine Control System- Automatic System Adjustment- System Diagnosis- Summary of Control Modes.

UNIT-IV: Vehicle Motion Controls and Automotive Instrumentation (15 Hours)

Cruise Control Electronics - Stepper Motor-based Actuator Electronics- Antilock Braking System - Electronic Suspension Control System- Electronic Steering Control- Modern Automotive Instrumentation- Input and Output Signal Conversion- Advantages of Computer Based Instrumentation- Measurement Examples- Fuel Quantity- Coolant Temperature- Oil Pressure- Vehicle Speed- Trip Information Function of the System

Unit-V: E Vehicle Communications (15 Hours)

IVN- CAN- Local Interconnect Network (LIN)- FlexRay IVN- MOST IVN- Vehicle to Infrastructure Communication- Vehicle-to-Cellular Infrastructure- Quadrature Phase Shifter and Phase Modulation (QPSR)- Short-Range Wireless Communications- Satellite Vehicle Communication- GPS Navigation- Safety Aspects of Vehicle-to-Infrastructure Communication- Electronic Safety-Related Systems- Airbag Safety Device- Blind Spot Detection- Automatic Collision Avoidance System- Lane Departure Monitor – Advanced driver-assistance systems (ADAS) – Software Defined Vehicle (SDV).

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. William B. Ribbens (2017), *Understanding Automotive Electronics* (8th Edition), Butterworth Heinemann Woburn.

Unit	Book	Chapter	Sections
I	1	4	all
II	1	5	all
III	1	6	all
IV	1	7, 8	all
V	1	9, 10	all

Books for Reference:

1. James Larminie and John Lowry (2003), *Electric Vehicle Technology Explained*, John Wiley and Sons.
2. Robert Bosch (2000), *Automotive Hand Book* (5th edition), SAE.
3. Al Santini (2013), *Automotive Electricity and Electronics*, Cengage Learning.

Websites and eLearning Sources:

1. https://www.tutorialspoint.com/difference-between-sensors-and-actuators
2. https://www.udemy.com/course/automotive-engineering-digital-powertrain-controlsystems/
3. https://www.speedgoat.com/products-services/i-o-connectivity/protocols/can-fd
4. https://www.elprocus.com/automotive-electronics-and-its-innovations/
5. https://www.techtarget.com/iotagenda/definition/vehicle-to-vehicle-communicationV2V-communication

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements	Cognitive Level (K- level)
	On successful completion of this course, students will be able to	
CO1	Acquire the basics of automotive sensors, controls and network protocols	**K1**
CO2	Understand the concepts of Automotive Electronics	**K2**
CO3	Apply various protocols for automotive control and communication networks	**K3**
CO4	Analyze the Sensors and Actuators of Automotive Electronics Instrumentation	**K4**
CO5	Evaluate Digital Powertrain Control Systems	**K5**
CO6	Create next generation Electric Vehicle Technology System	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours**		**Credits**
2	**25PEL2CC03**		**Core Course - 3:** Automotive Electronics						**5**		**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	2	2	3	2	2	3	2.3
CO2	2	3	2	3	2	2	2	3	2	3	2.4
CO3	3	3	3	2	2	3	3	3	2	2	2.6
CO4	2	2	3	2	1	3	3	3	3	3	2.5
CO5	2	2	3	2	1	3	3	3	3	3	2.5
CO6	2	3	2	2	2	3	3	2	3	3	2.5
Mean Overall Score											**2.46 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	**25PEL2CC04**	**Core Course - 4:** Embedded Systems Design and Programming – 2 (Internship Embedded Course)	**5**	**4**

Course Objectives
To describe the features of microcontrollers
To understand the architecture of microcontrollers and embedded Linux
To solve domestic and industrial problems with embedded systems
To analyse the functions of embedded systems
To recommend the microcontroller, embedded systems and create an embedded systems for domestic and industrial needs

UNIT-I: Arduino Embedded System (15 Hours)

AVR architecture - Atmega328p features – architecture – Arduino features – Arduino I/O – Arduino peripheral blocks – Arduino IDE – Arduino language - simple programs

UNIT-II: CORTEX-M CORTEX-R Microcontrollers (15 Hours)

LPC2148 features – Architecture – Pinout and description – Development board – ARM Keil IDE – Simple applications - ARM Cortex M85 Architecture and features - ARM Cortex R82 Architecture and features

UNIT-III: STM32F103C8 Embedded System (15 Hours)

Features – Architecture – Pinout and Pin description – memory mapping – Development board – STM32Cube – Architecture – Firmware package – Simple applications

UNIT-IV: Embedded Linux (15 Hours)

Embedded Linux Fundamentals –Embedded Linux Commands - VI Editors –Kernel - Kernel Module Vs Application - Device Driver - The Role of Device Driver - Types of Device Driver - Character Driver - Block Driver and Network Driver

UNIT-V: Embedded System Design (15 Hours)

Train controller – FIR filter - Data compressor – Audio player – Digital Still camera – Engine Control Unit – Air quality monitoring system

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Study Material prepared by the department
2. Marilyn Wolf (2012), *Computers as Components Principles of Embedded Computing System Design* (3rd edition), Elsevier.

Unit	Book	Chapter	Sections
I	1	1	All
II	1	2	All
III	1	3	All
IV	1	4	All
V	2	1-6	E.g., 1.4, 2.1, 3.8, 4.9, 5.12, 6.11

Books for Reference:

1. Data sheet - Atmega328p, LPC2148, Cortex M85, Cortex R82, STM32F103C8, stm32cubef1
2. www.arduino.cc
3. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef and Philippe Gerum (2008), *Building Embedded Linux Systems* (2nd Edition), O'Reilly Media.

Websites and eLearning Sources:

1. https://www.arduino.cc/reference/en/
2. https://www.arm.com/products/silicon-ip-cpu/cortex-m/cortex-m85
3.https://www.st.com/
4. https://ubuntu.com/blog/what-is-embedded-linux
5. https://www.techopedia.com/definition/29946/embedded-linux

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements	Cognitive Level (K- level)
	On successful completion of this course, students will be able to	
CO1	Describe the architecture and different modes of operations of a microcontroller and Cortex-M processor	**K1**
CO2	Outline and restate the microcontroller programs	**K2**
CO3	Analyze the implementation of Microcontrollers in various applications	**K3**
CO4	Identify requirements of RTOS and IoT in applications	**K4**
CO5	Asses and develop programming skill for an embedded system	**K5**
CO6	Design and construct embedded system with Arduino, Cortex-M Processor and IoT	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**				**Hours**			**Credits**
2	**25PEL2CC04**			**Core Course - 4:** Embedded Systems Design and Programming – 2 (Internship Embedded Course)				**5**			**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	3	2	3	3	3	3	2.5
CO2	2	2	2	3	3	3	3	2	3	3	2.6
CO3	2	2	3	3	2	2	3	3	2	3	2.5
CO4	2	2	3	2	3	2	3	2	3	2	2.4
CO5	2	2	3	3	2	2	2	3	3	3	2.5
CO6	2	3	3	2	3	2	2	3	3	2	2.5
Mean Overall Score											**2.5 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25PEL2CC05	**Core Course - 5:** Design of Analog Circuits	4	3

Course Objectives
To describe PCB layout issues, inductance effects, and high-speed circuit considerations
To apply analog circuit design principles in ADC/DAC implementations and sensor signal conditioning
To analyze noise sources in electronic circuits and evaluate their impact on circuit performance
To decide appropriate analog circuits for real-world applications, including filters and signal processing.
To synthesize high-performance analog circuits for applications like sensor interfaces and communication systems.

UNIT-I: Review of Passive Components in PCB Layout (12 Hours)

PCB layout issues-approximate inductance of a PCB trace above a ground plane Design case study high-speed semiconductor laser diode driver –low and high frequency response analysis of single stage amplifier

UNIT-II: Feedback Control and Operational Amplifiers (12 Hours)

Negative feedback amplifier- Lead and lag networks - feedback loop Photodiode amplifier – MOSFET current source - Ideal V/I source - capacitive load compensation - model to investigate overshoot
Operational amplifier circuits: voltage follower - amplifying Analog signals - current to voltage conversion - instrumentation amplifier - floating current source - amplifier design pitfalls.

UNIT-III: ADC and DAC Design (12 Hours)

Basics of Analog design - key specifications - CMOS SAR topology - delta sigma converters - classes of input signal - Temperature sensor signal chains - using RTD for temperature sensing -signal conditioning circuits of RTD based temperature sensor - piezoresistive pressure sensor-signal conditioning and allied circuits - photo diode and photo sensing signal conditioning path using a SAR ADC. PWM as DAC - changing digital signal to Analog - DAC - comparator for conversion - combining comparator with timer - delta sigma ADC implementation - Error analysis - voltage reference and input voltages.

UNIT-IV: Noise: (12 Hours)

Types of Noise – Evaluation of noise in a circuit - device noise – resistor noise - amplifier noise - ADC noise - power supply noise

UNIT-V: Analog Filter Design (12 Hours)

Low pass filter - Normalization and denormalization-poles and zeros - Active low pass filter - frequency dependent negative resistance filter - High pass filter- Op-amp requirement for filter design - Gyrator filters - Band pass filter and band reject filter.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Book for Study:

1. Robert A. Pease, *Analog Circuits: world class designs*, 3rd edition, Elsevier's Science & Technology, 2008.

Unit	Book	Chapter	Sections
I	1	5	all
II	1	2,3	Specified sections
III	1	13	Specified sections
IV	1	8	Specified sections
V	1	6,7,10,11	Specified sections

Book for Reference:

1. Peter D. Hiscocks, *Analog Circuit Design*, Second Edition, Peter D. Hiscocks, 2011

2. Jim Williams, *The Art and Science of Analog Circuit Design*, 1st Edition, Butterworth –Heinemann, 1998.
3. Bob Dobkin and Jim Williams, *Analog Circuit Design*, 1st Edition, Elsevier, 2011.

Websites and eLearning Sources:

1. https://www.ti.com/design-resources/design-tools-simulation/analog-circuits/amplifier-circuits.html
2. https://www.sciencedirect.com/topics/engineering/analog-circuit-design
3. https://hardwarebee.com/step-by-step-guide-analog-design/
4. https://www.analog.com/media/en/training-seminars/design-handbooks/Basic-Linear-Design/Chapter12.pdf
5. https://www.ti.com/lit/an/slyt191/slyt191.pdf?ts=1655207502203&ref_url=https%253A%252F%252Fwww.google.com%252F

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements	Cognitive Level (K- level)
	On successful completion of this course, students will be able to	
CO1	Acquire the design fundamentals of Analog Circuits	**K1**
CO2	describe analog circuits of various applications	**K2**
CO3	Apply the theory to study the performance of Analog Circuits	**K3**
CO4	Analyze the working of analog circuits	**K4**
CO5	Decide the Analog Circuits for real applications	**K5**
CO6	Synthesize the Analog Circuits for real applications	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**25PEL2CC05**			**Core Course - 5:** Design of Analog Circuits					**4**		**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	2	3	2	2	3	3	2.5
CO2	3	2	3	2	2	3	3	2	2	2	2.4
CO3	3	2	2	2	3	3	3	2	2	2	2.4
CO4	3	2	2	3	2	3	3	2	2	3	2.5
CO5	3	2	2	3	2	3	3	2	2	2	2.4
CO6	3	2	2	3	2	3	2	2	3	3	2.5
Mean Overall Score											**2.44 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	**25PEL2CP02**	**Core Practical - 2:** Automotive Sensors and Embedded System	**8**	**5**

Any 16 Experiments

1. Design of buck boost regulator.
2. Analog Filter Design
3. Phototransistor and Opto TRIAC, TSOP 17 photo modules for PCM remote control system
4. PV system assembling for 12 V load.
5. Study of PWM charge controller for solar.
6. MOC3041 zero cross opt isolators and TL173L linear hall effect sensor and KMZ51
7. LM35, RTD, Thermistor, DS18S20 / DS18B20
8. Automotive Sensors characteristics
9. Magnetic field sensor, Pressure, Vibration and A1425 analog speed sensors
10. Study of E-Vehicle
11. Design of simple cruise control
12. MEMS sensors performances – BP, Heartbeat, ….
13. Sinewave generation and Acoustic echo cancellation using TMS320C54
14. ADC, DAC, RTC and PWM – STM32F103
15. Interrupt and Timer in LPC2148 – Stratify OS
16. Characteristics of Antennas
17. DTFT signal – SCILAB
18. Delta modulation - MATLAB
19. Audio analysis – MATLAB
20. Design of transducer – light, sound and temperature
21. Process control – SCADA
22. Analysis of Pulse Code Modulation
23. Edge Detection using MATLAB
24. Basic CCS programming
25. Design of Traffic Light Controller
26. Interfacing Temperature Sensor to Renesas
27. Design of CAN
28. I2C communication - Application
29. Embedded Linux programming
30. FIR and IIR filter design

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	25PEL2OE02	**Open Elective - 2 (BS):** Computer Hardware and Networks	4	2

Course Objectives
To describe the architecture and components of a computer, including motherboards, chipsets, and expansion cards
To explain the BIOS, boot process, and system startup sequence, including BIOS updates and troubleshooting
To apply memory installation and configuration techniques, including RAM, cache, and logical memory management
To analyze hard disk drive construction, interfaces, transfer protocols, and disk management techniques
To evaluate network structures, topologies, and configurations, including wireless networking and security aspects and configure a PC for networking by setting up network adapters, addressing schemes, and Bluetooth connections

UNIT-I: Computer Architecture (12 Hours)

Basic block of a computer- Motherboard designs-motherboard form factors-components of motherboard-upgrading a motherboard- Chipsets and controllers- socket type- north bridge and south bridge- processor generations- controller chips-chipset function-intel and non-intel chipsets. Expansion cards.

UNIT-II: BIOS and Boot Process (12 Hours)

Introduction to BIOS-BIOS utilities and programs-BIOS manufacturers-Booting sequence cold boot versus warm boot-POST process-BIOS start-up screen-system configuration summary. BIOS updates and flash BIOS-flashing dangers-dealing with a corrupt BIOS-boot block.

UNIT-III: Computer Memory (12 Hours)

Brief overview of ROM-CMOS-RAM-RAM types-matching memory to the motherboard Logical memory configuration-Dealing with memory errors-Installing memory modules in a PC-Installing SIMM and DIMM-Configuring the PC for memory-Removing a memory module-installing a cache module-Enabling the internal and external cache.

UNIT-IV: Hard Disk Drive (12 Hours)

Construction of HDD-Interfaces-ST506/412-ESDI-IDE-SCSI-FC-AL-system bus interface Transfer protocols- formatting the disk-partitioning the hard disk-disk space requirements-Disk compression –RAID.

UNIT-V: Network and Communication (12 Hours)

Network basics-network structure-network components-Servers-Cabling-Network Devices Network topologies-network addressing-configuring a pc for network connection-wireless networking-access point and network adapters-Bluetooth.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Ron Gilster (2001), *PC hardware: A beginner's guide*, McGraw Hill.

Unit	Book	Chapter	Sections
I	1	1	All
II	1	2	All
III	1	4, 5	All
IV	1	10, 11	All
V	1	17, 18	All

Books for Reference:

1. Joel Z. Rosenthal, Kevin Jay Irwin (2003), *PC Repair and Maintenance: A Practical Guide*, Charles River Media publishers.
2. Dylan Mach (2019), *Networking for Beginners*, independently published.
3. Kevin Wilson (2018), *Computer hardware*, independently published.

Websites and eLearning Sources:

1. https://www.geeksforgeeks.org/difference-between-hardware-and-networking/
2. https://www.toolbox.com/tech/networking/articles/what-is-network-hardware/
3. https://www.tutorialspoint.com/Basic-Network-Hardware
4. https://www.youtube.com/watch?v=maG8gHMLfl4
5. https://www.crucial.com/articles/pc-builders/what-is-computer-hardware

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements	Cognitive Level (K- level)
	On successful completion of this course, students will be able to	
CO1	Acquire the basics of computer peripherals	**K1**
CO2	Explain the functions of each component in the computer	**K2**
CO3	Operate the computer by installing the Operating System	**K3**
CO4	Analyze the symptoms of a computer faults	**K4**
CO5	Decide a suitable configuration for a task	**K5**
CO6	Plan a suitable configuration for a task	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours/Week**		**Credits**
2	**25PEL2OE02**			**Open Elective - 2 (BS):** Computer Hardware and Networks					**4**		**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	2	3	2	2	2	2	2.2
CO2	2	3	2	3	2	3	2	2	2	2	2.3
CO3	2	3	2	3	2	3	2	2	3	2	2.4
CO4	2	3	2	3	2	2	2	2	3	3	2.4
CO5	3	2	2	2	2	3	2	2	2	2	2.2
CO6	2	2	2	3	3	1	2	2	3	2	2.2
Mean Overall Score											**2.28 (High)**

Semester	Course Code	Title of the Course	Hours/ Weeks	Credits
2	25PSS2SE01	**Skill Enhancement Course:** Soft Skills	4	2

Course Objectives
To provide a focused training on soft skills for students in colleges for better job prospects
To communicate effectively and professionally
To help the students take active part in group dynamics
To familiarize students with numeracy skills for quick problem solving
To make the students appraise themselves and assess others

Unit I: Effective Communication & Professional Communication (12 Hours)

Definition of communication - Barriers of Communication - Non-verbal Communication. Effective Communication - Conversation Techniques - Good manners and Etiquettes - Speech Preparations & Presentations - Professional Communication.

Unit II: Resume Writing & Interview Skills (12 Hours)

Resume Writing: What is a résumé? Types of résumés – Chronological - Functional and Mixed Resume - Purpose and Structure of a Resume - Model Resume.

Interview Skills: Types of Interviews - Preparation for an interview – Attire - Body Language - Common interview questions - Mock interviews & Practicum.

Unit III: Group Discussion & Personal effectiveness (12 Hours)

Basics of Group Discussion- Parameters of GD- Topics for Practice - Mock GD & Practicum & Team Building. *Personal Effectiveness*: Self Discovery - Goal Setting with questionnaires & Exercises.

Unit IV: Numerical Ability (12 Hours)

Introducing concepts - Average – Percentage - Profit and Loss - Simple Interest - Compound Interest - Time and Work - Pipes and Cisterns.

Unit V: Test of Reasoning (12 Hours)

Introducing Verbal Reasoning: Series Completion – Analogy - Data Sufficiency - Assertion and Reasoning and Logical Deduction. *Non-Verbal Reasoning*: Series - and Classification.

Teaching Methodology	Chalk and talk, PPT, Mathematical models, Video presentation

Books for Study:

1. Melchias G., Balaiah, J. & Joy, J. L. (Eds). (2018). Winner in the Making: A Primer on soft Skills. Trichy, India: St. Joseph's College.

Books for Reference:

1. Aggarwal, R. S. (2010). A Modern Approach to Verbal and Non- Verbal Reasoning. S. Chand.
2. Covey, S. (2004). 7 Habits of Highly effective people. Free Press.
3. Gerard, E. (1994). The Skilled Helper (5th Ed.). Brooks/Cole.
4. Khera, S. (2003). You Can Win. Macmillan Books.
5. Murphy, R. (1998). Essential English Grammar, (2nd Ed.). Cambridge University Press.
6. Sankaran, K., & Kumar, M. (2010). Group Discussion and Public Speaking (5th Ed.). M.I. Publications.
7. Trishna, K. S. (2012). How to do well in GDS & Interviews? (3rd Ed.). Pearson Education.
8. Yate, M. (2005). Hiring the Best: A Manager 's Guide to Effective Interviewing and Recruiting

Websites and eLearning Sources:

1. https://www.indeed.com/career-advice/resumes-cover-letters/communication-skills
2. https://www.seek.com.au/career-advice/article/50-communication-skills-for-the-workplace-your-resume
3. https://southeast.iu.edu/career/files/power-phrases.pdf
4. https://dese.ade.arkansas.gov/Files/20201209124449_Professional-Communication.docx

5. https://www.dol.gov/sites/dolgov/files/ETA/publications/00-wes.pdf
6. https://www.tmu.ac.in/other_websites/cdoe.tmu.ac.in.old/study-material/28-08-2024/COMMON/SEMESTER_2/MAIN_SOFT_SKILLS.pdf
7. https://byjus.com/maths/profit-and-loss-questions/
8. https://www.indiabix.com/

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, students will be able to	
CO1	Recall various soft skill sets	**K1**
CO2	Understand personal effectiveness in any managerial positions	**K2**
CO3	Apply verbal and non-verbal reasoning skills to solve problems	**K3**
CO4	Differentiate problems at work and home; and design solutions to maintain work-life balance	**K4**
CO5	Assess growth and sustainability and infuse creativity in employment that increases professional productivity	**K5**
CO6	Construct plans and strategies to work for better human society	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
2	**25PSS2SE01**		**Skill Enhancement Course:** Soft Skills							**4**	**2**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	2	3	2	3	2.7
CO2	3	3	3	2	3	3	3	3	3	3	2.9
CO3	3	2	2	3	3	3	3	3	3	3	2.8
CO4	3	3	2	2	3	3	3	3	3	3	2.8
CO5	3	3	3	2	2	3	3	3	3	3	2.8
CO6	3	3	3	2	2	3	3	3	3	3	2.8
										Mean Overall Score	**2.8 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25PEL3CC06	**Core Course - 6:** VLSI Design and VERILOG Programming	5	4

Course Objectives
To familiarize with Low-Power Design Methodologies used in VLSI
To enrich the knowledge of MOS Transistors and Inverters.
To apply the fundamental concepts of FPGA for various applications
To explore various ideas about Scaling Factors and Testing Supply Voltage Scaling for Low Power.
To design and build simple circuits, simulate using Xilinx IDE and testing digital circuits using Verilog AMS

UNIT-I: Low Power VLSI Technology (15 Hours)

Introduction - Low-Power Design Methodologies - MOS Fabrication Technology - Basic Fabrication Processes - NMOS Fabrication Steps- CMOS Fabrication Steps- Latch-Up Problem and Its Prevention- Short-Channel Effects - Design rules and layout diagram – Lambda based design rules.

UNIT-II: MOS Transistors and Inverters (15 Hours)

Introduction- MOS Transistors- the Structure of MOS Transistors- The Fluid Model- Modes of Operation of MOS Transistors-Electrical Characteristics of MOS Transistors- MOS Transistors as a Switch -MOS Inverters- Inverter and Its Characteristics- MOS Inverter Configurations- Switching Characteristics- Delay Parameters- Driving Large Capacitive Loads.

UNIT- III: Supply Voltage Scaling for Low Power (15 Hours)

Introduction- Device Feature Size Scaling- Architectural-Level Approaches- Voltage Scaling Using High-Level Transformations - Multilevel Voltage Scaling- Challenges in MVS Dynamic Voltage and Frequency Scaling- Adaptive Voltage Scaling- Subthreshold Logic Circuits

UNIT-IV: Basic Concepts of FPGA (15 Hours)

INTRODUCTION TO FPGAs: Evolution of programmable devices- FPGA Design flow Applications of FPGA - FPGA boards and Software tools - FPGA building blocks –digital system Design Examples: Design of Universal block - Memory- Floating point multiplier Barrel shifter.

UNIT-V: Circuit Design and Simulation Using VIVADO Design Suite (15 Hours)

Xilinx - Vivado Design Suite - Verilog: Verilog fundamental -Design Flows & EDA Tools Code Structure-Data types -Operators and Attributes- overloading -Concurrent Code:
Concurrent versus Sequential- Using Operators- WHEN, Generate and Block- Sequential Code: Process-Signals and Variables - IF, WAIT- CASE -Using Sequential- Code to Design Combinational Circuits. System Verilog: Verilog + - Coverage – Randomization – Assertion functional coverage- Object oriented programming, define – parameter–Verilog-AMS: Verilog Family of Languages-Mixed Signal Simulators-Applications of Verilog–AMS- Analog Modeling

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Ajit Pal (2015), *Low-Power VLSI Circuits and Systems*, Springer India.
2. Samir Palnitkar (2003), *Verilog HDL*, 2nd Edition, Pearson Education.

Unit	Book	Chapter	Sections
I	1	1, 2	all
II	1	3, 4	all
III	1	7	all
IV	2	1, 2, 3	all
V	2	8	all

Books for Reference:

1. Peter Van Zant (1997), *Microchip fabrication*, McGraw Hill.
2. Plummer, J.D., Deal, M.D. and Griffin, P.B. (2000), *Silicon VLSI Technology: Fundamentals* (3rd Edition), Practice and Modeling, Prentice-Hall.
3. Justin Rajewski (2017), *Leaning FPGAs* (1st Edition), O'Reilly Media, Inc.

Websites and eLearning Sources:

1. https://www.tutorialspoint.com/vlsi_design/index.htm
2. http://www.eeherald.com/section/design-guide/Low-Power-VLSI-Design.html
3. https://www.nandland.com/articles/fpga-101-fpgas-for-beginners.html
4. https://docs.xilinx.com/v/u/hvSo8dqbS1aQfQu8EocbwA
5. https://www.electronicshub.org/introduction-to-fpga/

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements	Cognitive Level (K- level)
	On successful completion of this course, students will be able to	
CO1	Identify various Semiconductor Devices used in VLSI	**K1**
CO2	Understand the basics of low power VLSI technology and Verilog programming	**K2**
CO3	Apply the basic concepts of FPGA for different applications	**K3**
CO4	Analyse Scaling Factors and Testing Supply Voltage Scaling for Low Power.	**K4**
CO5	Test various digital circuits using Verilog AMS	**K5**
CO6	Develop circuits and simulate using Xilinx IDE using Verilog AMS	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours/Week**		**Credits**
3	**25PEL3CC06**		**Core Course - 6:** VLSI Design and VERILOG Programming						**5**		**4**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	2	2	2	2	2	2	2.0
CO2	2	2	2	2	2	2	2	2	2	3	2.1
CO3	2	3	3	2	2	2	2	3	2	2	2.3
CO4	2	2	2	3	3	2	2	3	3	3	2.5
CO5	2	3	2	3	3	3	2	3	3	3	2.7
CO6	2	2	3	3	2	3	2	3	2	2	2.4
Mean Overall Score											**2.33 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25PEL3CC07	**Core Course - 7:** Electronic Instrumentation and Virtual Instrumentation	4	3

Course Objectives
To explain basic concepts and definitions in measurement and describe the bridge configurations and their applications.
To elaborate discussion about the importance of signal generators and analyzers in Measurement.
To provide knowledge on design of process control by using virtual instrumentation techniques.
To provide knowledge in process analysis by VI tools.
To give basic knowledge in describing function analysis and to get adequate knowledge VI tool sets.

UNIT-I: Introduction to Instrumentation (12 Hours)

Functions of instruments- Electrical Units -Measurement Standards- Error in Measurement- Statistical Analysis of Error in Measurement -Limiting Errors-Elements of Electronic Instruments-Selection، Care, and Use of Instruments- Static and Dynamic Characteristics of Instrumentation.

UNIT-II: Bridges and Basic Electronic Instruments (12 Hours)

Bridge circuits - Resistance measurement: D.C. bridge circuit -Voltmeter–ammeter method - Resistance-substitution method- Use of the digital voltmeter to measure resistance -The ohmmeter - Inductance measurement- Capacitance measurement - Current measurement Cathode ray oscilloscope -Frequency measurement- Phase-locked loop - The Wien bridge Phase measurement.

UNIT-III: Digital Instruments (12 Hours)

Digital Storage Oscilloscope- Vector Scope-Digital Phase meter- Digital capacitance meter Digital pH meter- Microprocessor based instruments-Function Generators- Spectrum Analyzer- Single channel and multichannel Data Acquisition Systems- Data Loggers Environmental Monitoring Systems: Water quality and Air quality Measurement Systems Pollution Monitoring.

UNIT –IV: Virtual Instrumentation (12 Hours)

Introduction- Graphical system design (GSD) model - Design flow with GSD -Virtual instrumentation - Virtual instrument and traditional instrument- Hardware and Software in virtual instrumentation- Virtual instrumentation for test, control and design -Virtual instrumentation in the engineering process- Virtual Instruments Beyond Personal Computer Graphical System Design Using LabVIEW -Graphical Programming And Textual Programming- Software Environment- Creating and Saving a VI-Front Panel Toolbar- Block Diagram-Data Types- Data Flow Program.

UNIT- V: Modular Programming and Motor Control on LabVIEW (12 Hours)

Introduction-Modular Programming in LABVIEW -Icon and Connector Panel-Creating an Icon - Building A Connector Panel- Displaying Sub VI s And Express VIs as Icons or Expandable Nodes- Creating SubVI from Sections of A VI- Opening and Editing Sub VIs - Placing SubVIs on Block Diagrams- Saving SubVIs- Creating A Stand-Alone Application Components of a Motion Control System - Software for Configuration, Prototyping and Development - Motion Controller- Move Types- Motor Amplifiers and Drives.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Larry D. Jones, *Electronic Instruments and Measurements* (2nd edition), Prentice-Hall International Editions.
2. Alan S. Morris (2001), *Measurement and Instrumentation Principles* (3rd edition).
3. H S Kalsi (2006), *Electronic Instrumentation* (2nd Edition Sixth reprint), McGraw hill Companies.
4. Jovitha Jerome (2010), *Virtual Instrumentation using LabVIEW*, PHI Learning PVT. Limited.

Unit	Book	Chapter	Sections
I	1	1	1.1-1.10
II	2	7	7.1 to 7.7
III	3	6, 9, 17	6.10, 6.14, 8.8, 9.6, 17.4, 17.5, 17.8.
IV	4	1,2	1.1 to 1.11, 2.1 to 2.15
V	4	3	3.1 to 3.12

Books for Reference:

1. Gregory B. A. (1981), *An introduction to Electrical Instrumentation and measurement System* (2nd edition), Palgrave HE UK.
2. Alan S. Morris, Reza Langari (2012), *Measurement and Instrumentation Theory and Application*, Elseiver.
3. Jeffrey Travis and Jim Kring (2007), *LabVIEW for Everyone*, Prentice Hall Edition.

Websites and eLearning Sources:

1.https://ocw.tudelft.nl/wpcontent/uploads/Reader_ET8017_Electronic_Instrumentation__Chapter1.pdf.
2. https://www.tutorialspoint.com/electronic_measuring_instruments/index.htm
3. https://www.electronics-notes.com/articles/test-methods/labview/vis-virtual-instruments.php
4. https://mindmajix.com/labview-tutorial
5. https://www.ni.com/getting-started/labview-basics/

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements	Cognitive Level (K- level)
	On successful completion of this course, students will be able to	
CO1	Understand the errors in measurement and characteristics of instrumentation, used to solve the problems in instruments.	**K1**
CO2	Distinguish an AC and DC bridges and apply the same in various basic electronic instruments for real time problems	**K2**
CO3	Create the program by applying SubVIs and empower to integrate real-world signals for earlier error detection.	**K3**
CO4	Analyze the principles of virtual instrumentation	**K4**
CO5	Evaluate the virtual instrumentation for various industrial applications	**K5**
CO6	Develop and analyze modern and digital instruments for laboratorial, clinical and environmental applications	**K6**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**						**Hours/Week**		**Credits**	
3	**25PEL3CC07**	**Core Course - 7:** Electronic Instrumentation and Virtual Instrumentation						**4**		**3**	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	2	3	3	2	2	2	2.4
CO2	3	2	3	2	2	2	2	3	3	2	2.4
CO3	2	2	3	3	2	2	2	2	3	2	2.3
CO4	3	2	2	2	2	2	2	3	3	3	2.4
CO5	3	2	2	3	3	3	2	2	2	3	2.5
CO6	3	3	3	2	2	2	3	3	2	2	2.3
Mean Overall Score											**2.38 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25PEL3CC08	**Core Course - 8:** Internet of Things with Single Board Computer	5	4

Course Objectives
To describe the basic of IoT and IIoT
To understand the concepts of IoT network model
To apply IoT techniques in real time applications using single board computer
To analyse the working of single boards computers
To evaluate and design IoT and IIoT systems for a specific need

UNIT-I: IoT Basics (15 Hours)

Introduction - Architectures- Wireless Networks-– Devices-Security and Privacy-Event-Driven Systems - IoT System Architectures: Protocols Concepts – IoT - Oriented Protocols -Databases - Time Bases-Security - IoT Devices: The IoT Device Design Space-Cost of Ownership and Power Consumption - Cost per Transistor and Chip Size - Duty Cycle and Power Consumption - Platform Design

UNIT-II: IoT Network Model (15 Hours)

Event-Driven System Analysis: Introduction -IoT Network Model-Events-Networks-Devices and Hubs-Single-Hub Networks-Multi-hub Networks-Network Models and Physical Networks-IoT Event Analysis: Event Populations-Stochastic Event - Environmental Interaction Modeling-Event Transport and Migration

UNIT-III: IIoT and Security and Safety (15 Hours)

Industrial Internet of Things: Industry 4.0-Industrial Internet of Things (IIoT) - IIoT Architecture-Basic Technologies-Applications and Challenges-Security and Safety: Systems Security-Network Security-Generic Application Security-Application Process Security and Safety-Reliable, Secure design IoT Applications-Run Time Monitoring- ARMET Approach Privacy and Dependability-Security Testing IoT Systems.

UNIT-IV: Introduction to Single Board Computer (15 Hours)

Introduction - Architecture - applications - Overview on Raspberry Pi - GPIO – Comparison of different Raspberry Pi boards-shields - overview of Beagle bone – features - NVIDIA Jetson Nano Special Features - NVIDIA Jetson Xavier nx - special features.

Installing and preparing Raspberry Pi - flashing SD Card - Booting up - Configuring Pi - Troubleshooting - Using Command Line interface - root user commands - configuring network connection - remote desktop access using Putty software- Raspberry Pi4 Architecture Specifications

UNIT-V: Hardware Interface with Raspberry Pi (15 Hours)

Installing RPI. GPIO- setting up I2C and SPI- Connecting and controlling LED-Switching a high-power DC device using a Transistor-making a user interface to turn ON and OFF a device controlling servo motors-controlling the speed of DC motor-using resistive sensors with Raspberry Pi.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk, hands on training.
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Dimitrios Serpanos, *Internet-of-Things (IoT) Systems, Architectures, Algorithms, Methodologies,* Springer International Publishing
2. Material prepared by department
3. Simon Monk (2014), *Raspberry Pi cookbook*, O'Reilly Media Inc.,

Unit	Book	Chapter	Sections
I	1	1, 2, 3	all
II	1	4	all
III	1	5, 6	all
IV	2		all
V	3	8, 9, 10, 12	8.3,8.4,8.6, 9.1,9.2, 9.4,9.7, 10.1,10.3, 12.1

Books for Reference:

1. Tripathy B. K. and Anuradha J, *Internet of Things (IoT) Technologies, Applications, Challenges, and Solutions,* Taylor & Francis Group.
2. Constandinos X. Mavromoustakis George Mastorakis, Jordi Mongay Batalla (2016), *Internet of Things (IoT) in 5G Mobile Technologies,* Springer International Publishing Switzerland.
3. Anandarup Mukherjee, Arijit Roy (2022), *Introduction to IoT* (1st edition), Cambridge University Press.

Websites and eLearning Sources:

1. https://www.oracle.com/in/internet-of-things/what-is-iot/#:~:text=The%20Internet%20of%20Things%20(IoT)%20describes%20the%20network%20of%20physical,and%20systems%20over%20the%20internet.
2. https://www.techtarget.com/whatis/feature/IoT-basics-A-guide-for-beginners
3. https://www.javatpoint.com/iot-internet-of-things
4. https://www.iberdrola.com/innovation/what-is-iiot#:~:text=The%20Industrial%20Internet%20of%20Things%20(IIoT)%20is%20the%20collection%20of,the%20internet%20to%20industrial%20applications.
5. https://www.raspberrypi.org/

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Recall and describe IoT and IIoT	**K1**
CO2	Understand the concepts of IoT and IIoT	**K2**
CO3	Apply IoT techniques in real time applications using single board computer	**K3**
CO4	Analyze the working of IoT devices	**K4**
CO5	Evaluate single board computers systems in applications	**K5**
CO6	Design IoT and IIoT systems for a specific need	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**					**Hours/Week**		**Credits**	
3	**25PEL3CC08**		**Core Course - 8:** Internet of Things with Single Board Computer					**5**		**4**	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	2	3	3	2	2	2.4
CO2	2	2	3	2	3	2	2	3	2	2	2.3
CO3	2	3	2	2	2	2	2	2	3	3	2.3
CO4	2	2	2	2	3	2	2	2	3	2	2.2
CO5	2	3	3	2	3	2	2	3	2	2	2.4
CO6	2	3	3	2	3	2	3	3	2	2	2.5
Mean Overall Score											**2.35 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25PEL3CP03	**Core Practical - 3:** Single Board Computer and FPGA	8	5

Any 16 Experiments

1. Design of data logger using Arduino and microSD card for temperature measurement.
2. Interfacing Bluetooth module and ESP 8266 -01 with Arduino
3. ADXL335 interfacing with Arduino.
4. GSM and GPS module interfacing with Arduino.
5. Multiplexer and demultiplexer with Quartus II
6. Developing Data Visualization Interfaces in Python with Dash
7. Adder subtractor with Quartus II
8. Study of loading OS and GPIO (DHT11) with Raspberry Pi
9. Web hosting with Raspberry Pi
10. GLCD interfacing with Arduino
11. PCF8591 interfacing with Raspberry Pi for ADC and DAC study.
12. Node MCU for IoT node configuration (4 nodes)
13. Machine Vision: Recognizing objects and scenes using Python
14. Pick and place robot
15. Developing MUX and DEMUX and verifying the same in Vivado IDE
16. Implementing Full adder, Full subtractor, Multiplexer, divider and ALU in FPGA
17. Implementing Decoder, priority encoder, 8-bit comparator and 8-bit latch in FPGA
18. Implementing D flip-flop with synchronous and asynchronous inputs,4-bit up / down counter with control input in FPGA (clock source to be switch)
19. Implementing clock divider, pulse counter (for delay program) shift registers and barrel shifter in FPGA
20. Interfacing FPGA with PC through DB9 by implementing UART
21. Interfacing LCD and keypad with FPGA.
22. Study of different types of network cables and Connections
23. OS installation, server command and network configuration
24. Data analysis – LabView
25. Design of computer network – LAN
26. Multi-function gates – Verilog
27. Design of encoder and decoder in Verilog
28. Testbench for multiplexer and demultiplexer in Verilog
29. Design of PH meter
30. Data logger for environment monitoring
31. Pollution monitoring IoT
32. Study of Antanas
33. Transmission line characteristics
34. PLC programming

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25PEL3ES02A	**Discipline Specific Elective - 2:** Electromagnetics and Antenna Design	4	3

Course Objectives
To acquire Knowledge on fundamental concepts of Electro-Magnetic waves
To understand EM waves propagation and antennas
To Illustrate EM wave propagating devices and evaluate the modes of operation
To compare different types of Antennas
To assess and synthesis and design of antennas for various requirements

UNIT-I: Introduction to Electromagnetic Wave Theory (12 Hours)

Static Electric Field-Electro Magnetic waves- Divergence Theorem- Stroke's Theorem Coulomb's Law-Electric field due to charge distribution- Gauss Law-Equation of continuity Inconsistency of Ampere Law-Boundary conditions for Electric field- Static magnetic field Biot-Savart's Law-Magnetic field intensity due to finite and infinite conductor- Boundary conditions for Magnetic field

UNIT-II: EM Wave Equations and Transmission Lines (12 Hours)

Maxwell's Equations- Electromagnetic wave equation for free space- EM wave equation for conducting medium-Uniform Plane waves-Poynting Theorem- Transmission Lines-Types of Transmission lines-Transmission line parameters-Properties of Symmetrical Networks Current and Voltage along an infinite line – SWR- Applications of the Smith chart.

UNIT-III: Waveguides and Antennas (12 Hours)

Introduction to Waveguides- Transverse Electric waves- Transverse Magnetic waves characteristics of TE and TM waves-Transverse Electro-Magnetic waves- velocities of propagation-Introduction to Antenna-Types of Antennas- Radiation Mechanism- Antenna parameters

UNIT-IV: Design of Antenna (12 Hours)

Design and performance study of finite length Dipole- Halfwave Dipole Antenna- Loop Antenna-Design and study of small Circular Loop Antenna- Folded Dipole Antenna Broadband Antennas- Design of Frequency dependent Log Periodic Antennas-Antenna Array Two Element Array- Design Procedure

UNIT-V: Advanced Antenna Design (12 Hours)

Aperture Antennas- Design considerations- Horn Antennas- Types of Horn Antennas Microstrip and Mobile Communication Antennas- Reflector Antennas- Smart Antennas-Smart Antenna system design and simulation.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Edward C. Jordan, Keith G. Balmain (2002), *Electromagnetic Waves and Radiating Systems* (2nd edition). Prentice Hall of India,15th reprint.

2. Bakshi U. A, Bakshi A. V. (2009), *Electromagnetic waves and Transmission lines* (second revised edition), Technical Publications.

3. Constantine A. Balanis (2016), *Antenna Theory Analysis and Design* (fourth edition), Wiley.

Unit	Book	Chapter	Sections
I	1	1,2,3,4	1.01,1.05,2.03,2.05,2.11,3.02,3.03 4.01,4.02, 4.04
II	1 2	4,5,611,12	4.03,5.01-5.05,6.01 11.1,11.2,11.3,11.4,11.7, 12.5,12.11
III	2 3	131,2,9,10,11	13.1-13.71.1-1.3, 2,9.6,10.3,11.4
IV	3	4,5,6	4.5, 4.6, 5.1,5.2,6.1,6.2,6.5
V	3	12,13,14,15,16	12.1,12.7,13.1,13.2,13.3, 14.1-14.4,15.1-15.4,16.1,16.2,16.10,16.11

Books for Reference:

1. Dr. Dhananjayan P. (2013)**,** *Electromagnetic Fields***,** Laksmi publications.
2. Prasad K. D. (2009), *Antenna and Wave Propagation* (2nd Edition), Sathya Prahashan.
3. Akira Ishimaru (2017), *Electromagnetic wave propagation, Radiation and Scattering from fundamentals to Applications,* IEEE press.

Websites and eLearning Sources:

1. https://www.allaboutcircuits.com/textbook/alternating-current/chpt-14/waveguides/
2. https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/
3. https://edurev.in/courses/23240_Electromagnetic-Fields-Theory
4. https://examsdaily.in/antenna-pdf-download
5. https://www.sathyabama.ac.in/course-materials/antenna-and-wave-propagation

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements	Cognitive Level (K- level)
	On successful completion of this course, students will be able to	
CO1	Acquire knowledge on fundamental concepts of Electro-Magnetic waves	**K1**
CO2	Explain EM waves propagation	**K2**
CO3	Illustrate EM wave propagating devices and evaluate the modes of operation	**K3**
CO4	Compare different type of Antennas	**K4**
CO5	Recommend antennas for various requirements	**K5**
CO6	Design antennas for various requirements	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**				**Hours/Week**				**Credits**
3	**25PEL3ES02A**		**Discipline Specific Elective - 2:** Electromagnetics and Antenna Design				**4**				**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	1	2	1	2	1	1	1.6
CO2	1	3	2	3	3	2	3	2	2	2	2.3
CO3	2	3	2	2	2	2	3	2	3	3	2.4
CO4	2	3	2	3	3	2	3	2	3	3	2.6
CO5	1	3	2	3	3	2	3	2	3	3	2.5
CO6	1	2	2	3	1	3	3	3	2	3	2.3
Mean Overall Score											**2.28 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25PEL3ES02B	**Discipline Specific Elective - 2:** Power Electronics and Solar PV Systems	4	3

Course Objectives
To identify suitable semiconductor devices for power control applications
To understand the working of high-power rectifiers and solar power systems
To calculate the energy requirement for the system requirements
To evaluate different power handling devices
To decide and develop a solar power system for the needs and become an entrepreneur

UNIT-I: Power Semiconductor Devices (12 Hours)

Introduction – Difference between linear and power devices - Power diodes - types - series connected and parallel connected diodes - BJT - steady state characteristics - switching characteristics - Power MOSFET- characteristics - COOLMOS - SIT - IGBTs, –switching characteristics – Thyristors – control characteristics - Silicon HV thyristors, MCT, BRT & EST- SiC devices.

UNIT-II: Rectifiers and DC-DC Converters (12 Hours)

Single phase half - wave rectifiers - single phase full - wave rectifiers with RL load- -three phase bridge rectifiers- DC-DC converters- step-down operation- Generation of duty cycle - with RL load - Principle of step-up operation -with resistive load - performance parameters - converter classification - switching mode regulators buck regulators - boost regulators - Buck boost regulators - comparison of regulators – chopper circuit design

UNIT-III: Inverters and Charge Controllers (12 Hours)

Full bridge converter - square wave inverter - Fourier series analysis -harmonic distortion - amplitude and harmonic control - half bridge inverter -multilevel inverters - PWM inverters - PWM harmonics - three phase inverters- induction motor speed control - PWM charge controller.

UNIT-IV: Solar PV Systems and PSIM Programming (12 Hours)

Electricity generation with PV cells – Basic of Solar PV systems -blocks of solar PV system - PV modules - solar array (roof top panel connection) - function of inverter - energy storage – charge controllers - calculation of solar panel battery – types of battery - MPPT –MPPT algorithm - MPPT charge controller. grids. PSIM- Introduction -programming - power computation.

UNIT-V: Smart Grids (12 Hours)

Definitions and Need for Smart Grid - Smart grid drivers – Functions -opportunities - Challenges and benefits - Difference between conventional& smart Grid - Concept of Resilient &Self-Healing Grid - off grid and on-grid - Introduction to Smart Meters - Advanced Metering infrastructure (AMI) drivers and benefits- Phasor Measurement Unit-(PMU) - Intelligent Electronic Devices (IED) &their application for monitoring & protection.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Muhammad H. Rashid (2009), *Power electronics* (3rd edition), Pearson.
2. Smets, A.H., Jäger, K., Isabella, O., Swaaij, R.A. and Zeman, M. (2015), *Solar Energy: The physics and engineering of photovoltaic conversion, technologies and systems*, UIT Cambridge.
3. (2017), *PSIM User Manual*.
4. Stuart Borlase (2012), *Smart Grid: Infrastructure Technology and Solutions*, CRC Press.

Unit	Book	Chapter	Sections
I	1	1	1.1, 2.1-2.4,2.6, 3.1-3.5, 4.4, 5.2-5.4, 6.1- 6.4,6.6,8.1,8.2, 9.8, lecture notes
II	1	11,12,13	11.2, 12.2.4, 13.1-13.5
III	1	15,17	15.2,15.3,15.7, 17.2,17.3
IV	2 3	1, 3, 12,13,15, 17,19, 20,2,4,8	1.3,3, 3, 12.2,13.3, 15.1-15.4, 17.1-17.3, 19.1-19.4, 20.1,20.22.1, 4.1.1-4.1.3, 8.1.3, 8.1.4
V	4	2,3	2.1,2.2, 2.4.4,2.4.5, 3.1,3.3.1, 3.10.1-3.10.3, lecture notes

Books for Reference:

1. Ned Mohan (2003), *First Course on Power Electronics and Drives* (1st edition), MNPERE.
2. Robert W. Erickson & Dragan Maksimovic (2004), *Fundamentals of Power Electronics* (2nd Edition), Kluwer Academic Publisher.
3. Parimita Mohanty, Tariq Muneer and Mohan Kolhe (2016), *Solar Photovoltaic System Applications*, Springer International Publishing, Switzerland.

Websites and eLearning Sources:

1. https://www.tutorialspoint.com/power_electronics/index.htm
2. https://www.electrical4u.com/concept-of-power-electronics/
3. https://electronicscoach.com/power-electronics.html
4. https://www.energy.gov/eere/solar/solar-photovoltaic-technology-basics
5. http://www.ews-solarpower.co.uk/24-how-does-the-system-work

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Identify suitable semiconductor devices for power control applications	**K1**
CO2	Illustrate the working of high-power rectifiers and solar power systems	**K2**
CO3	Calculate the energy requirement for the system requirements	**K3**
CO4	Evaluate different power handling devices	**K4**
CO5	Recommend a solar power system for a requirement and become an entrepreneur	**K5**
CO6	Plan a solar power system for a specific need	**K6**

Relationship Matrix

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	**25PEL3ES02B**	**Discipline Specific Elective - 2:** Power Electronics and Solar PV Systems	**4**	**3**

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	3	3	3	3	3	2	2	2.5
CO2	3	3	2	2	3	2	2	3	2	1	2.3
CO3	1	2	3	2	3	1	3	3	3	2	2.3
CO4	3	2	2	2	3	3	2	3	2	3	2.5
CO5	3	3	3	2	1	3	2	3	2	3	2.5
CO6	3	3	3	2	2	2	2	2	3	1	2.3
										Mean Overall Score	**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25SPS3RM01	Research Methodology and IPR	4	2

Course Objectives
To spell the research methodology and IPR
To compare different methods of doing research
To experiment using various methodology
To evaluate applied method and IPR
To do the research by following appropriate method

UNIT I: Introduction to Research Methodology (12 Hours)

Definition and importance of research in Science - Types of research - fundamental - applied research – Inter disciplinary research - Scientific method: Observation – hypothesis – experimentation – conclusion - Identifying research gaps in science - Framing hypotheses and objectives - Importance of literature review in research - Tools for finding relevant research papers - evaluation and critical analysis of existing work.

UNIT II: Research Design, Planning and methodology (12 Hours)

Choosing a research problem in science - Formulating research objectives and specific goals - Creating a timeline for research work - Types of sampling methods - Tools and techniques for data collection in science experiments - Ethical considerations in scientific research - Plagiarism, falsification, and fabrication - Ensuring transparency and reproducibility in research - Quantitative Research Methods in Science - Qualitative Methods in Science - Data Visualization and Interpretation - Experimental Research - Computational Physics Research

UNIT III: Writing a Research Paper (12 Hours)

Structure of a Scientific Paper: Sections of a research paper (Abstract, Introduction, Methods, Results, Discussion, Conclusion) - Writing tips for clarity and precision.
Citing Sources and Referencing: Proper citation formats - Using reference management tools. Peer Review Process: Importance of peer review in scientific research - How to write and respond to peer reviews.
Data Interpretation and Presentation: Analyzing Results - Presenting Research Findings.
Supporting AI tools.

UNIT IV: Intellectual Property Rights (IPR) (12 Hours)

Intellectual Property - Types of IPR - Importance of IPR in science and innovation - The role of IPR in academic and industrial collaborations – Patents - Patent Search and Filing - Copyrights in Scientific Research - Trade Secrets and Confidentiality

UNIT V: Licensing and Commercialization of Research (12 Hours)

Licensing Agreements - Commercialization of Research - Legal and Ethical Considerations in IPR - IPR in Academia vs Industry - IPR Enforcement and Litigation - Case Studies and Recent Developments in IPR and Research - Emerging Trends in IPR - Startup

Teaching Methodology	Lectures, Demonstrations, Presentations and Videos

Books for Study:

1. Text Prepared by the Department.

Unit	Book	Chapters	Sections
I	1	1	All
II	1	2	All
III	1	3	All
IV	1	4	All
V	1	5	All

Books for Reference:

1. Michael Alley (2018), *The Craft of Scientific Writing* (3rd Ed.), Springer.
2. Ranjit Kumar, *Research Methodology: A Step-by-Step Guide for Beginners*,

3. Lee and Wills, *Intellectual Property and Innovation Management in Small Firms*
4. Howard G. Birnberg, *Patent Law for Researchers and Engineers*
5. Frederick J. R. P, *Introduction to Scientific Research*.
6. Geoffrey Marczyk, David DeMatteo and David Festinger (2005), *Essentials of Research Design and Methodology,* John Wiley & Sons, Inc.

Websites and eLearning Sources:

1. https://paperpal.com/blog/academic-writing-guides/what-is-research-methodology
2. https://www.indeed.com/career-advice/career-development/research-methodology
3. https://research.com/research/how-to-write-research-methodology
4. https://ipindia.gov.in/
5. https://www.youtube.com/watch?v=nJza2kfI8GU
6. https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

(* subject to availability - not to be used for exam purpose)

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K-Level)**
	On successful completion of this course, students will be able to	
CO1	Define research and different methods to be followed and IPR	**K1**
CO2	Understand different methodology adapted for scientific research and IPR	**K2**
CO3	Apply various methodology to do research	**K3**
CO4	Examine suitable methods for scientific research	**K4**
CO5	Evaluate and interpret the results of research	**K5**
CO6	Formulate scientific methods and do the research	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours**		**Credits**
3	**25SPS3RM01**		Research Methodology and IPR						**4**		**2**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	3	2	3	2	1	**2.3**
CO2	3	3	2	2	3	3	2	2	2	1	**2.3**
CO3	3	2	2	3	3	2	2	3	**3**	**2**	**2.5**
CO4	3	2	2	3	3	2	3	3	2	1	**2.4**
CO5	3	3	2	3	3	2	2	3	**3**	**2**	**2.5**
CO6	3	2	3	3	3	2	2	3	2	2	**2.3**
										Mean Overall Score	**2.38 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	**25PEL3SL03A**	**Self-Learning:** Programmable Logic Controller	**-**	**2**

Course Objectives
To define different types of PLC and basic I/O modules
To understand PLC programming of basic logics
To apply programming of basic logics in PLC
To analyse basic relay switching circuits in PLC
To implement timer and counter based programs in various applications and design a network control system with PLC and SCADA

UNIT-I: PLC Overview

Programmable logic controllers- parts of PLC-principles of operation-modifying the operation the I/O Section-Discrete I/O modules- Analog I/O modules-I/O specifications-Memory design and types-programming terminal devices-Recording and retrieving data-human machine interfaces

UNIT-II: PLC Programming

Number system and codes- Fundamentals of logic- AND, OR, NOT, XOR function-hardwired logic versus programmed logic-Producing the Boolean equation for a given logic circuit programming word level logic instruction.

PLC programming languages- Bit level logic instructions-instruction and branch instruction Internal relay instructions- programming examine if closed and examine if open instruction entering the ladder program-modes of operation-connecting with analog devices.

UNIT-III: Developing Fundamental PLC Wiring Diagrams

Electromagnetic control relays-contactors-motor starters-manually operated switches mechanically operated switch-sensors-output control devices-Seal in circuits-electrical interlocking circuits-latching relays-converting relay schematics into ladder program-writing a ladder program from a narrative description-instrumentation

UNIT-IV: Programming Timers, Counters and Other Instructions

Mechanical timing relays-timer instructions-on delay timer-off delay timer-retentive timer cascading timer-counter instructions-up counter-down counter-cascading counter-incremental encoder-counter application-combining counter and timer-high speed counters. Program control instruction-Master control reset instruction-jump and subroutine instruction-immediate input and output instructions-forcing external I/O addresses-selectable timed interrupt Temporary End and suspend instruction. Math instructions.

UNIT-V: Process Control, Network Systems and Scada

Structure of control systems-on/off control-PID control-motion control-Data Communications Data Highway - Serial communication – Device Net-ControlNet- Ether Net / IP-MODBUS Fieldbus – PROFIBUS – DP - Supervisory control and data acquisition (SCADA)

Teaching Methodology	Demo Videos, PPT, Handouts
Assessment Methods	MCQ, Written Assignment, Prototype model construction,

Books for Study:

1. Frank D. Petruzella (2017), *Programmable logic controllers* (fifth edition), McGraw Hill Education.

Unit	Book	Chapter	Sections
I	1	1,2	1.1-1.4,2.1-2.11
II	1	3,4,5	Overview of chapter 3,4.2-4.7,5.3-5.11
III	1	6	6.1-6.13,
IV	1	7	7.1-7.6,8.5-8.7,9.1
V	1	14	14.2-14.7

Books for Reference:

1. William Bolton (2015), *Programmable logic controllers* (Sixth edition), newness publications.
2. Pradeeka Seneviratne (2017), *Building Arduino PLCs: The essential techniques you need to develop Arduino-based PLCs*, Apress publishers.
3. Daniel Kandray (2010), *Programmable automation technologies: an introduction to CNC robotics and PLCs*, Industrial press.

Websites and eLearning Sources:

1. https://instrumentationtools.com/ladder-diagram-programming/
2. https://control.com/technical-articles/ladder-logic-in-programmable-logic-controllersplcs/
3. https://www.automation.com/en-us/articles/2018/a-beginners-plc-overview-part-3-of- 4-plc-inputs-an
4. https://dipslab.com/plc-input-output-modules-2/
5. https://control.com/textbook/programmable-logic-controllers/inputoutput-iocapabilities/

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Acquire knowledge on different types of PLC and basic I/O modules	**K1**
CO2	Understand the programming of basic logics	**K2**
CO3	Apply programming of basic logics in PLC	**K3**
CO4	Analyse basic relay switching circuits in PLC	**K4**
CO5	Implement timer and counter based programs in various applications	**K5**
CO6	Design a network control system with PLC and SCADA	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**					**Hours/Week**			**Credits**
3	**25PEL3SL03A**		**Self-Learning:** Programmable Logic Controller					**-**			**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	3	3	2	2	2	2.4
CO2	3	2	3	2	2	3	3	2	2	2	2.4
CO3	3	2	3	2	3	2	2	2	2	2	2.3
CO4	2	3	2	3	2	3	2	3	2	2	2.4
CO5	3	3	2	2	2	2	2	3	2	3	2.4
CO6	2	2	2	3	2	2	2	2	3	3	2.3
Mean Overall Score											**2.36 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25PEL3SL03B	**Self-Learning:** Nanoelectronics	-	2

Course Objectives
To describe the basics of nanoelectronics and devices
To understand the Quantum mechanics fundamentals, nanomaterials and fabrication techniques required to acquire knowledge on nanoelectronics
To apply the electron transition in nano electronic devices, operations and its characteristics
To analyse the inner behavior of electrons in nanomaterials
To evaluate nano structure and develop a new nanomaterial for electronic applications

UNIT-I: Quantum Mechanics of Electronics

Introduction to Nano Electronics – Top –Down Approach – Bottom – Up approach General postulates of Quantum Mechanics – Operators for Quantum Mechanics – Eigen values and Eigen functions – Hermitian Operators –Time Independent Schrodinger's Equation – Electrons in a Potential Well

UNIT-II: Materials for Nanoelectronics

Semiconductors – Crystal Lattices - Bonding in Crystals – Electron Energy Bands – Direct Band Gap and Indirect Band Gap Semiconductors - Band Structure of Semiconductor Alloys – Semiconductor Heterostructure – Organic Semiconductors –Carbon Nanomaterials.

UNIT-III: Growth- and Fabrication for Nanostructures

Bulk Crystal and Heterostructure Growth – Single Crystal Growth – Epitaxial Growth – Molecular Beam Epitaxy – Clusters and Nanocrystals – Methods of Nanotube Growth – Arc-Discharge and Laser Ablation – Chemical Vapor Deposition – Directed Growth of Single Walled Nanotube – Self Assembly of Nanostructures

UNIT-IV: Electron transport in Semiconductors

Time and Length Scales of the electrons in solids – Statistics of the electron in solids and Nanostructures - The Density of States of Electrons in Nanostructure – Electron transport in Nanostructures – Electrons in Quantum Well – Electrons in Quantum Wires – Electrons in Quantum Dots.

UNIT-V: Nanoelectronics Devices

Resonant-tunneling Diodes – Field-effect Transistor – Single Electron Transistor – Potential-effect Transistor – LEDs and Lasers – Quantum-dot Cellular Automata – Nanoelectromechanical System Devices.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis,
Assessment Methods	MCQ, Written Assignment, Prototype model construction,

Books for Study:

1. Daniel Bes (2012), *Quantum Mechanics: A Modern and Concise Introductory Course (Graduate Texts in Physics)* (3rd ed), Springer.
2. Anupama B. Kaul (2013), *Microelectronics to Nanoelectronics Materials, Devices & Manufacturability* (1st Edition), CRC Press, Taylor & Francis Group.
3. Georage W. Hanson (2008), *Fundamentals of Nanoelectronics*, Pearson Education. Hassan

Unit	Book	Chapter	Sections
I	1		Relevant sections
II	2		Relevant sections
III	2		Relevant sections
IV	3		Relevant sections
V	3		Relevant sections

Books for Reference:

1. Raza (2019), *Nanoelectronics Fundamentals Materials Devices and Systems* (), Springer.
2. Kamal Singh S.P. Singh (2016), *Elements of Quantum Mechanics* (), S. Chand & Company Pvt. Ltd.
3. KAR A (2017), *Nanoelectronics and Materials Development* (INTECH Edition.).
4. Loutfy H. Madkour (2019), *Nano electronic Materials: Fundamentals and Applications* (1st ed.), Springer (Advanced Structured Materials Book 116).
5. Robert Puers, *Livio Baldi, Marcel Van de Voorde, Sebastiaan E. van Nooten* (2017), Nanoelectronics: Materials, Devices, Applications, 2 Volumes
(Applications of Nanotechnology).
6. Valdimir V. Mitin- Viatcheslav A. Kochelap and Michal A. Stroscio (2008), *Introduction to Nanoelectronics*, Cambridge University Press.

Websites and eLearning Sources:

1. https://www.sciencedirect.com/topics/materials-science/nanoelectronics
2. https://www.nanowerk.com/nanoelectronics.php
3. https://www.azonano.com/article.aspx?ArticleID=6234
4. https://www.azom.com/article.aspx?ArticleID=18333
5. https://www.sigmaaldrich.com/IN/en/applications/materials-science-and-engineering/microelectronics-and-nanoelectronics
6. https://nano.stanford.edu/research/nanoelectronic-devices

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Identify nanoelectronics and devices	**K1**
CO2	Explain the Quantum mechanics fundamentals, nanomaterials and fabrication techniques required to acquire knowledge on nanoelectronics	**K2**
CO3	Apply the electron transition in nanoelectronics devices, operations and its characteristics	**K3**
CO4	Analyze the inner behavior of electrons in nanomaterials	**K4**
CO5	Evaluate the nano structure of a material	**K5**
CO6	Develop a new nanomaterial for electronic applications	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours/Week**		**Credits**
3	**25PEL3SL03B**			**Self-Learning:** Nanoelectronics					**-**		**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	3	2	2	2	2	2.3
CO2	3	2	3	2	2	2	3	2	2	2	2.3
CO3	3	2	3	2	3	2	2	2	2	2	2.3
CO4	2	3	2	3	2	3	2	3	2	1	2.3
CO5	3	2	2	2	2	2	2	3	2	3	2.3
CO6	2	2	2	3	2	2	2	2	3	3	2.3
Mean Overall Score											**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	25PEL3SL03C	**Self-Learning:** Medical Electronics	-	2

Course Objectives
To recognize bio medical measurement and instruments
To understand bio medical signal measurements and the operations of bio medical instruments
To illustrate the bio medical instrumentation techniques
To categorize bio medical instruments
To compare different bio medical instrumentation techniques and choose the suitable instruments for bio medical needs

UNIT-I: Introduction to Bio-Medical Instrumentation

Physiological Systems of Human body- Resting and Action Potential-Basic Medical Instrumentation System-Half Cell Potential- Silver-Silver Chloride Electrodes- Electrodes for ECG- Electrodes for EEG- Electrodes for EMG- Micro Electrodes-Classification of Transducers-Pressure Transducers- Transducers for body temperature measurement Biosensors-Smart sensors

UNIT-II: Signal Conditioners and Bio-Medical Recording Systems

Signal Conditioners- Preamplifier- Bridge Amplifiers-Signal recovery and data acquisition-Bio signal Analysis- Electro Cardio Graph- Phono Cardio Graph- Electro Encephalo Graph- Electro Myo Graph-other Bio Medical Recorders

UNIT-III: Blood –Related Bio-Medical Measurement

Blood Pressure Measurement- Measurement of Heart Rate-Pulse Oximeters- Electromagnetic Blood Flowmeters- Ultrasonic Blood Flowmeters-Spirometry- Blood pH Measurement - Measurement of Blood pCO2 and BloodpO2 – Photometers and Colorimeters

UNIT-IV: Human Assistive Bio-Medical Devices

Pacemakers- Defibrillators-Cardiac Monitor- Methods of Monitoring Fetal Heart Rate Heart-Lung Machine-Angiography-Pulmonary Function Analyzers- Ventilators-Lithotriptors Haemo -Dialysis Machine- Surgical Diathermy

UNIT-V: Advanced Bio-Medical Applications

Bedside Patient Monitoring Systems- Elements of Bio-Telemetry-Design of Bio-Telemetry System-Computers in Medicine- laser in Medicine- Magnetic Resonance Imaging- Computer Tomography-Microwave Diathermy for Electrotherapy-Nerve Stimulators

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis,
Assessment Methods	MCQ, Written Assignment, Prototype model construction,

Books for Study:

1. Khandpur R.S (2011), *Handbook of Biomedical Instrumentation* (2nd Edition), Tata McGraw-Hill, New Delhi, 18TH reprint.
2. Dr. Arumugam M. (2011), *Biomedical Instrumentation* (2nd Edition), Anuradha Publications. Reprint 2011.

Unit	Book	Chapter	Sections
I	1 2	1,2,31	1.2, 2.3-2.6,2.8,3.2,3.5,3.6,3.9,3.10 1.5,1.6
II	1 2	4,53	4.2,4.3,5.1,5.3-5.6 3.5,3.9,3.10
III	1 2	6,7,10,14,15	6.5,6.7,10.3,14.4,15.2 6.10,6.14,7.5
IV	1 2	6,8,13,315,6,7	6.2,8.2,13.5,31.2,31.3 5.2,5.5,5.7,5.8,6.2,6.8,7.12
V	1 2	2,6,8,9,10,20,22	6.3,20.1-20.3,22.1-22.4,29.3,29.5,29.6 8.2,8.3,10.2,10.3

Books for Reference:

1. Leslie Cromwell (2007), *Biomedical Instrumentation and Measurement* (2nd Edition), Prentice Hall of India, New Delhi.

2. Myer Kutz (2003), *Standard Handbook of Biomedical Engineering and Design* (1st Edition), McGraw Hill Publisher.
3. Joseph J. Carr and John M. Brown (2004), *Introduction to Biomedical Equipment Technology* (4th Edition), Pearson Education.

Websites and eLearning Sources:

1. https://www.udemy.com/course/electronics-with-applications-on-biomedicalengineering/
2. https://www.edx.org/course/fundamentals-of-biomedical-imaging-ultrasounds-x-ray
3. https://doi.org/10.1016/B978-0-323-85413-9.00005-0
4. https://link.springer.com/chapter/10.1007/978-3-540-36841-0_154
5. https://youtu.be/iK-6q4nnmtA

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements	Cognitive Level (K- level)
	On successful completion of this course, students will be able to	
CO1	Remember the Physiological systems and classify the types of electrodes and transducers	**K1**
CO2	Interpret various Bio Medical Recorders	**K2**
CO3	Categorize Blood related Measurements and Techniques	**K3**
CO4	Appraise the performance of Bio Medical Instruments for major organs	**K4**
CO5	Assess the need of modern society with professional ethics in Modern Bio Instruments and recommend solutions for the same	**K5**
CO6	Plan a Bio Instruments for the need of modern society with professional ethics	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours/Week**		**Credits**
3	**25PEL3SL03C**			**Self-Learning:** Medical Electronics					**-**		**2**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	1	2	1	2	2	1	1	2	3	3	1.8
CO2	2	2	2	3	3	1	2	2	3	3	2.3
CO3	2	3	3	2	3	1	1	2	3	3	2.3
CO4	2	3	2	3	3	2	2	2	3	3	2.5
CO5	3	3	2	3	3	2	2	2	3	3	2.6
CO6	2	2	2	2	1	2	2	2	1	2	1.8
										Mean Overall Score	**2.22 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25PEL4CC09	**Core Course - 9:** Artificial Intelligence	6	5

Course Objectives
To observe AI and Machine Learning Basics
To understand AI logics and types of Machine learning and its applications
To solve problems using AI
To analyse deep learning and neural networks
To evaluate AI applications and create AI solutions

UNIT-I: AI Logic **(18 Hours)**

Introduction - Propositional Logic - First-order Predicate Logic - Limitations of Logic

UNIT-II: Search, Games and Problem Solving **(18 Hours)**

Uninformed Search - Heuristic Search - Games with Opponents - Heuristic Evaluation Functions - State of the Art - Problems

UNIT-III: Reasoning with Uncertainty **(18 Hours)**

Computing with Probabilities - Principle of Maximum Entropy - LEXMED, an Expert System for Diagnosing Appendicitis - Reasoning with Bayesian Networks

UNIT-IV: Machine Learning and Data Mining **(18 Hours)**

Data Analysis - Perceptron, a Linear Classifier - Nearest Neighbor Method - Decision Tree Learning - Learning of Bayesian Networks - Naive Bayes Classifier – Clustering - Data Mining in Practice

UNIT-V: Neural Networks **(18 Hours)**

From Biology to Simulation - Hopfield Networks - Neural Associative Memory - Linear Networks with Minimal Errors - Backpropagation Algorithm - Applications

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Wolfgang Ertel (2011), *Introduction to Artificial Intelligence*, Springer-Verlag London.

Unit	Book	Chapter	Sections
I	1	1, 2, 3, 4	1.1, 1.2, 2.1 – 2.7, 3.1 – 3.6, 4.1 – 4.4
II	1	6	6.1 – 6.6
III	1	7	7.1 – 7.4
IV	1	8	8.1 – 8.8
V	1	9	9.1 – 9.7

Books for Reference:

1. Stuart Russell and Peter Norvig (2016), Artificial Intelligence a Modern Approach (3rd Edition), Pearson Education Limited.

Websites and eLearning Sources:

1. https://www.simplilearn.com/tutorials/artificial-intelligence-tutorial/what-is-artificial-intelligence
2. https://www.ibm.com/topics/artificial-intelligence
3. https://builtin.com/artificial-intelligence
4. https://cloud.google.com/learn/what-is-artificial-intelligence
5. https://www.oracle.com/in/artificial-intelligence/what-is-ai/
6. https://www.mygreatlearning.com/blog/what-is-artificial-intelligence/

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Describe Artificial Intelligence in various stages	**K1**
CO2	Express AI and machine learning	**K2**
CO3	Apply various machine learning for data analytic	**K3**
CO4	Analyse deep learning and neural networks to find the accuracy of the system design	**K4**
CO5	Recommend AI solutions to a social need	**K5**
CO6	Collect data and to develop an AI system	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours/Week**		**Credits**
4	**25PEL4CC09**			**Core Course - 9:** Artificial Intelligence					**6**		**5**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	2	2	2	2	2.3
CO2	2	3	3	3	2	3	2	2	2	2	2.4
CO3	2	3	3	3	2	3	2	2	3	2	2.5
CO4	2	3	3	3	2	2	2	2	3	3	2.5
CO5	3	2	3	2	2	3	2	2	2	2	2.3
CO6	3	1	3	2	3	2	3	3	2	2	2.4
Mean Overall Score											**2.4 (HIGH)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25PEL4CP04	**Core Practical - 4:** IoT and AI	8	4

Any 16 Experiments

1. PID algorithm implementation for temperature control
2. Thermal printer interfacing with microcontroller
3. Study of Heartbeat sensor and interfacing with microcontroller.
4. ICM105A VGA CMOS sensor
5. MPU 6050 IMU Sensor interfacing with microcontroller
6. AC bridge for signal conditioning
7. Perceptron learning – AI
8. Reinforced learning in google colab - AI
9. Design of a Smart lighting system - AI
10. Battery management system - AI
11. Single neuron implementation - AI
12. IOT – warning light connected to an MQTT server
13. Fiber optic characteristics
14. Data communication and Wireless data transfer.
15. Design and analysis of MAC protocol
16. Data encryption and decryption using microcontroller.
17. Text and sound data transfer - LASER
18. Study of BLDC motor and drone application
19. Design of RPM counter
20. RF communication for Drone.
21. Design of wireless sensor network with two sensors
22. Design of vehicle tracking system
23. FPGA - VivadoHLx Software - Verilog
24. 3-bit binary adder – Verilog
25. Design of accelerometer and application
26. Weather data collection using Python
27. Digital Read, ADC, Interrupt and PWM using Python
28. Simulation of WSN with LEACH Protocol using Mannasim Simulator
29. Fingerprint Sensor interfacing,
30. Image processing - PYTHON

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25PEL4ES03A	**Discipline Specific Elective – 3:** Control System and Industry 4.0	4	3

Course Objectives
To acquire knowledge on fundamentals of control system and industrial automation
To explain the time-domain and frequency-domain analysis of a control system
To explain various controllers available in industrial automation
To understand various performance parameters of control systems and standards of industrial automation
To understand the concepts of industry 4.0 and design techniques

UNIT-I: Introduction (12 Hours)

Control System – open loop and closed loop systems- Mathematical models: mechanical system- electrical system -Transfer function- Laplace transforms- Block diagram Algebra signal flow graphs- feedback characteristics of control system.

UNIT-II: Time and frequency domain Analysis (12 Hours)

Time response: type and order of control system- test signals- Time response of first and second order systems to unit step input. Time Domain specifications and their formulae-frequency response- correlation between time and frequency response-bode plots-Nyquist plot-Nyquist stability criterion-determination of closed loop response from open loop response.

UNIT-III: Error analysis and Controllers (12 Hours)

The role of feedback system, error analysis- Response of 2nd order system with P, PI and PID controllers- Ziegler Nichols rules for tuning PID controllers- Design of PID controllers with frequency response approach - comparison of the controller response- Design concepts of modified PID controller- two degrees of freedom control- zero placement approach to improve response characteristics

UNIT-IV: Introduction to automation and automation system (12 Hours)

Automation- basic concept: Definition-positioning concept- components and application of automation system: automation system application –function of automation system- levels of automation- important concepts- Analog and digital- input and output types- numbering system- electrical power - processes- Documentation and file formats. Components and hardware- power control- actuators, sensors and movement- Ac and DC motors- control devices-machine system- process control system and automated machinery machine and system design-safety- application.

UNIT-V: Industry IoT 4.0 (12 Hours)

Introduction- Industry 4.0- Definition of industry 4.0 - Key paradigm of Industry 4.0-Industry 4.0 conception-framework of Industry 4.0: conception and technologies-Nine pillars of technological advancement - Macro perspective of industry 4.0 - Micro perspective of industry 4.0 - Industry 4.0 components - Industry 4.0 design principles - Impact of industry 4.0 – RAMI 4.0 – Servitization - Product service system (PSS) - SMARTness and Pervasive Computing - The Industry 4.0 Architecture – Cloud computing – Big data analytics as service provider.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Katsuhiko Ogata (2010), *Modern control engineering* (5th Edition), Upper Saddle River, NJ: Prentice Hall.
2. Nagrath IJ and M Gopal (2006), *Control Systems Engineering* (4th Edition), New Age International (P) Ltd., Publishers.
3. Politeknik Port Dickson (2013), *Industrial Automation: An Engineering Approach*.
4. Frank Lamb (2013), *Industrial automation: hands-on*. McGraw-Hill Education.

5. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, - Handbook of Industry 4.0 and SMART Systems‖ Taylor and Francis,2020

Unit	Book	Chapter	Sections
I	1 2	12, 3	1.1,1.2,1.32.4,2.5, 2.6, 2.7, 3.1- 3.7
II	2 1	5 7	5.1, 5.2,5.3, 5.4, 8.2-8.45.8, 7.2, 7.3,7.5, 7.6, 7.8, 7.10
III	1 2	8 3	8.1-8.73.1 -3.6
IV	3, 2, 4	1, 22, 3, 4, 9, 10	1.1, 1.2, 1.3, 2.1-2.4, 2.1-2.7, 3.1-3.6, 4.1, 9.1-9.6, 10
V	1	1, 2, 3, 4, 5	1.1-1.5, 2.1-2.2, 3.1-3.2, 4.1-4.2, 5.1-5.2

Books for Reference:

1. Levine, W.S. (2011), *Control system fundamentals* (2nd Edition), CRC press.
2. Manesis, S. and Nikolakopoulos, G. (2018), *Introduction to industrial automation*. CRC Press.
3. Norman S. Nise (2015), *Control System Engineering* (7th Edition), Courier Kendallville.

Websites and eLearning Sources:

1. https://sites.google.com/view/vivekmohan/control-system-lecture-notes.
2. https://www.princeton.edu/~cuff/ele201/kulkarni_text/frequency.pdf.
3. https://learnemc.com/time-frequency-domain
4. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0242428.
5. https://www.msec.be/verboten/seminaries/ICS_archs_and_sec_essentials/ICS_Overview.pdf
6. https://api.pageplace.de/preview/DT0400.9780429849688_A39912589/preview-9780429849688_A39912589.pdf

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements	Cognitive Level (K- level)
	On successful completion of this course, students will be able to	
CO1	Acquire knowledge on basic concepts of control system and industrial automation	**K1**
CO2	Explain the time-domain and frequency-domain analysis of an industrial automation model to predict the system's behaviour.	**K2**
CO3	Apply various controllers in industrial automation	**K3**
CO4	Analyze the performance of control systems	**K4**
CO5	Design the control system and automation for an application	**K5**
CO6	Evolve concepts and techniques of industry 4.0	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours/Week**		**Credits**
4	**25PEL4ES03A**			**Discipline Specific Elective – 3:** Control System and Industry 4.0					**4**		**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	2	3	3	2	2	2.4
CO2	2	2	3	2	3	2	2	3	2	2	2.3
CO3	2	3	2	2	2	2	2	2	3	3	2.3
CO4	2	3	2	2	3	2	2	2	3	2	2.3
CO5	2	2	3	2	3	3	2	2	3	3	2.5
CO6	3	3	2	2	3	2	2	2	3	3	2.6
Mean Overall Score											**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	25PEL4ES03B	**Discipline Specific Elective – 3:** Biomedical Signal and Image Processing	4	3

Course Objectives
To study bio signals from organs and wavelet transformation
To understand Brain CT, ECG and EEG signal processing using various algorithms
To apply signal and image processing in bio medical applications
To analyse and compare the signal processing techniques in bio medical applications
To develop suitable algorithm for bio signal processing

UNIT-I: ECG Signal Processing (12 Hours)

Origin of ECG Signal – ECG Electrode Placement – Modeling and Representation of ECG – Heart Rate – Processing and Feature Extraction of ECG: Time Domain Analysis – Frequency Domain Analysis – Wavelet Domain Analysis.

UNIT-II: EEG Signal Processing (12 Hours)

The Brain Wave – Characteristics of EEG Signal – Basic Principle of EEG Signal Analysis - Brain Computer Interface (BCI) EEG signal Processing System Block Diagram - EEG signal Acquisition – Signal Preprocessing using Adaptive Filtering - Signal Extraction using FFT and Wavelet Transformation.

UNIT-III: Brain CT-scan image processing (12 Hours)

CT Scanner and Detector - Pre- Processing using Image Restoration – Edge Detection Using Canny and Prewitt Methods – Gobar Filter to Detect Region of Interest – Detect the Features Using BLOB (binary large object) Analysis.

UNIT-IV: MRI Image Processing (12 Hours)

Preprocessing using Gaussian Filter – Image Enhancement using Threshold Based Anisotropic Diffusion Filter - Threshold model on bounding box method - Parameters used to define a bounding box - Threshold with bounding box approach to detect tumor – Image Segmentation - Morphological Dilation and Erosion.

UNIT-V: Fingerprint Biometrics (12 Hours)

Finger Print Sensors – Useful Features of the Fingerprint - Fingerprint Recognition Systems – Histogram Equalization – Fingerprint Image Enhancement Using Fourier Transform – Binarization – Image Segmentation - Minutiae Extraction – Finger Print Indexing – Advantages and Disadvantages.

Teaching Methodology	Demo Videos, PPT, Handouts, circuit simulations and analysis, Chalk and talk
Assessment Methods	MCQ, Written Assignment, Prototype model construction, Circuit Simulation, Troubleshooting

Books for Study:

1. Kayvan Najarian and Robert Splinter (2012), *Biomedical Signal and Image Processing*, CRC Press, Taylor & Francis Group
2. Sinha G. R. and Sandeep B. Patil (2013), *Biometrics: Concepts and Applications*, Wiley.

Unit	Book	Chapter	Sections
I	1		Relevant sections
II	1		Relevant sections
III	1		Relevant sections
IV	1		Relevant sections
V	2		Relevant sections

Books for Reference:

1. Mohana rathinam," *Enhanced Image Filtration using Threshold based Anisotropic Filter for Brain Tumor Image Segmentation* ", Proceedings of the Third International Conference on Intelligent Sustainable Systems

[ICISS 2020] IEEE Xplore Part Number: CFP20M19-ART; ISBN: 978-1-7281-7089-3
2. Joni-Kristian Kamarainen*, "Gabor Features in Image Analysis", Machine Vision and Pattern Recognition Laboratory*, Lappeenranta University of Technology (LUT Kouvola
3. Nilesh Bhaskarrao Bahadure, Arun Kumar Ray and Har Pal Thethi, *"Image Analysis for MRI Based Brain Tumor Detection and Feature Extraction Using Biologically Inspired BWT and SVM",*
4. *International Journal of Biomedical Imaging*, Volume 2017, Article ID 9749108, 12 pages, https://doi.org/10.1155/2017/9749108
5. Rupavathy. Na, and Dr. M. J. Carmel Mary Belindab," *Anisotrophic Filter Based Detection of Brain Tumor* ", Turkish Journal of Computer and Mathematics Education Vol.12 No.9 (2021), 172-181.
6. Sonka, Hlavac and Boyle, Reprint 2011 " *Digital Image Processing and Computer Vision*", CENGAGE

Websites and eLearning Sources:

1. http://taylorandfrancis.com Learning, Sixth Indian.
2. https://ieeexplore.ieee.org/document/5783430
3. https://library.oapen.org/handle/20.500.12657/41663
4. https://www.sciencedirect.com/journal/biomedical-signal-processing-and-control
5. https://www.southampton.ac.uk/courses/modules/isvr6138

(* subject to availability - not to be used for exam purpose)

CO. No.	CO - Statements On successful completion of this course, students will be able to	Cognitive Level (K- level)
CO1	Recognize bio signals from organs and wavelet transformation	**K1**
CO2	Understand Brain CT, ECG and EEG signal processing using various algorithms	**K2**
CO3	Apply signal and image processing in bio medical applications	**K3**
CO4	Analyse the signal processing techniques in bio medical applications	**K4**
CO5	Compare and recommend suitable algorithm for bio signal processing	**K5**
CO6	Develop algorithm to design an ECG, EEG arrhythmia detection system detect brain tumor and fingerprint biometric system	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours/Week**		**Credits**
4	**25PEL4ES03B**			**Discipline Specific Elective – 3:** Biomedical Signal and Image Processing					**4**		**3**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	2	3	3	2	2	2.4
CO2	2	2	3	2	3	2	2	3	2	2	2.3
CO3	2	3	2	2	2	2	2	2	3	3	2.3
CO4	2	2	2	2	3	2	2	2	3	2	2.2
CO5	2	2	2	2	3	2	2	2	2	2	2.1
CO6	2	2	2	2	3	2	2	2	2	2	2.1
Mean Overall Score											**2.23 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	**25PEL4PW01**	Project work & Viva Voce	**12**	**8**

To get resources, learn new techniques from experts and get industrial exposure
To understand research methodology and report preparation
Able to involve in research, entrepreneur and get employability in hardware and software industries.

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	**25PEL4CE01**	Comprehensive Examination	**-**	**2**

UNIT-I: Analog and Digital Systems, Embedded Systems Design and Programming

UNIT-II: Signal Processing and Electronic Communication

UNIT-III: Automotive Electronics, Power Electronics and Control Systems

UNIT-IV: VLSI Design and Programming and Instrumentation

UNIT-V: IoT and AI

Books for Study:
Respective course books

Books for Reference:
Respective course books