M. Sc. ELECTRONICS

SYLLABUS - 2018

SCHOOL OF EXCELLENCE
with
CHOICE BASED CREDIT SYSTEM (CBCS)

SCHOOL OF PHYSICAL SCIENCES
St. JOSEPH'S COLLEGE (Autonomous)
Special Heritage Status Awarded by UGC
Accredited at 'A' Grade (3rd cycle) by NAAC
College with Potential for Excellence Conferred by UGC
DBT-STAR & DST-FIST Sponsored College
TIRUCHIRAPPALLI - 620 002, INDIA

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS)

POSTGRADUATE COURSES

St. Joseph's College (Autonomous), a pioneer in higher education in India, strives to work towards the academic excellence. In this regard, it has initiated the implementation of five "Schools of Excellence" from the academic year 2014-15, to standup to the challenges of the 21st century.

Each School integrates related disciplines under one roof. The school system allows the enhanced academic mobility and enriched employability of the students. At the same time this system preserves the identity, autonomy and uniqueness of every department and reinforces their efforts to be student centric in curriculum designing and skill imparting. These five schools will work concertedly to achieve and accomplish the following objectives.

- Optimal utilization of resources both human and material for the academic flexibility leading to excellence.
- Students experience or enjoy their choice of courses and credits for their horizontal mobility.
- The existing curricular structure as specified by TANSCHE and other higher educational institutions facilitate the Credit-Transfer Across the Disciplines (CTAD) - a uniqueness of the choice-based credit system.
- Human excellence in specialized areas
- Thrust in internship and / or projects as a lead towards research and
- The multi-discipline nature of the newly evolved structure (School System) caters to the needs of stake-holders, especially the employers.

What is Credit system?

Weightage to a course is given in relation to the hours assigned for the course. Generally, one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The following Table shows the correlation between credits and hours. However, there could be some flexibility because of practical, field visits, tutorials and nature of project work.

For PG courses, a student must earn a minimum of 110 credits as mentioned in the table below. The total number of minimum courses offered by a department are given in the course pattern.

POSTGRADUATE COURSE PATTERN (June 2018 onwards)

Part	Semester	Specification	No. of Courses	Hours	Credits	Total Credits
1	I-IV	**Core Courses** Theory Practical	 12-14 3-6	84	68	81
	II	**Self-Paced Learning**	1	-	2	
	III	**Interdisciplinary Core**	1	6	5	
	IV	**Comprehensive Examination** **Project Work**	1 1	- 6	2 4	
2	I-III	**Core Electives**	3	12	12	12
3	II	**IDC (Soft Skills)**	1	4	4	**12**
	III	**IDC (WS)** **IDC (BS)**	1 1	4 4	4 4	
4	I	**Extra Credit Courses-1 (MOOC)**	1	-	(2)	(4)
	III	**Extra Credit Courses-2 (MOOC)**	1	-	(2)	
5	IV	Outreach Programme (SHEPHERD)	1	-	5	**5**
		TOTAL		**120**		**110 (+4 extra credits)**

Note: IDC: Inter-Departmental Courses, BS: Between School, WS: Within School

However, there could be some flexibility because of practical, field visits, tutorials and nature of project work. For PG courses, a student must earn a minimum of 110 credits. The total number of courses offered by a department is given above.

Course Pattern

The Post-Graduate degree course consists of five vital components. They are core course, core electives, IDCs, Extra credit courses, and the Outreach Programme.

Core Courses

A core course is the course offered by the parent department related to the major subjects, components like theories, practicals, Inter disciplinary core, self paced learning, comprehensive examination, Project work, field visits, library record and etc.

Inter-disciplinary Core

Inter-disciplinary Core should be shared by the various Departments of every School. This course should be opted by all the students belonging to the particular school. Each department of the respective school should allocate themselves the schedule and the units of the course.

Core Elective

The core elective course is also offered by the parent department. The objective is to provide choice and flexibility within the department. There are three core electives. They are offered in different semesters according to the choice of the school.

Extra Credit Courses

In order to facilitate the students gaining extra credits, the extra credit courses are given. According to the guidelines of UGC, the students are encouraged to avail this option of enriching by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL etc.

Inter-Departmental Courses (IDC)

IDC is an interdepartmental course offered by a department / School for the students belonging to other departments / school. The objective is to provide mobility and flexibility outside the parent department / School. This is introduced to make every course multi-disciplinary in nature. It is to be chosen from a list of courses offered by various departments.

There are three IDCs. Among three, one is the Soft-Skill course offered by the JASS in the II Semester for the students of all the Departments. The other one is offered "With-in the school" (WS) and the third one is offered "Between the school" (BS). The IDCs are of application oriented and inter disciplinary in nature.

Subject Code Fixation

The following code system (9 characters) is adopted for Post Graduate courses:

Year of Revision ↓	PG Code of the Dept ↓	Semester ↓	Specification of Part ↓	Running number in the part ↓
18	P##	*x*	*x*	*xx*
18	**PEL**	**1**	**1**	**01**

For Example :

I MSc - Electronics, first semester **'Design of Analog Circuits'**
The code of the paper is **18PEL1101**.
Thus, the subject code is fixed for other subjects.

Specification of the Part

I - Core Courses: (Theory, Practical, Self paced Learning, Inter-disciplinary Core, Core, Comprehensive Examination, Project work)
II - Core Electives
III - Inter Departmental Courses (WS, Soft Skill & BS)
IV - Extra credit courses
V - Outreach Programme (Shepherd)

EXAMINATION

Continuous Internal Assessment (CIA):

PG - Distribution of CIA Marks	
Passing Minimum: 50 Marks	
Library Referencing	5
3 Components	35
Mid-Semester Test	30
End-Semester Test	30
CIA	**100**

Mid-Semster & End-Semester Tests

Centralised – Conducted by the office of Controller of Examinations

1. Mid-Semester Test & End-Semester Test: (2 Hours each); will have Objective + Descriptive elements; with the existing question pattern PART-A; PART-B; and PART-C
2. CIA Component III for UG & PG will be of 15 marks and compulsorily objective multiple choice question type.
3. The CIA Component III must be conducted by the department / faculty concerned at a suitable computer centres.
4. The 10 marks of PART-A of Mid-Semester and End-Semester Tests will comprise only: OBJECTIVE MULTIPLE CHOICE QUESTIONS; TRUE / FALSE; and FILL-IN BLANKS.
5. The number of hours for the 5 marks allotted for Library Referencing/ work would be 30 hours per semester. The marks scored out of 5 will be given to all the courses (Courses) of the Semester.
6. English Composition once a fortnight will form one of the components for UG General English

SEMESTER EXAMINATION

Testing with Objective and Descriptive questions

Part-A: Objective MCQs only (30 Marks)

Answers are to be marked on OMR score-sheet. The OMR score-sheets will be supplied along with the Main Answer Book. 40 minutes after the start of the examination the OMR score-sheets will be collected

Part-B & C: Descriptive (70 Marks)

Part-B: 5 x 5 = 25 marks; inbuilt choice;

Part-C: 3 x 15 = 45 marks; 3 out of 5 questions, open choice.

The Accounts Paper of Commerce will have

Part-A: Objective = 25 marks

Part-B: 25 x 3 = 75 marks

Duration of Examination must be rational; proportional to teaching hours 90 minute-examination / 50 Marks for courses of 2/3 hours/week (all Part IV UG Courses) 3-hours examination for courses of 4-6 hours/week.

GRADING SYSTEM

1. Grading

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added. The marks thus obtained, will then be graded as per the scheme provided in the following 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 (GPA)** and **Cumulative Grade Point Average (CGPA)** respectively. These two are calculated by the following formulae:

GPA = $\frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$ **WAM** (Weighted Averag Marks) = $\frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$

where,

'C_i' is the Credit earned for the Course-*i,*
'G_i' is the Grade Point obtained by the student for the Course '*i*',
'M' is the marks obtained for the course '*i*', and
'*n*' is the number of Courses **Passed** in that semester.

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

2. Classification of Final Results

i) The classification of final results shall be based on the CGPA, as indicated in the following Table-2.

ii) For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly, the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99, and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.

iii) Absence from an examination shall not be taken as an attempt.

Table-1: Grading of the Courses

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

Table-2: Final Result

CGPA	Classification of Final Results	Corresponding Grade
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-appearance

Credit based weighted Mark System is to be adopted for individual semesters and cumulative semesters in the column 'Marks Secured' (for 100).
A Pass in Outreach Programme (SHEPHERD) will continue to be mandatory although the marks will not count for the calculation of the CGPA.

Declaration of Result:

Mr./Ms. _____ has successfully completed the Post Graduate in _____ programme. The candidate's Cumulative Grade Point Average (CGPA) is _____ and the class secured _____ by completing the minimum of 110 credits.
The candidate has also acquired _____ (if any) extra credits offered by the parent department courses.

M. Sc. ELECTRONICS

Course Pattern - 2018 Set

Sem	Code	Subject Title	Hr	Cr
I	18PEL1101	Design of Analog Circuits	6	5
	18PEL1102	Design of Digital Circuits	6	5
	18PEL1103	Signals and Systems	6	5
	18PEL1104	Electronics Practical-I	8	6
	18PEL1301	IDC (WS) - Electronics Media	4	4
	18PEL1401	Extra Credit Course-I (MOOC)	-	(2)
		Total for Semester –I	**30**	**25**
II	18PEL2105	Embedded System-I	6	5
	18PEL2106	Digital Signal Processing and PDSP	6	4
	18PEL2107	Power Electronics and Solar PV systems	6	4
	18PEL2108	Electronics Practical –II	8	6
	18PEL2109A	Self-paced Learning: Automotive Electronics	-	
	18PEL2109B	Self-paced Learning: Programmable Logic Controllers and Programming	-	
	18PEL2109C	Self-paced Learning: Medical Electronics	-	2
	18PSS2301	IDC: Soft Skills	4	4
		Total for Semester –II	**30**	**25**
III	18PEL3110	Embedded System-II	4	4
	18PEL3111	Electronics Practical –III	8	6
	18SPS3101A	Interdisciplinary Core: Spectroscopy and Statistical Thermodynamics	6	5
	18SPS3101B	Interdisciplinary Core: Spectroscopy **		
	18SPS3101C	Interdisciplinary Core: Sensors and Transducers		
	18PEL3201A	VLSI Design and VHDL Programming (or)	4	4
	18PEL3201B	Electromagnetic Theory		
	18PEL3202A	Computer Hardware and Networks (or)	4	4
	18PEL3202B	Instrumentation		
	18PEL3302	IDC: BS-Consumer Electronics	4	4
	18PEL3112	In-Plant Training	-	2
	18PEL3402	Extra Credit Course-II (MOOC)	-	(2)
		Total for Semester –III	**30**	**29**
IV	18PEL4113	Embedded System-III	6	5
	18PEL4114	Control System and Robotics	6	5
	18PEL4115	Electronics Practical-IV	8	6
	18PEL4201A	Internet of Things and AI (or)	4	4
	18PEL4201B	Modern Communication Systems		
	18PEL4116	Project Work	6	4
	18PEL4117	Comprehensive Examination	-	2
		Total for Semester –IV	30	**26**
	18PCW4501	Outreach Programme (SHEPHERD)	-	5
		Total Credits for All Semesters	**120**	**110+(4)**

Programme Outcomes (POs):

1. Students are prepared to be creators of new knowledge leading to innovation, entrepreneur and employable in various sectors such as Private, Government and Research organizations.
2. Students are trained to evolve/ adopt new technologies in their own discipline.
3. Students are groomed to engage in lifelong learning process by exploring knowledge independently
4. Students are framed to design and conduct experiments/ demonstrate/ create models to analyze and interpret data.
5. Students ought to have the ability of effectively communicating the findings of Biological Sciences/ Computing Sciences/ Languages and Culture/ Management Studies/ Physical Sciences/ and to incorporate with existing knowledge.

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.

_____

Semester I **Hours/Week: 6**
18PEL1101 **Credits : 5**

DESIGN OF ANALOG CIRCUITS

Course Outcomes:

1. Ability to understand different type of amplifiers and their working
2. Acquire knowledge on current mirrors, voltage and current reference circuits.
3. Acquire knowledge on various transistor configuration
4. To understand the knowledge about frequency response in circuits
5. Analyze the characteristics of OP-Amp
6. To master on special amplifiers and data converters.
7. To understand characterize the analog IC's
8. Apply the fundamental concepts of design of multistage amplifier for real time applications.

Unit-I: SINGLE AND MULTI-STAGE AMPLIFIERS (15 hr)

Device model selection - Two-Port modeling of amplifiers - Basic single transistor amplifier stages - Common emitter - Common source - Common base - Common gate - Common collector - Common drain configuration and common emitter amplifier - Multiple transistor amplifier stages - CC - CE, CC - CC and Darlington configurations - Cascode configuration - Active cascode - Differential pairs - DC transfer characteristics emitter coupled pair - Emitter degeneration - Source coupled pair.

Unit-II: CURRENT MIRRORS, ACTIVE LOADS & REFERENCES (15 hr)

Current mirrors - General properties - Simple current mirror - Simple current mirror with degeneration- Wilson current mirror - Active loads-common emitter, common source amplifier with complementary load - Depletion load - Voltage and current references - Low current biasing - Supply insensitive biasing.

Unit-III: FREQUENCY RESPONSE OF AMPLIFIERS (14 hr)

Single stage amplifiers - Miller effect - Frequency response for differential amplifier - Voltage buffers - Emitter follower - Source follower - Current buffers - Common base and common gate amplifier response - Multistage amplifier frequency response - Dominant pole approximation - Zero value time constant analysis - Cascade voltage amplifier - Current mirror loading - Circuit time constants

Unit-IV: OP AMP CHARACTERISTICS (14 hr)

Op amp topologies – single supply op amp issues - op amp input stages - FET input stages - rail to rail input stages - output stages - output stage surge protection - Specifications - input off set voltage - offset adjustment - internal and external method - input offset voltage drift and ageing effects - input bias current - input bias current - input impedance - manipulating noise and gain - open loop gain - Frequency response - settling time - Op amp noise - voltage noise - current noise - shot noise - noise figure - popcorn noise - CMRR - PSRR

Unit-V: SPECIAL AMPLIFIERS AND DATA CONVERTERS (14 hr)

Instrumentation amplifiers - Difference amplifier - AD627 two op amp instrumentation amplifier - Programmable gain amplifiers - design issues - AD526 PGA - DAC programmed PGA. Isolation amplifiers - isolation techniques - AD210 three port isolator - Data converters - introduction - trends in data converters - ADC and DAC static transfer functions and dc errors - quantization noise - ADC/DAC specifications - driving ADC inputs - driving ADC/DAC reference inputs - buffering DAC outputs general considerations.

Books for study

1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, "Analysis and design of Analog integrated circuits", 5th edition, 2009, John Wiley.
2. Walt Jung, "Op amp applications handbook", 1st edition, 2005, Newnes.

Books for reference

1. Tony Chan Carusone, David A. Johns and Kenneth W. Martin, "Analog integrated circuit design" , 2nd edition, 2011, John wiley.
2. Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 7th edition Prentice Hall.

Unit	Book	Sections
I	1	3.1, 3.2, 3.3.1 - 3.3.4, 3.3.6 - 3.3.8, 3.4.1 – 3.4.3, 3.5.1 - 3.5.4
II	1	4.1, 4.2.2 – 4.2.4, 4.2.6, 4.3.1 – 4.3.3, 4.4.1.1 - 4.4.1.2, 4.4.2, 4.4.2.1
III	1	7.1, 7.2.1, 7.2.2, 7.3
IV	2	1.1-1.4
V	2	2.1 - 2.3, 3.1 - 3.5

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PEL1101				Title of the Paper DESIGN OF ANALOG CIRCUITS									Hours 6	Credits 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	PSO6	PSO7	PSO8		
CO1	5	4	4	4	4	5	4	4	4	5	4	3	5	4.2	
CO2	5	4	3	4	3	4	4	4	3	4	4	4	4	3.8	
CO3	5	4	3	4	3	4	4	4	4	4	4	4	4	3.9	
CO4	5	4	4	4	4	4	4	4	3	3	4	4	3	3.7	
CO5	5	4	5	4	5	4	4	4	5	3	4	4	4	4.2	
CO6	5	4	4	4	4	4	4	4	5	3	4	4	4	4.0	
CO7	5	3	4	4	3	4	3	4	4	3	4	3	3	3.6	
CO8	5	3	4	4	3	4	3	4	4	3	4	4	3	3.7	
Overall Mean Score for COs														3.9	

Result: The Score for this Course is 3.9 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$

Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester I **Hours/Week: 6**
18PEL1102 **Credits : 5**

DESIGN OF DIGITAL CIRCUITS

Course Outcomes:

1. Ability to understand the combinational logic functional theory and design.
2. Acquire knowledge on data transmission system
3. To perceive the design concepts of counters and shift registers
4. Acquire knowledge on clock-driven sequential circuits.
5. Analyze design concepts of event driven circuits
6. To simulate and implement the digital design concepts in software.
7. To verify the digital circuits outputs in Lab VIEW
8. Apply the fundamental concepts of design digital circuits for real time applications.

Unit-I: COMBINATIONAL LOGIC CIRCUITS AND DESIGN PRINCIPLES (14 hr)

Introduction to combinational logic circuits - Gate signal conventions - Gate expansion - Noise margin - propagation time - fan-out - Multiplexers and data selection (2:1, 4:1) - Interconnecting multiplexers (64:1) - De Multiplexers(1:8) - Multiplexers /De Multiplexers data transmission system - Decoders (3:8) - Decoder networks - Display decoding - Encoder circuit principles - Encoding networks.

Unit-II: COUNTERS AND REGISTERS (13 hr)

Introduction - Clock signal - Basic counter design - Scale of-five up counter - Integrated circuit counters - Cascading of IC counter chips -Use of shift registers as counters and sequence generators - Universal state diagram of shift registers - Design of decade counter - Multi-bit rate multipliers.

Unit-III: CLOCK-DRIVEN SEQUENTIAL CIRCUITS (15 hr)

Basic synchronous sequential circuits - analysis of a clocked sequential circuit - design steps for synchronous sequential circuits - Design of sequence detector -Moore and mealy state machines - State reduction - State assignment - algorithmic state machine charts - clock skew - clock timing constraints. PLL - setup and holding time analysis in digital circuit

Unit-IV: EVENT-DRIVEN CIRCUITS (15 hr)

Design procedure: asynchronous sequential circuits - stable and unstable

states - design of sequence detector - state reduction for incompletely specified machines - gate delays - generation of spikes the elimination of static hazards - design of hazard -free combinational networks-asynchronous circuit design.

Unit-V: LABVIEW FOR DIGITAL CIRCUITS (15 hr)

LabVIEW basics: Navigating LabVIEW- troubleshooting and Debugging VIs – implementing a VI- relating data – storing measurement data – developing modular application- instrument control – common design techniques and patterns. Digital circuit simulations using LabVIEW: building logic circuits and verifying its truth table, simplifying the Boolean expressions – proving the POS circuit – proving the SOP circuit.

Books for study:

1. BrianHoldsworth and clive woods, "DIGITAL LOGIC DESIGN" Elsevier-4th edition,2005.

Reference books

1. M.Morris Mano, "Digital logic and Computer Design", PHI, 1979.
2. Charles.H.Roth, Jr, "Digital Systems Design using VHDL", PWS Publishing Company, 2001.
3. John B. Peatman, "Digital hardware Design", McGraw hill.

Unit	Book	Sections
I	I	4.16-4.19,5.1-5.4,5.7-5.15
II	I	7.1-7.5, 7.13-7.15, 7.19-7.21, 7.26, 8.1-8.6, 8.9-8.11, 8.14, 8.15
III	I	Lecture material (PLL - setup and hold time analysis)
IV	I	9.2,9.3,9.8,9.9,9.15-9.21
V		Lecture notes

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PEL1102					Title of the Paper DESIGN OF DIGITAL CIRCUITS								Hours 6	Credits 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	PSO6	PSO7	PSO8		
CO1	5	4	3	4	4	4	3	3	4	4	3	3	4		3.7
CO2	4	4	3	4	3	4	4	2	4	4	3	4	4		3.6
CO3	4	3	3	3	3	4	4	4	3	4	3	3	5		3.5
CO4	4	4	3	2	4	4	3	3	2	4	3	3	5		3.3
CO5	4	4	3	2	4	4	3	2	3	4	4	4	4		3.4
CO6	4	3	3	4	4	4	3	5	3	4	4	4	4		3.7
CO7	4	3	4	4	4	4	4	5	3	4	4	4	4		3.9
CO8	4	3	4	4	4	4	3	5	3	4	4	4	4		3.8
										Overall Mean Score for COs					3.6

Result: The Score for this Course is 3.6 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 6**
18PEL1103 **Credits : 5**

SIGNALS AND SYSTEMS

Course Outcomes:

1. Ability to analyze signals and LTI Systems.
2. Understand Laplace Transforms of functions
3. Ability to solve some important properties of Laplace Transform
4. To perceive the Fourier series of functions.
5. Acquire knowledge on Fourier transform
6. To solve the mathematical problems in Fourier transform
7. Understand the complex functions and Z transforms.
8. Knowledge on signals and their functions by simulating them in SIMULINK and MATLAB.

Unit-I: LAPLACE TRANSFORM (15 hr)

Definition of Laplace transform - Problems - Piecewise or sectional continuity - Sufficient condition for existence of Laplace transform - Some properties of Laplace transform - Some methods for finding Laplace transforms - Laplace transform of some special function.

Unit-II: FOURIER SERIES (15 hr)

Function definition - Dirichlet conditions - Parseval's identity: Fourier series - Fourier's integral Fourier coefficients and identification - Convergence of Fourier series - Physical applications of Fourier series.

Unit-III: FOURIER TRANSFORM (15 hr)

Signals: Definition - Classification of signals - Basic operations on signals - Types of signals. Continuous-time Fourier Transform (CTFT) - CTFT representation of aperiodic signal - Properties of CTFT - Problems - Discrete Time Fourier Transform (DTFT): Definition - DTFT representation of aperiodic signal - Properties of DTFT - Problems.

Unit-IV: Z-TRANSFORM (15 hr)

Z-Transforms (Double and Single sided) - Relationship between the Z-transform and discrete - time Fourier transform - Relationship between the Z - plane and S - plane - Methods of inverse Z- transforms - Power series method (long-division) - Partial-fraction method - Residual method.

Unit-V: MATLAB and SIMULINK PROGRAMMING (12 hr)

Introduction to MATLAB-Matrices - Working with matrices - Basic plotting - Basic signals and its functions - MATLAB Programming: Representation of basic signals - Discrete convolution - Stability test – Simulink :Create - import - export - display - manage signals -transfer function blocks for different signals and operations -Fourier transform: DTFT, CTFT, coefficient identification in Fourier series - stability analysis using Z transform -Up/ Down sampling sinusoidal signal sequence.

Books for Study

1. B.D Gupta, "Mathematical Physics", 3rd reprint, Vikas publishing House Pvt Limited, 2009.
2. Poornachandra S., "Signals and Systems", Vijay Nicole imprints Pvt. Ltd., 2004.

Books for References

1. Alan V. Opphenehim, Alan S. willsky and Hamid nawab S., "Signals and Systems", 2nd Edition, PHI, 2004.
2. Ramesh Babu P, AnandaNatarajan R., "Signals and System", 3rd Edition, Scitech publication private limited, 2007.
3. P. Kandasamy, K. Thilagavathi, K. Gunavathi, "Engineering Mathematics Vol-1",S.Chand limited, 2009

Unit	Book	Sections
I	1	10.1,10.2, 10.6, 10.8, 10.9, 10.11
II	1	9.1,9.2, 9.5, 9.6, 9.8, 9.9
III	2	1.1-1.4, 7.1-7.4, 8.1-8.3
IV	2	11.1-11.4, 11.7-11.9, 11.12
V		Lecture Notes

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PEL1103					Title of the Paper SIGNALS AND SYSTEMS								Hours 6	Credits 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	PSO6	PSO7	PSO8		
CO1	4	3	2	3	3	5	3	2	3	3	3	4	4	3.2	
CO2	4	4	2	4	2	5	4	3	2	3	3	4	4	3.4	
CO3	4	3	2	3	4	5	4	4	2	3	3	4	4	3.5	
CO4	4	3	2	4	3	5	3	4	2	4	3	4	5	3.5	
CO5	4	3	2	3	3	5	2	3	2	4	3	4	5	3.3	
CO6	4	3	2	3	2	5	4	2	2	4	3	4	4	3.3	
CO7	4	3	2	3	2	5	4	2	2	4	3	4	4	3.3	
CO8	4	3	2	3	2	5	4	2	2	4	3	4	4	3.3	
													Overall Mean Score for COs	3.4	

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No.of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester I **Hours/Week: 8**
18PEL1104 **Credits : 6**

Electronics Practical-I
ANALOG, DIGITAL, SIGNALS AND SYSTEMS EXPERIMENTS

Any 12 Experiments

1. Design of CB,CC and CE transistor amplifier
2. Programmable gain amplifier using op amp
3. Wheatstone bridge with instrumentation amplifier for temperature measurement
4. ADC performance parameter study
5. DAC performance parameter study
6. Encoder and decoder study (RF, gray to binary and binary to gray, DTMF decoder, BCD to seven segment)
7. Design of two pair 4-bit sequential counter (HEX).
8. Design of 8-bit registers using flip-flop and gate IC's
9. Design of mod-n counter.
10. Waveform generation using MATLAB
11. Sampling of sine wave using MATLAB
12. Coefficient identification in Fourier series using Simulink
13. Stability test using bode plot using Simulink.
14. Construct and study Op-Amp applications-I (Non-inverting, Inverting, Integrator, Differentiator, Unity gain amplifier)
15. Construct and study Op-Amp applications-II (Instrumentation Amplifier, V to I, I to V (4-20mA))
16. Construct and study Op-Amp applications-III (Clipper and Clamper)
17. Construct and study Op-Amp applications-IV (Comparator, Zero crossing detector, Window detector, Peak detector Precision rectifier)
18. FET amplifier design
19. Construct and study the Power control rectifier using SCR, TRIAC and UJT
20. Study of Adder, subtractor and IC based BCD adder and subtractor
21. Study of Encoder and Decoder
22. Study of Shift register (SISO, SIPO, PISO & PIPO) and Universal shift register IC
23. Study of multiplexer and de-multiplexer (Construction and chip study)
24. Solving simultaneous equation using op-amp.
25. Construction of UP and Down counter using flip-flops.

Semester I **Hours/Week: 4**
18PEL1401 **Credits : 4**

IDC (WS): ELECTRONICS MEDIA

Course Outcomes:

1. Ability to understand the essential electronic components for media
2. Ability to distinguish the elements of photography
3. To identify the audio systems
4. Acquire knowledge on video broadcasting systems.
5. To installation and maintenance of the electronics media devices
6. Apply the functionalities of electronic devices and circuits in electronic media.

Unit- I: ELEMENTS FOR ELECTRONIC MEDIA (10 hr)

Introduction to electronic media-Semiconductors, ICs, Amplifier: Classification and characteristics – Oscillator – Digital electronics: Analog and digital signals – Power supply sources – Switch Model Power Supply (SMPS) – Inverters – Modulation AM and FM - receivers – Characteristics of a receiver – Radio transmitters – ADCs and DACs – general purpose Public addressing system.

Unit-II: ELEMENTS OF PHOTOGRAPHY (8 hr)

Introduction to Digital and film photography - Digital images and their characteristics - Pixels and resolutions - Digital Camera and their types - Different camera formats - working of an SLR and DSLR Cameras - Features and functions of SLR and DSLR Cameras -Various camera controls – Exposure - Image sensors - Different storage formats - Image printing equipment – gadgets for image sharing.

Unit- III: SOUND AND AUDIO BROADCASTING SYSTEM (11 hr)

Principles of Sound - Characteristics of Sound – types sound waves and its propagation - Amplitude and Acoustical - Phase - Loudness, Frequency and Human Hearing - Timbre and Sound Envelope – Physical types of microphones - directional response, accessories, positioning – Factors governing microphone selection.

Audio systems and Equipments – Types of cables and connectors and their uses - Transmission and Reception - Mixing console - special effects units – equalizers - compressors - output devices - The Sound Recording Room - Networking of studio and studio environment.

Unit-IV: VIDEO AND BROADCASTING SYSTEM (11 hr)

Basics of Video: Analog and Digital Video - Types of color video signals - Component Video - Composite video - S-video - Chroma sub-sampling - NTSC video - PAL Video - Digital Video - Video Scanning Formats - Video and audio compression - Definition, purpose and types of compression.

Equipment for Videography: Handycam and Broadcast quality Video Camera - Features of Video cameras - Video capturing devices - Web Camera - PTZ camera - Video tuning cards - Video editing systems and their components - Video mixers - Video file rendering, storing and retrieving systems - Streaming of video over net.

Unit-V: MEDIA OUTPUT SYSTEMS (8 hr)

LCD, Plasma screens, IPOD, PDAs, Multimedia projectors, types of speakers, Active and passive speakers - Size of speakers - Home theater network - connection diagram - types of cables, DolBy, DTS, CUBE. Introduction to M-Learning- Mobile devices for e-portfolios - Mobile devices in the classroom - The combination of wireless technology and mobile computing.

Books for Study

1. Lecture Material provided by the department

Books for Reference

1. Jan Maes and March Vereammen “Digital Audio Technology”, 4th Edition Focal Press,2001
2. Randy Thom, Audiocraft: An Introduction to the Tools and Techniques of Audio Production, 2nd edition (National Federation of Community Broadcasters, 1989).
3. Carl Hausmanm and Philip Benoit “Announcing, Broadcasting, Communicating Today,Thomson, 2004.
4. J. Schiller, “Mobile Communications”, PHI/Pearson Education, Second Edition, 2003.
5. Handbook for Sound Engineers, Glen Ballou, Third edition, Focal Press, 2002.
6. The Sound Studio, Alec Nisbett, Seventh Edition, Focal Press, 2003.
7. Practical Recording Techniques, Bruce Bartlett and Jenny Bartlett, Third Editions, Focal Press, 2001.
8. Digital Camera Techniques, Jon Tarrant, Focal Press, 2002.
9. Videomaker Guide to Digital Video and DVD Production, Videomaker, Third edition, Focal Press, 2004.
10. Encyclopedia of Electronic Media, Christopher Sterling, Focal Press, 1998.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PEL1401					Title of the Paper IDC (WS): ELECTRONICS MEDIA							Hours 4	Credits 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	PSO6	PSO7	PSO8	
CO1	5	4	4	3	4	2	4	4	2	3	4	4	4	3.7
CO2	5	4	4	3	4	2	4	4	2	3	4	4	4	3.7
CO3	5	4	4	3	4	2	4	4	2	3	4	4	4	3.7
CO4	5	4	4	3	4	2	4	4	2	3	4	4	4	3.7
CO5	5	4	4	3	4	2	4	4	2	3	4	4	4	3.7
CO6	5	4	4	3	4	2	4	4	2	3	4	4	5	3.7
													Overall Mean Score for COs	**3.7**

Result: The Score for this Course is 3.7 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II **Hours/Week: 6**
18PEL2105 **Credits : 5**

EMBEDDED SYSTEM-I

Course Outcomes:

1. Ability to understand the basics of 8 bit microcontroller
2. Ability to write assembly language program in 8051 microcontroller
3. To acquire knowledge on interfacing techniques of 8bit microcontroller
4. Acquire the basics of 16bit microcontroller
5. To understand the knowledge on 32bit microcontroller
6. Acquire knowledge on ARM instruction set
7. Analyze the interfacing protocols
8. Knowledge on programming in Keil µVision and MPLAB IDEs

Unit-I: 8 BIT MICROCONTROLLER (13 hr)

Introduction to Embedded systems - Anatomy of a typical microcontroller - Harvard and Von-Neumann architecture – Intel 8051A- Architecture – pin out – SFRs- Reset – memory map -Addressing modes -instruction set with example Assembly Language Programs: Data transfer instructions - Arithmetic instructions - Logical instructions – Jump and Call instructions - Single bit instructions.

Unit-II: 8051 MICROCONTROLLER INTERFACING WITH EMBEDDED C PROGRAMMING (13 hr)

I/O port programming - Timer and counter of 8051- serial communication - RS 232 standards – interrupts - interfacing with keypad - LCD interfacing – ADC and DAC interfacing - stepper motor interfacing.

Unit-III: 16-BIT MICROCONTROLLER (15 hr)

PIC24FJ64GA004 Architecture – memory organization- System Control and Reset – Interrupts – oscillator and power saving modes –I/O Ports with example programs – Timers – Input Capture Unit-(ICU) – Output Compare Unit-(OCU) -Serial Peripheral Interface – UART – Parallel Master Port – RTCC – ADC - Instruction Set

Unit-IV: 32-BIT MICROCONTROLLER (16 hr)

RISC and ARM design philosophy – ARM7TDMI LPC2148 core architecture - ARM state and THUMB state register set – Pipeline – Exceptions -Interrupts and vector table - ARM-Thumb Interworking - Memory map - On-chip Peripherals: GPIO – Timer – ADC and DAC – Watch Dog Timer – Real Time

Clock – BrownOut detector – ARM instruction set - THUMB instruction set.

Unit-V: INTERFACE PROTOCOLS AND WIRLESS COMMUNICATION NETWORKS (15 hr)

Communication protocols: Introduction to Serial and Parallel communication protocols-UART-I2C- SPI- USB- Ethernet- CAN- LIN – PCI – MIPL and DDR protocol. Wireless communication networks: Bluetooth- ZigBee - Wi-Fi - GSM.

Text Books:

1. The 8051 Microcontrollers and embedded systems – Mohamed Ali Mazidi, Janice Gillispie Mazidi
2. PIC 24FJ64GA004 Datasheet.
3. LPC214X User Manual – Revision 4, 2012.

Reference Books:

1. Kenneth J. Ayala, "The 8051 microcontroller", cengage learning, 2004.
2. Martin Bates, "Interfacing PIC microcontrollers-Embedded Design by Interactive Simulation", Newnes Publication, 2006.
3. Andrew N. Sloss, Dominic Symes, Chris Wright - "ARM System Developer's Guide: Designing and Optimizing System Software", Elsevier Inc, 2004.
4. Jan Axelson, "Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port" - Penram Publications, 1996.
5. Jan Axelson, "Serial Port Complete – second edition.

Unit	Book	Sections
I	1	1.1,1,2,2.2-2.7,3.1-3.3,5.1-5.3,6.1-6.4
II	1	9.1,9.2,10.1-10.3,11.1-11.5
III	2	2,9,10,12,13,14,16,17,18, 20,25
IV	3	4, 6.1-6.20
V		Lecture notes

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PEL2105					Title of the Paper EMBEDDED SYSTEM-I								Hours 6	Credits 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	PSO6	PSO7	PSO8		
CO1	5	4	4	3	4	4	4	4	2	4	4	4	4		3.8
CO2	5	5	4	4	3	4	5	3	3	4	5	3	4		4.0
CO3	5	5	4	4	5	4	5	4	4	2	5	4	5		4.2
CO4	5	5	4	4	4	4	5	4	3	3	4	5	4		4.2
CO5	5	5	4	4	3	4	5	3	4	4	4	5	5		4.5
CO6	5	5	4	4	4	4	5	5	4	4	4	5	4		4.4
CO7	5	5	4	4	4	4	5	5	4	4	4	5	4		4.4
CO8	5	5	4	4	4	4	5	5	4	4	4	5	4		4.4
Overall Mean Score for COs															4.2

Result: The Score for this Course is 4.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 6**
18PEL2106 **Credits : 4**

DIGITAL SIGNAL PROCESSING AND ADSP

Course Outcomes:

1. To analyze the signal processing techniques in DSP
2. Ability to understand Discrete and fast Fourier transforms.
3. To design FIR filters to suit specific requirements for specific application
4. To design IIR filters to suit specific requirements for specific application
5. Design and apply the PDSP techniques using in CCS
6. Ability to design the filters in PDSP using MATLAB

Unit-I: DISCRETE FOURIER TRANSFORMS AND FAST FOURIER TRANSFORM (15 hr)

Frequency analysis of discrete - time signal - Properties of DFT- Problems. IDFT: Definition - Problems. FFT: Definition - Radix-2 FFT algorithm Decimation-in-time - Decimation-in- frequency - Problems - Inverse FFT Problems - Linear convolution: Cross table method – Matrix method - Circular convolution: Circle method - Matrix method - DFT-IDFT method –Section convolution: Overlap save method - overlap-add method.

Unit-II: FINITE IMPULSE RESPONSE (FIR) FILTERS (15 hr)

Introduction to FIR filters - Magnitude response of digital filters - Design of linear phase FIR filters using windows: Rectangular window function - Blackman window function - Hamming window function - Hanning window function - Design of linear-phase FIR filters by frequency-sampling method - design of optimal linear-phase FIR filters

Unit-III: IIR FILTERS AND ADAPTIVE FILTERS (17 hr)

IIR filter design- approximation of derivatives - Impulse invariance method - Bilinear transformation - design of Butterworth filter - design of Chebyshev filter - design of Elliptic filter - Frequency transformation analog and digital domain Adaptive filters: introduction - system modeling -adaptive equalization -adaptive line enhancer - adaptive noise canceling - minimum mean square error criterion

Unit-IV: PDSP USING CCS (13 hr)

Introduction to TMS320C5X Processor - different addressing modes - Familiarizing instructions related to multiply and accumulate operation- Linear convolution.-Circular convolution - Introduction to TMS320C6713 Processor - Special features -Code Composer Studio development – Code Generation

tools – creating a new project – adding files to a project – reviewing the code – building and running the program – changing program options and fixing syntax errors–Experiments using TMS320C5X: Generation of waveforms (square, triangle, ramp) -Experiments using TMS320C6713 Processor :Design of FIR filters (i) LPF (ii) HPF - Design of IIR filters. (i) LPF (ii) HPF

Unit-V: PDSP USING MATLAB (12 hr)

FIR, IIR Filter design and analysis: FFT and DFT – Speech Processing - Speech analysis - Speech coding - compression and coding - Channel vocoder - sub band coding - Image Processing- Image representation- Histogram equalization - Image segmentation- pixel based segmentation - Edge detection -Colour Image Processing.

Books for Study

1. Poornachandra S, Sasikala B, “Signals and Systems”, 3rd edition, Tata McGraw Hill Publishing, 2010.
2. Salivahanan S, Vallavaraj A, Gnanapriya C, “Digital Signal Processing”, Tata McGraw HillPublishing, 2003.
3. Venkataramani B, Bhaskar M, “Digital Signal Processors – Architecture, programming and Applications”, first reprint, TATA McGraw Hill,2003
4. TMS320C6000 Code Composer Studio tutorial
5. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education, 2002.

Books for Reference

1. Alan V. Opphenehim, Ronald W. Schafer, “Digital Signal Processing”, 2nd edition, PHI,2004.
2. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing Principles, Algorithm and Applications”, 4th Edition, PHI, 2007.
3. Ramesh Babu P., “Digital Signal Processing”, 4th Edition, Scitech Publication Pvt. Ltd, 2007

Unit	Book	Sections
I	1	9.1-9.6, 4.4-4.6
II	2	7.1-7.3, 7.4.2-7.4.3, 7.5
III	2	8.1-8.9
IV	3	4.1-4.9,6.2-6.4
V		Material prepared by the department

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PEL2106					Title of the Paper DIGITAL SIGNAL PROCESSING AND PDSP								Hours 6	Credits 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	PSO6	PSO7	PSO8		
CO1	5	4	4	3	4	3	3	2	2	3	2	3	3	3.2	
CO2	4	4	4	3	3	3	4	3	2	3	2	4	4	3.3	
CO3	4	4	3	2	3	3	4	3	2	4	2	4	4	3.2	
CO4	4	4	3	2	3	3	4	3	2	4	2	4	4	3.2	
CO5	3	4	3	4	4	3	3	5	2	5	2	4	5	3.6	
CO6	3	4	3	4	4	3	3	5	2	5	2	4	5	3.6	
													Overall Mean Score for COs	3.4	

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II **Hours/Week: 6**
18PEL2107 **Credits : 4**

POWER ELECTRONICS AND SOLAR PV SYSTEMS

Course Outcomes:

1. Acquire knowledge on advanced power semiconductor devices.
2. Analyze rectifiers and DC- DC converters
3. Classify and understand different power converters and inverters
4. To attain knowledge on solar PV systems.
5. Apply and interpret power systems using PSIM.
6. Ability to visualize the concepts of smart grids

Unit-I: POWER SEMICONDUCTOR DEVICES (16 hr)

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 - Advanced Silicon devices - Silicon HV thyristors, MCT, BRT & EST- SiC devices - diodes, thyristors, JFETs & IGBTs - Gallium nitrate devices - Diodes, MoSFETs.

Unit-II: RECTIFIERS AND DC-DC CONVERTERS (15 hr)

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 (14 hr)

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 & PSIM PROGRAMMING (13 hr)

Photovoltaic systems overview - 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 - instantaneous power - energy and average power - inductors and capacitors - RMS values of sinusoids - apparent power and power factor - Fourier analysis.

Unit-V: SMART GRIDS (14 hr)

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 -Introduction to Smart Meters - Advanced Metering infrastructure (AMI) drivers and benefits - Phasor Measurement Unit-(PMU) - Intelligent Electronic Devices (IED) & their application for monitoring & protection.

Books for study:

1. Muhammad H. Rashid, "Power electronics", 3rd edition, Pearson, 2009.
2. Daniel W. Hart, "Power Electronics", 1st edition, McGraw hill, 2011.
3. B. JayantBalinga, 'Advanced High Voltage Power Device Concepts', Springer New York 2011. ISBN 978 -1- 4614-0268-8.
4. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press, 2012.

Books for reference:

1. Ned Mohan: First Course on Power Electronics and Drives (1st edition 2003, MNPERE).
2. Robert W. Erickson & Dragan Maksimovic: Fundamentals of Power Electronics (2nd edition, 2004, Kluwer Academic Publisher).

Unit	Book	Sections
I	1	1.2 - 1.5, 2.5, 2.8 - 2.13, 3.4 - 3.7
	3	3, 7, 8, 9 lecture notes
II	1	4.7, 5.1 - 5.9, 5.12.
III	2	7.11, 7.13 - 7.16.
IV		Lecture notes prepared by the department
V	4	2, 5,6

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PEL2107	Title of the Paper POWER ELECTRONICS AND SOLAR PV SYSTEMS											Hours 6	Credits 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	PSO6	PSO7	PSO8	
CO1	5	4	3	3	3	3	3	2	3	3	4	3	4	3.3
CO2	5	4	3	4	4	3	5	2	4	3	4	3	4	3.7
CO3	5	3	3	4	4	3	5	2	5	3	4	3	4	3.7
CO4	5	3	3	4	3	3	4	2	4	4	4	3	5	3.6
CO5	5	3	3	4	4	3	5	5	3	4	4	3	4	3.8
CO6	5	4	3	4	4	3	5	5	3	4	4	3	4	3.9
Overall Mean Score for COs														3.6

Result: The Score for this Course is 3.6 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Totalof Values}}{\text{TotalNo.of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 8**
18PEL2108 **Credits : 6**

Electronics Practical-II
EMBEDDED SYSTEM-1, DSP & PDS, POWER ELECTRONICS

Any Sixteen Experiments:

1. Serial port interfacing with 8 bit microcontroller programming.
2. Microcontroller I/O programming for switch read, single loop with decision, two loops one for each state, 5X7 matrix LED display interfacing.
3. Flashing LED using microcontroller timer.
4. Interrupt programming
5. LCD interfacing with microcontroller
6. Matrix key pad interfacing with microcontroller
7. Study of I/O ports in 16 bit microcontroller - DIP switch, LED pattern generation, Matrix display and relay
8. Study and interfacing SPI protocol in 16 bit microcontroller
9. Communicating through I2C with 16 bit microcontroller input/output.
10. Study of timers and counters in 16 bit microcontroller.
11. Study of serial communication with 16 bit microcontroller.
12. Study of external ADC interfacing with 16 bit microcontroller.
13. Study of GPIO interfacing with 32 bit microcontroller.
14. Study of PWM using 32bit microcontroller programming.
15. Study of DAC using 32bit microcontroller programming.
16. Study of RTC using 32bit microcontroller programming.
17. Study of SSP using 32bit microcontroller programming.
18. Sinewave generation using TMS320C6713
19. Acoustic echo cancellation using TMS320C6713
20. PSIM simulator for power computation.
21. Power control using IGBT.
22. Design of buck boost regulator.
23. Study of PWM charge controller for solar.
24. PV system assembling for 12 V load.
25. Study of transformers (voltage and current transformer).

Semester II **Hours/Week: -**
18PEL2109A **Credits : 2**

Self-paced Learning:
AUTOMOTIVE ELECTRONICS

Course Outcomes:

1. Ability to understand the basics of modern automobile systems.
2. To acquire knowledge on ECU
3. Familiarize with CAN protocol used in automobiles.
4. Enhance LIN and FLEXRAY protocols used in automobiles.
5. Knowledge on hybrid and electric vehicles
6. Apply the concepts of electronic circuits bus and protocols in automobiles.

Unit-I: AUTOMOTIVE ELECTRONICS

Introduction to Automotive Industry and Modern Automotive Systems - Vehicle classifications and specifications - need for electronics in automobiles - Application of electronics in automobiles - Current trends in modern automobiles – Component electronic engine management - Electronic management of chassis system- Vehicle motion control- Free scale controller's families - MPC5XXX series Microcontroller

Unit-II: ELECTRONIC CONTROL Unit

Concept for electronic engine controls - management - ECU architecture - power train control module- hardware and software components- interfacing with sensors - system integration Standards; Control objectives - fuel economy-volumetric- thermal- air-fuel ratio, emission limits and vehicle performance; advantages of Electronic engine controls -open and closed loop fuel control; Electronic ignition-Block diagram of ignition system - fuel injection system -Types - AUTOSAR

Unit--III: CAN PROTOCOL

Controller Area Network (CAN) Protocol: History and foundation of CAN-CAN Applications-Main characteristics of CAN- CAN in OSI Reference Model- CAN Data Link Layer- Principles of data exchange in CAN-Arbitration - Data Frame - Remote Frame- Error detection and management in CAN - CAN physical Layer- Bit encoding - Bit timing - synchronization-Relationship between data rate - bus length -Single wire - twin wire media-CAN repeaters-Medium-to-medium gateway- Protocol handlers- Micro-controllers and line drivers - Time-Triggered CAN (TTCAN)- Comparison with other IVN protocols

Unit-IV: LOCAL INTERCONNECT NETWORK (LIN) AND FLEXRAY PROTOCOL

Introduction to LIN - LIN specification - LIN features - Technical overview, Work flow concept - LIN operation - LIN frame format - Scheduling table- Network management of LIN cluster, LIN Transport Layer- LIN node configuration and identification - LIN diagnostics- LIN physical layer. FlexRay Protocol- Future on board systems- Need for FlexRay- Origin of FlexRay, - FlexRay Objectives- FlexRay Features- Application requirements, Working of FlexRay-Network topologies

Unit-V: HYBRID AND ELECTRIC VEHICLES

Battery Technology: Energy density of various energy sources - storage devices- basics of battery- working principle- construction - good practices of battery maintenance - Other Energy Storage Devices for Hybrid Vehicles: Super capacitor - Ultra capacitor - fly wheel technology Electric Vehicle (EV): Requirement of drive train of EV - various configurations of drive train in EV - transmissions systems - motor sizing for EV - transmission requirement - general EV configuration - Energy consumption pattern in EV- driving pattern in EV - control of EV.

Books for study

1. Robert Bosch, "Automotive Hand Book" SAE, 5th edition, 2000
2. William B. Ribbens, Understanding Automotive Electronics, 5th Edition, Butterworth, Heinemann Woburn, 1998
3. Behrouz Forouzan. (2003) Data Communications and Networking, McGraw-Hill.
4. James Larminie and John Lowry. (2003) Electric Vehicle Technology Explained, John, Wiley and Sons

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PEL2109A	Title of the Paper Self-paced Learning: AUTOMATIVE ELECTRONICS												Hours -	Credits 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	PSO6	PSO7	PSO8		
CO1	4	4	3	3	4	3	2	2	2	4	4	4	2		3.2
CO2	4	4	3	3	4	3	2	2	2	4	4	4	2		3.2
CO3	4	4	3	3	4	3	2	2	2	4	4	4	2		3.2
CO4	4	4	3	3	4	3	2	2	2	4	4	4	2		3.2
CO5	4	4	3	3	4	3	2	2	2	4	4	4	2		3.2
CO6	4	4	3	3	4	3	2	2	2	4	4	4	2		3.2
Overall Mean Score for COs															3.2

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: -**
18PEL2109B **Credits : 2**

Self-paced Learning:
PROGRAMMABLE LOGIC CONTROLLERS AND PROGRAMMING

Course Outcomes:

1. To learn the basic concepts of PLC.
2. Analyze the Ladder logic programming in PLC
3. Enhance the advance PLC Programming concepts.
4. Acquire Knowledge on wiring and analog sensors.
5. To apply and interpret PLC programming using OMRON and KEYENCE.
6. Gain the knowledge on industrial automation.

Unit-I: INTRODUCTION TO PLC, LADDER DIAGRAM FUNDAMENTALS

Introduction to PLC - PLC Vs Microcontroller - Basic Components and their Symbols - Control Transformers - Fuses - Switches - Relays - Time Delay Relays - Fundamentals of Ladder Diagram - Basic diagram framework - Wiring Reference Designators - Boolean Logic & Relay Logic - AND-OR & ORAND - Ground Test - The Latch - Two handed Anti-Tie Down, Anti-Repeat - Combined Circuit - Machine Control Terminology

Unit-II: PROGRAMMABLE LOGIC CONTROLLER & FUNDAMENTAL PROGRAMMING

PLC Configurations - System Block Diagram - Update - Solve the Ladder - Physical Components Vs Program components - Light Control - Internal Relays - Disagreement Circuit - Majority Circuits - Oscillators - Holding Contacts - Always ON & OFF Contacts - Ladder Diagrams having complex Rung.

Unit-III: ADVANCED PROGRAMMING TECHNIQUES AND OVERVIEW OF MNEMONIC PROGRAMMING CODE

Ladder Program execution Sequence - One Shot- JK-Flip Flop - Counters - Sequencers - Timers - Master control Relays and control Zones - AND Ladder Rung - Entering Normally Closed Contacts - OR Ladder Rung - Simple Branches - Complex Branches.

Unit- IV: WIRING TECHNIQUES, ANALOG I/O & SENSORS

PLC Power Connection - Input wiring - Inputs having a single common - Isolated inputs - Output wiring - Relay outputs - Solid state outputs - Analog (A/D) inputs - Analog (D/A) output - Sensor Output classification -

Connecting Discrete sensors to PLC inputs - Proximity sensors - Optical Proximity Sensors.

Unit- V: WORKING IN OMRON & KEYENCE IDE WITH LADDER LOGIC

Introduction to OMRON & KEYENCE - Creating a project - Ladder Programming - Compiling and Executing - Ladder Programs - Logic Gate functions (AND, OR, NOT, NAND, NOR, XOR) - Using Timers (ON delay timer, OFF delay timer, one shot pulse, flashing pulse), Counters - Using Calendar functions

Book for Study

1. John R. Hackworth, Frederick D. Hackworth, Jr., "Programmable Logic Controllers, Programming Methods and Applications", New Delhi: Pearson Education, 3rd edition.

Book for Reference

1. John. W. Webb, Renoald A. Rein, "Programmable Logic Controller Principles and Application", Prentice Hall India, 5th Edition

Unit	Book	Sections
1	1	Lecture notes ,1.1-1.3
2	1	2.2-2.6, 3.1-3.9
3	1	4.1,4.2,4.4,4.8-4.11,5.1-5.5
4	1	6.1-6.7, 7.1-7.2,8.1,8.3-8.7
5	-	Lecture notes

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PEL2109B					Title of the Paper Self-paced Learning: PROGRAMMABLE LOGIC CONTROLLERS AND PROGRAMMING								Hours -	Credits 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	PSO6	PSO7	PSO8		
CO1	5	4	2	1	4	2	4	4	3	3	4	4	3	3.3	
CO2	5	4	2	1	4	2	4	4	3	3	4	4	3	3.3	
CO3	5	4	2	1	4	2	4	4	3	3	4	4	3	3.3	
CO4	5	4	2	1	4	2	4	4	3	3	4	4	3	3.3	
CO5	5	4	2	1	4	2	4	4	3	3	4	4	3	3.3	
CO6	5	4	2	1	4	2	4	4	3	3	4	4	3	3.3	
											Overall Mean Score for COs			**3.3**	

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II **Hours/Week: -**
18PEL2109C **Credits : 2**

Self-paced Learning: MEDICAL ELECTRONICS

Course Outcomes:

1. Ability to classify understand various electrodes and transducers in the field of medical electronics.
2. To identify the bio medical recorders.
3. Acquire knowledge on the diverse imaging systems.
4. To indentify the blood flow meters and blood cell counters.
5. Analyze various advance Bio-medical instruments.
6. To conceive ideas about functionalities of equipments used in hospitals.

Unit-I: ELECTRODES & TRANSDUCERS

Origin of bioelectric signals - Recording electrodes - Skin contact impedance - Electrodes for ECG - Electrodes for EEG - electrodes for EMG - Electrical conductivity of electrode jellies and cream - Transducers for biomedical parameters (table) - Pressure transducers - Pulse sensors - Respiration sensors.

Unit-II: BIOMEDICAL RECORDERS

Basic recording system - General considerations for bioelectric recorder amplifiers - Sources of noise in low level recording circuits - Preamplifiers Main amplifier & driver stage - Writing systems - Electrocardiograph Phonocardiograph - Electroencephalograph - Electromyograph

Unit- III: MEASUREMENT & ANALYSIS TECHNIQUES IN BLOOD

Blood flow meters: Electromagnetic blood flow meter- Blood gas analyzers: blood pH measurement - Measurement of blood pCO2 - Blood pO2 measurement - Blood cell counters: methods of cell counting - Coulter counters - Automatic recognition and differential counting of cells.

Unit- IV: MODERN IMAGING SYSTEMS

X-ray machine - CT scanner: basic principle - Contrast scale - system components - NMR: principles of NMR imaging - Fourier transform of the FID - Bloch equation - Image reconstruction techniques - Discrimination based on relaxation rates - Basic NMR components – Applications- biological effects - advantages of NMR imaging system.

Unit-V: ADVANCES IN BIOMEDICAL INSTRUMENTATION

Pacemakers - Artificial heart valves - Defibrillators - Ventilators - Audiometers - Anesthesia machine - Angiography - Endoscope - Cryogenic surgery.

Books for study

1. R. S. Khandpur, "Handbook of biomedical instrumentation", Tata McGraw-Hill Publisher, New Delhi,2003.
2. M. Arumugam, "Biomedical instrumentation"Anuradha publications, 1994.

Book for Reference

1. Leslie Cromwell Fred J. Weibell, Erich A. Pfeiffer, "Biomedical instrumentation and measurements", 2nd edition, Prentice Hall of India Pvt Ltd

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PEL2109C					Title of the Paper Self-paced Learning: MEDICAL ELECTRONICS								Hours -	Credits 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	PSO6	PSO7	PSO8		
CO1	5	4	2	4	3	4	2	1	4	2	4	3	3		3.2
CO2	5	4	2	4	3	4	2	1	4	2	4	3	3		3.2
CO3	5	4	2	4	3	4	2	1	4	2	4	3	3		3.2
CO4	5	4	2	4	3	4	2	1	4	2	4	3	3		3.2
CO5	5	4	2	4	3	4	2	1	4	2	4	3	3		3.2
CO6	5	4	2	4	3	4	2	1	4	2	4	3	3		3.2
Overall Mean Score for COs															3.2

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 4**
18PSS2301 **Credits : 4**

IDC: SOFT SKILLS

Course Outcomes:

1. Students are taught the various nuances of grooming such as, good manners and etiquettes and they are trained to practice them in the class rooms.
2. Students are empowered with public speaking skills via extempore speeches and prepared speeches, presented before the class and assessed by the trainer as well as the companions which eventually helps build self confidence of the students.
3. Students learn the different types of resumes and different types of interview skills and write and print their own resumes and present before the interview panel for their mock interview.
4. Students actively learn the ten parameters of group discussion, perform on the stage with their colleagues, which is videotaped, reviewed and evaluated.
5. As students go through their teenage, self discovery becomes a tool to develop their personality facilitated with scientific psychological personality tests.
6. Students are guided to knowing their SWOT (Strengths, Weaknesses, Opportunities and Threats)and setting their short term and long term goals for their lives.

Module 1: Basics of Communication: Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication,

Effective Communication: The Art of Listening, Exercises in Kinesthetics, Production of Speech, Organization of Speech, Modes of delivery, Conversation Techniques, Dialogue, Good manners and Etiquettes, Politeness markers & Listening links.

Module II: Resume Writing: What is Resume? Types of Resume? Chronological, Functional and Mixed Resume, Steps in preparation of Resume, structure and framework for writing resume, Intensive training / personalized training on resume writing. **Interview Skills**: Common interview questions, Attitude, Body Language, The mock interviews, Phone interviews, Behavioral interviews.

Module III: Group Discussion: Group Discussion Basics, GD Topics for Practice, Points for GD Topics, Case-Based and Article based Group Discussions, Points for Case Studies, and Notes on Current Issues for GDS & Practicum with video coverage. **Team Building:** Team Vs Group – Synergy,

Stages of Team Formation, Broken Square-Exercise, Win as much as you win- Exercise, Leadership – Styles, Work ethics.

Module IV: Personal Effectiveness: Self Discovery, Self Esteem, Goal setting, Problem-solving, Conflict and Stress Management

Module V: Numerical Ability: Average, Percentage, Profit and Loss, Problems on ages, Simple Interest, Compound Interest, Area, Volume and Surface Area,Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Calendar, Clocks, Permutations and Combinations, Probability.

Module VI: Test of Reasoning: Series Completion, Analogy, Data Sufficiency, Blood Relations, Assertion and Reasoning, Logical Deduction, Direction. **Non-Verbal Reasoning**: Series, Classification

Text Book

1. Melchias, G., Balaiah John., John Love Joy (Eds) 2015. *Winners in the making*. St.Joseph's College, Trichy-2

References

1. Aggarwal, R. S. *Quantitative Aptitude, S.Chand & Sons*
2. Aggarwal, R.S. (2010). *A Modern Approach to Verbal and Non Verbal Reasoning*. S. Chand & Co, Revised Edition.
3. Covey, Stephen. (2004). *7 Habits of Highly effective people,* Free Press.
4. Egan Gerard (1994). *The Skilled Helper* (5th Ed). Pacific Grove, Brooks/ Cole.
5. Khera, Shiv (2003). *You Can Win.* Macmillan Books, Revised Edition.
6. Murphy, Raymond. (1998). *Essential English Grammar*. 2nd ed., Cambridge University Press.
7. Prasad, L. M. (2000). *Organizational Behaviour, S.Chand & Sons.*
8. Schuller, Robert. (2010). *Positive Attitudes*. Jaico Books.
9. Trishna's (2006). *How to do well in GDs & Interviews*, Trishna Knowledge Systems.
10. Yate, Martin. (2005). H*iring the Best: A Manager's Guide to Effective Interviewing and Recruiting*.

Modules	Topics	Examination Pattern	
		CIA	Online
I	Basics of Communication	15	5
II	Resume Writing & Interview Skills	15	5
III	Group Discussion & Team Building	10	5
IV	Personal Effectiveness	10	5
V	Numerical Ability (Common Session)	5	10
VI	Test of Reasoning (Common Session)	5	10
Total		**60**	**40**

Semester III **Hours/Week: 4**
18PEL3110 **Credits : 4**

EMBEDDED SYSTEM - II

Course Outcomes:

1. Ability to learn the basics of AVR microcontroller and Arduino UNO.
2. Demonstrate the peripheral interfacing with microcontrollers
3. To Understand the basics of Arduino and single board computers
4. Knowledge on programming using PYTHON
5. To analyze various architectures and programming IDE
6. Acquire knowledge on GPIO interface with RASPBERRY PI

Unit-I: AVR MICROCONTROLLER & ARDUINO (12Hr)

AVR microcontroller architecture – ATmega8u – ATmega16u - ATmega328 – pin description - Boot loader - Arduino - hardware - different types of Arduino boards – Arduino UNO specifications - IDE - command structure and basic syntax - Arduino library - Programming: Led blinking - Digital I/O - Analog channel read program - Serial program to read and write strings - PWM - interrupts.

Unit-II: EXTERNAL PERIPHERAL INTERFACING (10 hr)

Arduino Shields - RS485 - GPS - CAN - Ethernet – GSM SIM800 - ZigBee – Bluetooth HC05 - microSD card - motor -TFT display. Interfacing (display data in LCD): PIR sensor based door status indicator with LED - DC motor speed control with AD5171 digital potentiometer - Light intensity measurement with BH1750 - Acceleration measurement with ADXL335 - distance measurement with ultrasonic sensor - DHT11 based temperature and humidity data logging with microSD card

Unit-III: SINGLE BOARD COMPUTER (10 hr)

Introduction to Single Board computer – Raspberry pi 3 – Architecture - Specification – peripherals – Comparison of different Raspberry pi boards - 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.

Unit-IV: PYTHON PROGRAMMING (14 hr)

Introduction to Python programming - python2.7 idle - Programming Basics - handling strings - Numbers and Operators - Variables – basic arithmetic

operations - Making decisions - Functions - Classes and Objects – Numerical Programming.

Unit-V: RASPBERRY PI PROGRAMMING (14 hr)

I/O and shell programming: basics of shell programming - installing and testing GPIO in Python - programming LED- reading a button- using devices with I2C bus - reading analog data using an analog to digital converter - logging and plotting data - extending Raspberry Pi GPIO with an I/O expander. Web application programming: creating Web server - downloading data from a web server - configuring Raspberry Pi as web server - introduction to flask - flask basics - connecting real world application on Web.

Books for study

1. Lecture Material provided by the department

Books for reference

1. Brian W. Evans “Arduino Programming note book” Creative commons, First Edition, 2007
2. James Payne, “Beginning Python”, published by Wiley Publishing, Inc, 2010.
3. Matt Richardson and Shawn Wallace, “Getting started with Raspberry Pi”, by O’Reilly Media, Inc, First edition, 2012.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PEL3110					Title of the Paper EMBEDDED SYSTEM-II								Hours 4	Credits 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	PSO6	PSO7	PSO8		
CO1	4	5	3	4	4	3	4	3	5	4	3	5	5	4.0	
CO2	4	3	3	5	4	4	5	4	3	4	5	4	5	4.1	
CO3	4	4	4	5	4	4	4	4	3	4	3	5	5	4.2	
CO4	4	4	4	4	4	4	5	4	4	4	4	5	4	4.2	
CO5	5	5	4	4	4	4	5	4	4	4	4	4	4	4.2	
CO6	5	3	4	5	4	3	3	4	4	4	5	4	4	4.0	
													Overall Mean Score for COs	**4.1**	

Result: The Score for this Course is 4.1 (High Relationship)

Note:

Mapping	**1-20%**	**21-40%**	**41-60%**	**61-80%**	**81-100%**
Scale	**1**	**2**	**3**	**4**	**5**
Relation	**0.0-1.0**	**1.1-2.0**	**2.1-3.0**	**3.1-4.0**	**4.1-5.0**
Quality	**Very poor**	**Poor**	**Moderate**	**High**	**Very High**

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 8**
18PEL3111 **Credits : 6**

Electronics Practical-III:
EMBEDDED SYSTEMS-II, VLSI & VHDL PROGRAMMING, ROBOTICS EXPERIMENTS (Any 16 Experiments)

1. I/O programming in Arduino board
2. Design of data logger using arduino and microSD card for temperature measurement.
3. ESP 8266 -01 interfacing with arduino
4. ADXL335 interfacing with arduino.
5. Bluetooth module interfacing with arduino.
6. GSM and GPS module interfacing with Arduino.
7. Multiplexer and demultiplexer with quartus II
8. Finger print scanner interfacing with Arduino
9. Adder subtractor with quartus II
10. Study of loading OS and GPIO (DHT11) with Raspberry Pi
11. Web hosting with Raspberry Pi
12. GLCD interfacing with Arduino
13. PCF8591 interfacing with Raspberry Pi for ADC and DAC study.
14. Nodemcu for IoT node configuration (4 nodes)
15. Machine Vision: Recognizing objects and scenes
16. Pick and place robot
17. Developing test bench for MUX and DEMUX and verifying the same in ModelSIM
18. Implementing Full adder, Full subtractor, Multiplexer, divider and ALU in FPGA
19. Implementing Decoder, priority encoder, 8-bit comparator and 8-bit latch in FPGA
20. Implementing D flip-flop with synchronous and asynchronous inputs, 4-bit updown counter with control input in FPGA (clock source to be switch)
21. Implementing clock divider, pulse counter (for delay program) shift register and barrel shifter in FPGA
22. Interfacing FPGA with PC through DB9 by implementing UART
23. Interfacing keypad with FPGA.
24. Interfacing LCD with FPGA.
25. Study of different types of network cables and practically implement the cross wired cable and straight through cable using clamp tool. Connect the computers in Local area network
26. OS installation, server command and network configuration

Semester III **Hours/Week: 6**
18SPS3101A **Credits : 5**

Interdisciplinary Core:

SPECTROSCOPY AND STATISTICAL THERMODYNAMICS

Course Outcomes:

1. Students learn and understand the concept of Molecular spectroscopy
2. The concept of FT-IR is well understood
3. The concepts of Raman Spectroscopy is well understood
4. Students learn and understand the concepts of NMR spectroscopy
5. The concepts of probability distribution is understood
6. The concept of statistical thermodynamics is understood
7. Students learn and understand the concept of partial molar properties
8. The application of statistical thermodynamics is understood

Unit-I: Rotational and Vibrational Spectroscopy (18 hr)

Basic aspects of Spectroscopy - Characterisation of electromagnetic radiation - Quantization of energy. Microwave Spectroscopy - Rotation of molecules and selection rules, Diatomic molecules - Rigid and non-rigid rotator, Rotational constant and centrifugal distortion - Techniques and instrumentation. Vibrational spectroscopy - diatomic molecules, Harmonic and anharmonic oscillators - zero point energy - force constant - fundamental absorption and overtones (hot bands, fermi resonance) - Polyatomic molecules - Techniques and instrumentation of FT-IR.

Unit-II: Raman and NMR and Mossbauer Spectroscopy (18 hr)

Raman spectroscopy - Raman and Rayleigh scattering - Quantum and Classical theories of Raman effect - Stokes and anti-stokes lines - Pure rotational Raman spectra - Vibrational Raman spectra - Mutual exclusion rule - Polarized and depolarized Raman lines - Techniques and instrumentation. NMR - Hydrogen nuclei - Chemical shift and spin-spin splitting - Coupling constant (*J*). Splitting with and without chemical exchange - Interaction between spin and magnetic field - Gyromagnetic ratio – Instrumentationof NMR - FT NMR- Applications of 2D NMR techniques like COSY, NOESY. Applications of C^{13} NMR spectroscopy - Mossbauer spectroscopy - principles of Mossbauer spectroscopy, Doppler shift, Recoil energy, Isomer shift, Quadrupole splitting - Applications to various compounds.

Unit-III: ESR spectroscopy & Electronic Spectroscopy (18 hr)

ESR – Principle - Position of ESR absorptions - *g* value - Hyperfine splitting - Zero field splitting - ESR spectrum of free radicals and copper salicyaldehyde complexes.

Electronic spectra - Electronic spectra of diatomic molecules – Born Oppenheimer approximation - Vibrational coarse structure - Franck - Condon Principle - Dissociation energy and dissociation products - rotational fine structure of electronic vibration - vibration transition - Fortrate Diagram. Electronic angular momentum in diatomic molecules - Spectrum of molecular hydrogen - Molecular photoelectron spectroscopy - UV photo electron spectroscopy and X-ray photo electron spectroscopy.

Unit-IV: Fundamentals of Statistical Thermodynamics (Online) (18 hr)

Statistical method - Microstates, macro states - Permutations and combinations - Combinatory rule - Probability theorems – Ensembles - Phase space - Thermodynamic probability - Statistical equilibrium - Maxwell-Boltzmann statistics - Derivation of M.B. statistics - Relationship between entropy and probability - Heat capacity of solids - Einstein and Debye models - Statistical meaning of third law of thermodynamics.

Unit-V: Applications of Statistical Thermodynamics (18 hr)

Partition functions - Molar, translational, rotational and vibrational partition functions of diatomic and polyatomic molecules - Separation of partition function according to forms of energy-Partition function and vibrational energy - Total partition function - Electronic partition function-Derivation of thermodynamic quantities E, S, A, H, G, K and *Cp*, *Cv* using partition function-Sackur-Tetrode equation – Bose Einstein statistics - Fermi Dirac statistics - Electronic heat capacity of gases - Equipartition of energy - Classical and quantum statistical theory of heat capacities - Heat capacities for diatomic molecule - Rotational heat capacity of hydrogen molecule - Nuclear spin statistics - Nuclear spin entropy- Quantum statistics.

Textbooks

1. Banwell C N, *Molecular spectroscopy,* 2nd Ed., New Delhi, TATA McGraw Hill Co., 2010.
2. Kuriakose J. C and Rajaram J.C, *Thermodynamics,* Jalandar Shoban Lal Co., 1999.

References

1. Drago R S, *Physical Methods in Inorganic Chemistry,* New Delhi, East West Press Ltd, 1971.
2. Chang R, *Basic Principles of Spectroscopy,* New Jersey, Englewood Cliffs, 1978.
3. Straughan B P and Walker S, *Spectroscopy Volume 1,2,3,* New York, London Chapman and Hall, A Halstet Press Book, John Wiley & Sons Ins. 1975.

4. Barrow G M, *Introduction to Molecular Spectroscopy,* Tata McGraw - Hill Ed., 1993.
5. Gurdeep R Chatwal and Sham K Anand, *Spectroscopy*, Himalaya Publishing House, 2009.
6. Gupta, M. C., *Statistical Thermodynamics, 2nd* Edition, New Age International Publishers, Chennai, 1998.
7. Donald McQuarrie, *Statistical Thermodynamics,* Indian Edition, Viva Books Private Ltd., New Delhi, 2003.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18SPS3101A				Title of the Paper SPECTROSCOPY AND STATISTICAL THERMODYNAMICS								Hours 6	Credits 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	PSO6	PSO7	PSO8	
CO1	3	4	4	4	3	3	4	3	3	4	3	4	3	3.5
CO2	4	3	3	3	3	4	3	2	3	4	3	4	4	3.3
CO3	3	4	3	3	4	3	2	3	4	3	4	3	3	3.5
CO4	3	4	3	3	3	3	3	3	3	3	3	4	3	3.6
CO5	4	3	3	4	3	2	4	2	3	4	3	3	4	3.1
CO6	3	4	4	3	4	3	3	3	4	3	3	4	3	3.4
CO7	3	4	2	3	4	3	4	3	3	4	3	4	3	3.4
CO8	3	4	5	4	3	4	3	4	5	3	4	3	3	3.7
													Overall Mean Score for COs	3.43

Result: The Score for this Course is 3.43 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Totalof Values}}{\text{TotalNo.of POs\&PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 5**
18SPS3101B **Credits : 5**

IDC: SPECTROSCOPY

Course Outcomes:

1. Understand the aspects of rotational spectroscopy and its techniques.
2. Understand the theory and principles of vibrational spectroscopy and its techniques.
3. Comprehend the basics of Raman and their instrumentation techniques.
4. Understand the physics behind NMR and ESR spectroscopy and its instrumentation.
5. Perceive the theory and principles of electronic and X-ray spectroscopy.
6. Understand Mossbauer spectroscopic techniques and hyperfine spectral lines.
7. Understand phosphorescence and fluorescence.
8. Analyze the structure of compounds by various spectroscopic techniques.

Unit-I: ROTATIONAL SPECTROSCOPY

Basic aspects of spectroscopy-characterization of EM radiation, quantization of energy Microwave spectroscopy-rotation of molecules and selection rules, diatomic molecules; Rigid diatomic molecule - intensities of spectral lines-effect of isotppe substitution - Non-rigid rotator (rotational constant-centrifugal distortion constant) - polyatomic molecules -techniques and instrumentation - Chemical analysis.

Unit-II: INFRA-RED SPECTROSCOPY

Vibration Spectroscopy - diatomic molecules; Harmonic and anharmonic oscillators, Zero point energy - force constant - The diatomic vibrating rotator - fundamental vibrations and overtones (hot bands, Fermi resonance) - Influence of rotation on polyatomic molecules - Analysis by IR techniques - Techniques and instrumentation.

Unit-III: RAMAN SPECTROSCOPY

Raman spectroscopy: Raman Rayleigh scattering- Quantum and Classical theory of Raman effect- Pure rotational Raman spectra - Stokes and anti-Stokes lines – Raman activity of vibrations - mutual exclusion principle-overtones and combinations vibrations- vibrational Raman spectra-rotational fine structure-Polarized and depolarized Raman lines- Structure determination-Techniques and instrumentation.

Unit-IV: SPIN RESONANCE SPECTROSCOPY

Nature of spinning particles - Interaction between spin and magnetic field - Gyromagnetic ratio-The Larmor Presession - NMR: Hydrogen nuclei - chemical shift - spin-spin splitting - coupling constant - Chemical analysis by NMR - CNMR Spectroscopy – Instrumentation - FT-NMR - ESR- Principle - position of ESR absorptions - g value - hyperfine splitting - zero field splitting - ESR spectrum of free radicals and complex

Unit-V: ELECTRONIC AND MOSSBAUER SPECTROSCOPY

Born-Oppenheimer approximation - vibrational coarse structure - Frank-Condon Principle - dissociation energy and dissociation product- vibration transitions - Fortratdiagram-electronic structure of diatomic molecules - electronic angular momentum in diatomic molecules -spectrum of Molecular hydrogen - Photo electron spectroscopy - UV photo electron spectroscopy - X-ray photo electron spectroscopy. Mossbauer Spectroscopy - Principle - Doppler shift - recoil energy - isomer shift - quadrupole splitting - hyperfine splitting - Applications.

Books for Study:

1. Colin N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, TMH Edition, 4th Edition (1994).

Unit	Book	Sections
I	1	1.1, 1.2, 1.3, 2.1, 2.2, 2.3.1, 2.3.2, 2.3.3, 2.3.4, 2.3.5, 2.4.1, 2.4.2, 2.5, 2.6
II	1	3.1.1, 3.1.2, 3.1.3, 3.2, 3.3, 3.5.1, 3.5.2, 3.6.1, 3.6.3, 3.7.1, 3.7.2, 3.8.1, 3.8.3
III	1	4.1, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.4.1, 4.4.2, 4.4.3, 4.5, 4.6,
IV	1	7.1.1, 7.1.2, 7.1.3, 7.1.4, 7.1.5, 7.1.6, 7.2.1, 7.2.2, 7.2.3, 7.2.4, 7.2.5, 7.3.1, 7.3.2, 7.4, 7.4.1, 7.4.2, 7.5.1, 7.5.2, 7.5.3, 7.5.4, 7.5.5,
V	1	6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.1.6, 6.1.7, 6.2.1, 6.2.2 6.2.3, 6.2.4, 6.4, 5.5, 6.5, 6.5.1, 6.5.2, 9.1, 9.2.1, 9.2.2, 9.2.3

Books for Reference:

1. Straughan, B.P and Walker.S, Spectroscopy Vol. 1,2,3, Chapman and hall, London (1996).
2. Gurdeep R. Chatwal and Sham K. Anand, Spectroscopy, Himalaya Publishing House (2009).

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18SPS3101B					Title of the Paper SPECTROSCOPY								Hours 6	Credits 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**	**PSO6**	**PSO7**	**PSO8**		
CO1	4	4	4	4	4	4	2	4	3	4	3	1	4	3.59	
CO2	4	4	4	4	3	5	2	4	5	4	4	1	4	3.63	
CO3	4	4	4	4	4	3	2	4	3	4	4	3	4	3.61	
CO4	4	3	4	4	5	4	2	3	4	3	4	1	4	3.46	
CO5	5	4	4	4	4	4	3	3	3	3	3	4	4	3.55	
CO6	4	4	4	3	3	3	3	3	3	4	4	1	4	3.30	
CO7	4	3	4	4	4	3	3	4	5	3	4	4	4	3.76	
CO8	3	4	3	4	3	3	3	3	3	3	3	4	3	3.23	
													Overall Mean Score for COs	**3.51**	

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	**1-20%**	**21-40%**	**41-60%**	**61-80%**	**81-100%**
Scale	**1**	**2**	**3**	**4**	**5**
Relation	**0.0-1.0**	**1.1-2.0**	**2.1-3.0**	**3.1-4.0**	**4.1-5.0**
Quality	**Very poor**	**Poor**	**Moderate**	**High**	**Very High**

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester IV | **Hours/Week: 6**
18SPS3101C | **Credits : 5**

SENSORS AND TRANSDUCERS

Course Outcomes

1. Understand the working principles of various transducers.
2. Characterize and measure the non - electrical quantities
3. Acquire knowledge of measurement techniques of thermal conductivity
4. Enhance the knowledge on integrated sensors.
5. Able to understand the usage of electrolytic sensors
6. Learn about biosensors and MEMS based sensors
7. Design the signal conditioning circuits used in bio- instrumentation
8. To analyze the operations of various sensors used in industries and commercial applications.

Unit-I: TRANSDUCERS (15 hr)

Introduction to measurement - Direct and indirect measuring methods - Accuracy - Errors - Transducers - Resistive transducers - Potentiometers - Non-linear potentiometers function generators - Strain gauges - Types of strain gauges - Resistance thermometers – Variable inductance transducers - Linear variable differential transformer - Capacitive transducers - Piezo electric transducers - Hall Effect transducers - Magneto resistors

Unit-II: MEASUREMENT OF NON-ELECTRICAL QUANTITY (14 hr)

Measurement of vibrations - Seismic transducers - Measurement of flow rate - Measurement of thickness - Measurement of humidity - Measurement of sound using microphones - Measurement of pH value - Measurement of thermal conductivity - Measurement of pressure.

Unit-III: INTEGRATED SENSORS (14 hr)

LM 35 temperature sensor - DS18s20 1-wire digital thermometer - TSOP 17 photo modules for PCM remote control system - MOC3041 zero cross optoisolators - TL173L linear hall effect sensor - KMZ51 magnetic field sensor - MPXV5004G pressure sensor - A1425 analog speed sensor - LM1830 water level sensor - HC610 humidity sensor - ICM105A VGA CMOS sensor

Unit-IV: BIOSENSORS AND MEMS BASED SENSORS (15 hr)

Introduction - FET & MOSFET chemical sensor - Bio sensors - Ion exchange membrane electrodes - Oxygen electrodes - CO2 electrodes enzyme electrode - Construction - ISFET for glucose, urea - Electrolytic sensors - Optical

sensor - Fiber optic sensors - ADXL 335 accelerometer - MPU 6050 IMU Sensor.

Unit-V: SIGNAL CONDITIONING CIRCUITS (14 hr)

Signal conditioning basics – type of signal conditioning: analog and digital – analog signal conditioning amplification - attenuation – level shifting - Clippers – clampers - data sampling and optimization - Filters: RC filter - active filter - Wheatstone bridge - AC bridges- noise reduction techniques. Comparators – Schmitt trigger for noise removal – Current amplification – isolation.

Books for study

1. A.K. Sawhney, "A course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co. publishers,2011.
2. N.Mathivanan, "PC Based Instrumentation: Concepts and Practice", PHI, 2007.

Books for Reference

1. H. S. Kalsi, "Electronic Instrumentation", Tata McGraw-Hill publishers
2. Albert D. Helfrick and William D.Cooper, "Modern Electronic Instrumentation and Measurement techniques", New Delhi: Prentice Hall of India, 1995.

Unit	Book	Sections
I	1	25.2 – 25.9
II	1	25.11 – 25.13,25.16,25.17,25.19,25.22-25.24,25.28-25.31
III		Lecture notes
IV		Lecture notes
V	2	2.1 – 2.5, 2.7, lecture notes

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18SPS3101C					Title of the Paper SENSORS AND TRANSDUCERS								Hours 6	Credits 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	PSO6	PSO7	PSO8		
CO1	4	4	3	4	4	4	4	2	3	4	4	4	4		3.7
CO2	4	4	3	4	4	3	4	2	3	2	4	3	5		3.5
CO3	4	4	3	4	4	4	4	2	4	4	4	3	5		3.8
CO4	5	4	3	4	4	3	4	2	4	4	4	3	4		3.7
CO5	5	4	3	4	4	4	4	2	4	3	4	3	4		3.7
CO6	5	4	3	4	4	4	4	2	3	3	4	3	4		3.6
CO7	5	4	3	4	4	4	4	2	3	3	4	3	4		3.6
CO8	5	4	3	4	4	4	4	2	3	3	4	3	4		3.6
										Overall Mean Score for COs					3.6

Result: The Score for this Course is 3.6 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PEL3201A **Credits : 4**

VLSI DESIGN AND VHDL PROGRAMMING

Course Outcomes:

1. Understand the basics of VLSI technology and VHDL programming
2. To Compare and analyze various semiconductor devices used in VLSI
3. Analyse scaling factors and testing procedures for VLSI system.
4. Simulate and test various digital circuits using VHDL.
5. Ability to understand the concepts of data types and synthesis in VHDL programming
6. Acquire knowledge on circuit design and simulation using Xilinx IDE

Unit-I: SEMICONDUCTOR DEVICES FOR VLSI TECHNOLOGY (10 hr)

Basic MOS transistor - Enhancement and depletion mode transistor action - NMOS fabrication - CMOS fabrication - BICMOS technology - Pass transistor - NMOS inverter, CMOS and BICMOS inverter - latch-up in CMOS & BICMOS circuits - MOS layer - Design rules and layout diagram - Lambda based design rules - Contact cuts - Double metal MOS process rules - CMOS lambda based design rules- symbolic diagram.

Unit-II: SCALING AND TESTING FOR VLSI SYSTEM (10 hr)

Basic circuit concepts - Sheet resistance - Capacitance - Delays - Driving large capacitive loads - Propagation delays - wiring capacitance -Scaling factor for device parameter factors - limitation of scaling - switch logic — Pass transistors and transmission gates - Gate logic - The inverter - CMOS logic - real world VLSI design - Design styles and philosophy - interface with fabrication house - CAD tools for design and simulation - Aspects of design tools - Graphical entry layout - Design verification prior to fabrication - DRC - circuit extractors - Test and test ability - System partitioning.

Unit- III: CPLD and FPGA ARCHITECTURE (8 hr)

Architecture of Altera CPLDs - Applications of CPLDs- Altera FLASH logic PLDs- Commercially Available FPGAs- Structure of Xilinx SRAM-based FPGAs- Architecture of Altera FLEX 8000 and FLEX 10000 FPGAs-Actel FPGAs-Quick logic pASIC FPGAs.

Unit-IV: BASIC CONCEPTS OF VHDL (10 hr)

VHDL Terms - Describing Hardware in VHDL - Entity - Architectures - Concurrent Signal Assignment - Event Scheduling - Statement Concurrency - Structural Designs - Sequential Behavior - Architecture Selection -

Configuration Statements - Power of Configurations - Behavioral modeling Transport versus inertial delay - simulation deltas - drivers - generics - block statements - Sequential processing - Process statement - Signal assignment Vs Variable assignment - Sequential statement - Object types - Data types

Unit-V: CIRCUIT DESIGN AND SIMULATION USING QUARTUS II IDE (10 hr)

Quartus II-VHDL Design - CAD Flow Diagram- working with IDE - Project creation- VHDL Design Entry - Design Compilation - Pin Assignment- Design Simulation- FPGA Device Programming and Configuration -Testing the Designed Circuit-Design examples: basic gates-J K flip flop- S R flip flop- D flip flop.

Books for study

1. Douglas A. Pucknell & Kamran Eshraghian, "Basic VLSI design", 3rd edition, Prentice Hall of india pvt ltd, new delhi,1994.
2. Douglas L perry, "VHDL programming by example" 4th edition, Tata McGraw hill, New Delhi, 2008.
3. Stephen Brown and Jonathan Rose "Architecture of FPGAs and CPLDs", 1996.
4. Quartus II IDE software Tutorial

Books for Reference

1. VLSI Design – by K. Lal Kishore , V.S.V. Prabhakar, 2009.

Unit	Book	Sections
I	1	1.4,1.5, 1.7, 1.8, 1.10, 2.5, 2.6, 2.10, 2.12.3, 2.13, 2.14, 3.1, 3.3, 3.4, 3.8
II	1	4.1, 4.2, 4.6, 4.8-4.10, 5.1-5.3, 6.1-6.3, 10.8-10.13
III	3	Lecture notes
IV	2	Chapters 1, 2, 3
V		Quartus II IDE software Tutorial
		Lecture Notes

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PEL3201A					Title of the Paper VLSI DESIGN & VHDL PROGRAMMING								Hours 4	Credits 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	PSO6	PSO7	PSO8		
CO1	5	4	3	4	4	3	4	2	3	4	3	4	3	3.5	
CO2	4	4	3	4	4	3	4	2	4	4	3	4	4	3.6	
CO3	4	4	3	3	4	4	5	2	4	4	4	4	4	3.8	
CO4	4	3	3	3	4	3	5	5	2	4	4	3	4	3.6	
CO5	5	4	3	4	4	4	5	5	2	4	4	3	3	3.8	
CO6	5	4	3	4	4	4	5	5	3	4	4	3	3	3.9	
													Overall Mean Score for COs	3.7	

Result: The Score for this Course is 3.7 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 4**
18PEL3201B **Credits : 4**

ELECTROMAGNETIC THEORY

Course Outcomes:

1. Ability to understand the basic wave equations of Electromagnetic waves.
2. Acquire knowledge on pointing vector and wave guides
3. To classify and study various antennas with directional properties.
4. Analyse the fundamentals of transmission lines
5. Understand the principles of microwave devices.
6. Apply basic electro- magnetic laws and understand the operations of different antennas.

Unit-I: APPLIED ELECTROMAGNETIC WAVES (14 hr)

Equation of continuity for time varying fields - inconsistency of Ampere's law - Maxwell's equations - conditions at a boundary surface - electromagnetic waves: solution for free space conditions - uniform plane wave propagation and its characteristics - wave equations for conducting medium

Unit-II: POYNTING VECTOR AND WAVE GUIDES (12 hr)

Poynting's theorem - statement and proof - Interpretation of Poynting's vector - Instantaneous, average and complex Poynting vector- Waveguides: rectangular guides - TM waves in rectangular guides - TE waves in rectangular guides - Impossibility of TEM wave in waveguides

Unit-III: ANTENNAS & WAVE PROPAGATION (12 hr)

Antennas - Network theorems - directional properties of dipole antennas - travelling wave antennas - point of feed on standing wave antennas - two elemental array - antenna gain - wave propagation: Ground Wave Propagation - plane earth reflection - wave propagation in the ionosphere.

Unit-IV: TRANSMISSION LINES AND PRACTICAL ANTENNAS (12 hr)

Transmission lines: Basic principles - fundamentals of transmission lines - characteristic impedance - smith chart and its applications. VHF, UHF, SHF antennas: folded dipole antenna - Yagi Uda antenna - biconical antenna- corner reflector antenna - helical antenna - horn antenna - frequency independent antennas - microwave antennas - lens antennas.

Unit-V: MICROWAVE GENERATORS (10 hr)

Microwave Generation- Multicavity Klystron-Reflex Klystron- principle and operation of Magnetron -Travelling Wave Tubes (TWT) - Microwave Transistors - GaAsFET- Gunn Diode- PIN diode for detection of micro waves.

Books for Study

1. Edward C.Jordan, Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd edition. Prentice Hall Of India,1964.
2. K.D.Prasad, "Antenna and Wave Propagation", 2nd Edition, Sathya Prahashan, 2009.
3. George Kennedy, Bernard Davis, "Electronic Communication Systems" 4th Edition, Tata McGraw- Hill,2001.

Books for Reference

1. N.D. Deshpande, D.A. Deshpande and P.A. Rangole, "Communication electronics", Tata McGraw- Hill.

Unit	Book	Sections
I	1	4.01-4.04, 5.01-5.04
II	1	6.01-6.03,8.01-8.04
III	1	11.01-11.05, 11.11, 16.01, 16.02, 17.09
IV	2	11.01-11.05, 11.11, 16.01, 16.02, 17.09
V	3	11.2.1, 11.3.1, 11.4.1-11.4.2, 11.5.1, 12.2.2, 12.6, 12.8.1

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PEL3201B					Title of the Paper ELECTROMAGNETIC THEORY								Hours 4	Credits 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	PSO6	PSO7	PSO8		
CO1	5	3	2	2	3	3	5	2	4	2	4	3	3		3.1
CO2	5	3	3	2	3	4	5	2	4	2	3	3	4		3.3
CO3	5	3	3	2	4	4	5	2	4	2	3	3	4		3.4
CO4	5	3	2	2	4	4	5	2	4	2	3	3	4		3.3
CO5	5	3	3	2	4	3	5	2	4	2	4	3	3		3.3
CO6	5	3	3	2	4	3	5	2	4	2	4	3	3		3.3
											Overall Mean Score for COs				3.3

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$$

$$\text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PEL3202A **Credits : 4**

COMPUTER HARDWARE AND NETWORKS

Course Outcomes:

1. Understand the basic hardware configuration of a computer
2. Characterize the mother board and mother board chipsets
3. To avail knowledge on BIOS and the Boot processes.
4. Knowledge on various expansion cards, motherboard ports and connectors
5. Learn about the basics of networks and network topologies.
6. Apply basics of electronics to acquire knowledge on PC preventive maintenance and troubleshooting

Unit-I: Mother board and mother board chipset (8 hr)

Motherboards -Motherboard Designs -Motherboard Form Factors -The IBM PC XT -The IBM PC AT -The Baby AT Form Factor Micro-AT Form Factor -LPX and Mini-LPX Specifications. ATX Form Factor. Mini-ATX. NLX Form Factor The Components of the Motherboard. Chipsets and Controllers - Introduction to Chipsets - Socket Type - North Bridge and South Bridge - Processor Generations. Controller Chips- Bus Architectures-keyboard Controller - Super I/O Controller -Other Device Controllers-Chipsets -Chipset Functions

Unit-II: The BIOS and the Boot Process (10 hr)

Introduction to the BIOS. The BIOS Utilities and Programs BIOS Manufacturers -Booting the Computer -System Boot Sequence -Cold Boots versus Warm Boots -The POST Process. -BIOS Startup Screen. System Configuration Summary -ROMS, PROMS, AND EPROMS: Bios chips. The BIOS Configuration -System Configuration Data. -BIOS Updates and Flash BIOS -Flashing Dangers. Dealing with Corrupt BIOS -Flashing Security - The Boot Block.

Unit-III: Expansion Cards and Motherboard Ports & Connectors (12 hr)

Expansion Cards -Controller Cards -Input/output (I/O) Cards -Interface Cards -Memory Cards -Memory Expansion Card (MEC)-PC Card Memory -Modem Cards -Sound Cards. -Video Cards Working with Expansion Cards -Installing an Expansion Card -Troubleshooting Expansion Cards. Connectors on the Motherboard-Back Panel Connectors - Onboard Connectors -Front Panel Connectors .External Ports and Connectors -Serial Ports and Connectors – Pin outs and Cable Connections - Cabling the Connection -Configuring a

Serial Port -Troubleshooting a Serial Port -Parallel Port connectors -The FireWire Interface -Wireless Ports -Infrared Ports -Radio Frequency interfaces-PS/2 and DIN Connectors -Video Interfaces -Video Connectors -SCSI Interface -External SCSI Connectors -SCSI Standards -SCSI Voltage Differentials -Configuring SCSI Devices.

Unit-IV: Networks and communication (10 hr)

Network Basics -Network Structures. -Network Components -Servers - Cabling -Cable Types -Cable Characteristics -Ethernet Cable Designations - Broadband versus Baseband Twisted Pair Wire -Fiber Optic Cable. - Networking Devices -Network Topologies.

Unit-V: PC Preventive Maintenance and Troubleshooting (8 hr)

Preventive Maintenance of a PC -Input Devices: keyboard, mouse, other input devices –Output Devices: Monitor-Cleaning and Maintenance Supplies. Troubleshooting: FRMs – BIOS- POST Errors - Trouble Shooting CPU - Hard Disk Drives -Memory - Memory Errors-Trouble Shooting Video System - Power Supply - Sound System.

Books for Study:

1. Ron Gilster," PC Hardware: A Beginner's Guide", McGraw Hill, Professional, 2001.

Books for References:

1. Mueller, S., "Upgrading and repairing PCS", 2 Edition, Pearson education Inc, 2015
2. Govindarajulu, B., "IBM PC and Clones Hardware trouble shooting and Maintenance" McGraw Hill Education India Pvt Ltd, 2001.
3. Winn L. Rosch, "Hardware Bible", 6th Edition, Que, 2002.

Unit	Book	Sections
I	1	Chapter 4,5
II	1	Chapter 6
III	1	Chapter 11,19
IV	1	Chapter 20
V	1	Chapter 22,24

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PEL3202A					Title of the Paper COMPUTER HARDWARE AND NETWORKS								Hours 4	Credits 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	PSO6	PSO7	PSO8		
CO1	4	4	4	3	4	3	4	2	4	2	4	5	4	3.6	
CO2	4	4	4	3	4	3	4	2	4	2	4	5	4	3.6	
CO3	4	4	4	4	4	3	4	2	4	2	4	5	4	3.7	
CO4	4	4	4	4	4	3	4	2	4	2	4	5	4	3.7	
CO5	4	4	4	4	4	3	4	2	4	2	4	5	4	3.7	
CO6	4	4	4	3	4	3	4	2	4	2	4	5	4	3.7	
											Overall Mean Score for COs			**3.6**	

Result: The Score for this Course is 3.6 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs =** $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 4**
18PEL3202B **Credits : 4**

INSTRUMENTATION

Course Outcomes:

1. Understand the basics of analytical instruments
2. Classify and study various biomedical instruments
3. Indentify the troubleshooting PC based instruments
4. Ability to understand industrial network protocols
5. Enhance the knowledge on applications of instrumentation
6. Learn operate on different instruments

Unit-I: ANALYTICAL INSTRUMENTATION (8 hr)

Introduction to absorption and emission spectroscopy: Electromagnetic radiation – Spectrum - Atomic energy levels - Molecular electronic energy levels - Raman Effect - Nuclear spin behavior - Electron spin behavior - X-ray energy levels - UV-VIS spectroscopy: Principles – sources – detectors – filters – monochromators - instruments for absorption photometry.

Unit-II: BIO-MEDICAL INSTRUMENTATION (10 hr)

Bio-Electric signals - Electrodes: Origin of bio-electric signals - Recording electrodes - Skin contact impedance -electrodes for ECG - EEG and EMG – Microelectrodes - Physiological Transducers: Pressure transducers - Transducers for body temperature measurements - Pulse sensors - Respiration sensors.

Unit-III: PC BASED INSTRUMENTATION (12 hr)

Principles of data acquisition - Sampling theorem - aliasing - Sigma-Delta converter principles - signal conditioning, interference problems – shielding – grounding - sequential and simultaneous sampling - triggering - PC based data acquisition configurations: Plug-in type - printer port – GPIB - serial port - Local data acquisition system: Plug-in type DAS - sampling rate - effect of sampling time – resolution – range - number of channels of DAS - choosing appropriate DAS - deciding requirements for applications.

Unit-IV: INDUSTRIAL INSTRUMENTATION (10 hr)

Process, manufacturing automation networks: 4-20 mA current loop - HART communication - Fieldbuses: Fieldbus basics – Characteristics - field bus requirements – overview – MODBUS - PROFIBUS-DP and PA - DeviceNet and ControlNet - FOUNDATION Fieldbus - Industrial Ethernet Fieldbuses - Digital Controllers: Digital Electronics methods - Computers in Process

Control - Data Logging, Supervisory Control – DDC - Distributed Process Control (DCS).

Unit-V: Case study on different Instruments (8 hr)

Remote data acquisition modules: Data acquisition modules for RS-232 - RS-485 serial ports - communication examples - Design examples - Remote monitoring of data acquisition applications - Therapeutic equipment: Cardiac Pacemaker - Cardiac Defibrillators – Hemo dialysis machines - Control of heat exchangers - control of level – flow - control of distillation columns - control of chemical reactors - batch reactors.

Book for study

1. Lecture notes prepared by the department

Reference books

1. R.S. Khandpur, Handbook of biomedical instrumentation, TMH, 2001.
2. N. Mathivanan, PC Based Instrumentation: Concepts & Practice, PHI, 2007.
3. Curtis Johnson, Process control instrumentation technology, IV Ed., PHI, 1996.
4. R.S.Khandpur, Handbook of Analytical Instrumentation, TMH, 2000.
5. Galen W. Ewing, Instrumental Methods of Chemical Analysis, 5th Ed. McGraw Hill, 1985.
6. N.Mathivanan, Microprocessors, PC Hardware and Interfacing, PHI, 2005.
7. Douglas V.Hall, Microprocessors and Interfacing – Programming and Hardware, II Ed., McGraw Hill International Edition, 1999.
8. Instrumentation Devices and Systems, C.S.Rangan, G.R.Sharma, and V.S.V.Mani, TMH, 1995.
9. Mechanical and Industrial measurements, R.K.Jain, Khanna publishers, 1995

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PEL3202B					Title of the Paper INSTRUMENTATION								Hours 4	Credits 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	PSO6	PSO7	PSO8		
CO1	4	4	2	4	3	4	3	1	4	4	3	4	4		3.4
CO2	4	3	2	4	3	4	3	1	3	4	3	4	4		3.5
CO3	4	4	2	4	3	4	4	1	3	4	4	4	4		3.4
CO4	4	4	2	4	3	4	3	1	3	3	4	4	3		3.2
CO5	4	3	2	4	3	4	3	1	4	3	3	4	3		3.2
CO6	4	4	2	4	3	4	3	1	4	3	3	4	3		3.2
													Overall Mean Score for COs		3.3

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PBS3302 **Credits : 4**

IDC (BS): CONSUMER ELECTRONICS

Course Outcomes:

1. Ability to operate on different types of cameras
2. To classify and analyze various television technologies.
3. Knowledge on surveillance devices
4. Acquire knowledge on various smart gadgets
5. Ability to understand the home automation devices
6. Apply basics of electronics in consumer electronics field.

Unit-I: CAMERAS **(10 hr)**

Specifications for Cameras - Digital Camera – Camcorder – Infra Red Cameras - Discreet CCTVs – Varifocal Cameras – wireless Cameras –NVR and DVRS-standards and operation - MPEG and JPEG Standards - MPEG and JPEG coders and decoders.

Unit-II: TELEVISION **(11 hr)**

Block diagram of monochrome and PAL color TV receivers – standards - LCD – LED TV – Plasma displays – HDTV - Internet TV – HDMI, VGA AND MHL cords - LCD projectors- DTH standards and installation - Set Top Box.

Unit-III: SURVEILLANCE DEVICES **(10 hr)**

Security measures - CCTV systems –applications and limitations -Digital safe lockers– random number generators —Burglar Alarms -Video door phones – Anti-Theft bags -Smart car parking and anti-theft system –GPS trackers -NFC RFID security systems

Unit-IV: SMART GADGETS **(9 hr)**

Introduction - applications and limitations -Smart Phones – IPODS – Tablets – Kindles –Touch Screens –resistive and capacitive touch screens –Laptop - Satellite Radio – Bar Code Reader - ATMs - wireless phone.

Unit-V: HOME AUTOMATION DEVICES **(8 hr)**

Smart home appliances - Security system –3D food Printers -Dosa/ Roti makers – Humonoids for home applications– Smart meters – Introduction to IoT in home automation –IoT enabled: Air Conditioner – stabilizer – water heater

Book for study

1. Lecture notes prepared by the department.

Book for reference

1. S.P Bali, “Consumer Electronics”, Pearson Education Asia Pvt., Ltd., 2008 Edition

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PEL3302					Title of the Paper IDC (BS): CONSUMER ELECTRONICS								Hours 4	Credits 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	PSO6	PSO7	PSO8		
CO1	5	4	4	2	4	3	4	1	4	2	5	4	3	3.5	
CO2	5	4	4	2	4	3	4	1	4	2	5	4	3	3.5	
CO3	5	4	4	2	4	3	4	1	4	2	5	4	3	3.5	
CO4	5	4	4	2	4	3	4	1	4	2	5	4	3	3.5	
CO5	5	4	4	2	4	3	4	1	4	2	5	4	3	3.5	
CO6	5	4	4	2	4	3	4	1	4	2	5	4	3	3.5	
Overall Mean Score for COs														3.5	

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 6**
18PEL4113 **Credits : 5**

EMBEDDED SYSTEM-III

Course Outcomes

1. To understand the design basics of embedded system.
2. To acquire knowledge on custom single – purpose processors
3. Acquire knowledge on embedded software development tools
4. To Know and use RTOS to build an real – time embedded system
5. To analyze synchronization and data communication
6. To work with Micro EJ platform.
7. To familiarize embedded system design applications with real time operating system.
8. Able to understand the asynchronous data reception from multiple data communication Channels

Unit-I: Introduction to Embedded System

Introduction to Embedded systems – Classification – Application – Purpose of Embedded system – Characteristics – Quality attributes of embedded systems – Washing machine application specific embedded system – Automotive domain specific examples of embedded system (14 hr)

Unit-II: Software Architecture and Embedded Software Development Tools

Software Architecture: Round-Robin and Round-Robin with interrupts – Function Queue scheduling Architecture – Real time Operation system Architecture – Selecting Architecture - Embedded Software Development Tools: HOST and Target Machines – Linker/Locators for Embedded software – Getting embedded Software into the Target System (15 hr)

Unit-III: Real-Time Operating Systems and Memory Management

Defining an RTOS - A Brief History of Operating Systems - Introduction to Task and Task states – Tasks and data – Semaphores and shared data – Operating system services: Message queues, Mailboxes, and pipes – Timer function – Events — Interrupt routines in an RTOS Environment. Introduction - Dynamic Memory Allocation - Fixed-Size Memory Management - Blocking vs. Non-Blocking Memory Functions - Hardware Memory Management Units – Concurrency: Introduction - Guidelines and Recommendations for Identifying Concurrency - Schedulability Analysis (15 hr)

Unit-IV: Synchronization and Communication

Synchronization – Communication - Resource Synchronization Methods - Common Practical Design Patterns: Synchronous Activity Synchronization

- Asynchronous Event Notification Using Signals - Resource Synchronization - Specific Solution Design Patterns: Data Transfer with Flow Control - Asynchronous Data Reception from Multiple Data Communication Channels - Multiple Input Communication Channels - Using Condition Variables to Synchronize between Readers and Writers - Sending High Priority Data between Tasks – Implementing Reader Writer Locks Using Condition Variables. (14 hr)

Unit-V: Embedded Software Testing And Micro EJ

Introduction to embedded software testing – application Vs embedded testing – testing tools – Tessy – Parasoft – Vector software. Introduction to MicroEJ – Micro EJ Architecture Modules Overview – Features - Process Overview – Concepts - Building a Micro EJ Platform – Micro EJ OS Core Engine - Multi Applications - Graphics User Interface – Micro EJ Firmware - Virtual Device – Micro EJ Studio Getting Started - Wadapps Framework - Sandboxed Application Structure - Background Service Application - Activity Application - Shared Interfaces. (14 hr)

Textbook

1. Shibu K V "Introduction to embedded systems" 1st ed Tata Mcgraw Hill
2. David E.Simon –An Embedded Software Primer Pearson Education, 1999.
3. Qing-Li – Real Time Concepts for Embedded systems
4. Micro EJ device Developer's Guide user manual
5. Micro EJ Application Developer's Guide user manual

Reference Books

1. Jack Ganssle-Embedded System Hardware
2. Rajkamal – Embedded Systems Architecture, Programming and Design, TMH, 2008
3. Tim wilmshurst—An Introduction to Design of Small Scale Embedded systems—Pal Grave Publications.
4. John B. Peatman Design with P/C Microcontrollers—Pearson Education.
5. Johnathan. w.valvano – Embedded Microcomputer Systems, real time interfacing - Brooks/ Cole, 2000.

Unit	Book	Sections
I	1	1.1-1.6, 3.1-3.2, 4.1-4.2
II	2	5.1-5.5, 9.1-9.3,
III	2	6.1-6.3, 7.1-7.3, 7.5,
	3	13.1 – 13.5, 14.1, 14.3, 14.4
IV	3	15.1-15.7
V	4, 5	Lecture notes for embedded software testing Micro EJ user manual's

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PEL4113				Title of the Paper EMBEDDED SYSTEM-III								Hours 6	Credits 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	PSO6	PSO7	PSO8	
CO1	4	5	4	4	5	3	5	4	3	4	3	4	4	4.0
CO2	4	5	4	4	5	4	5	4	3	4	3	4	4	4.1
CO3	4	5	4	4	5	4	5	4	3	5	3	4	4	4.2
CO4	4	5	4	4	5	5	5	4	3	5	3	4	5	4.3
CO5	4	5	4	4	5	4	5	4	3	5	3	4	5	4.2
CO6	4	5	4	4	5	4	5	4	3	5	3	4	5	4.2
CO7	4	5	4	4	5	4	5	4	3	5	3	4	5	4.2
CO8	4	5	4	4	5	4	5	4	3	5	3	4	5	4.2
Overall Mean Score for COs														4.2

Result: The Score for this Course is 4.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester IV **Hours/Week: 6**
18PEL4114 **Credits : 5**

CONTROL SYSTEM AND ROBOTICS

Course Outcomes

1. Acquire knowledge on basic concepts of control system and robotics
2. Ability to understand the mathematical model of control system
3. Acquire knowledge on time response analysis
4. Study various controllers and errors
5. Understand the concepts of Kinematics and dynamics of Robots.
6. Analyze robot controls and applications.
7. Acquire basic hands on working with robotics
8. Applications of robotics with control system

Unit-I: Mathematical Models of Control System

Control system - Examples of control system - Block diagram reduction techniques - Signal flow graph using Mason's gain formula - M mathematical models : Mechanical system - electrical system - Electrical analogous of mechanical translational systems (two notes) - Electrical analogous of mechanical rotational systems (Force voltage &current). (10 hr)

Unit-II: Time Response Analysis

Time response - Test signals - Transfer function of a system - Laplace transform review Response of first order system for unit step input - Second order system response: Under damped - over damped - critically damped. Time domain specifications: Rise time - Time constant - Settling time. (10 hr)

Unit-III: Controllers and Errors

Response of 2nd order systems with P, PI & PID controllers - Comparison of the responses - Steady state error constants - Steady state error - unit step - unit ramp - unit parabolic signal - Generalized error coefficients - Correlation between static and dynamic error coefficients. (9 hr)

UNIT-IV: Kinematics and Dynamics of Robots

2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformations, Simple problems. Matrix representation, Forward and Reverse Kinematics Of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representation of robots, Basics of Trajectory Planning. (10 hr)

UNIT-V: Robot Control, Programming & Applications Robot controls

Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control. Introduction to Robotic Programming, On-line and off-line programming, programming examples. Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting, military, agriculture. (10 hr)

Books for study

1. Nagoor Gani, "Control system", 1st Edition, RBA publications, 2006.

Books for reference

1. R. Anandanatarajan & P. Ramesh Babu, "Control Systems Engineering", 2nd Edition, Scitech Publications, 2010
2. M. Gopal, "Control system principles and design", TMH, 1998.
3. B. C. Kuo, "Automatic Control Systems", 7th Edition, PHI, 1995.
4. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
5. Craig. J. J. "Introduction to Robotics- mechanics and control", Addison-Wesley, 1999

Unit	Book	Sections
I	1	1.1 - 1.3, 1.6,1.9 - 1.12
II	1	2.1 - 2.4, 2.9 - 2.10, Example 2.4
III	1	3.1 - 3.3, 3.5 - 3.15, 3.17
IV	1	4.1 - 4.8, 4.10, 4.11
V	1	5.1 - 5.5, 5.7, 5.8

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PEL4114					Title of the Paper CONTROL SYSTEM AND ROBOTICS								Hours 6	Credits 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	PSO6	PSO7	PSO8		
CO1	5	4	4	3	4	4	4	3	3	3	3	3	4		3.6
CO2	5	4	4	3	4	4	4	3	3	3	3	3	4		3.6
CO3	5	3	4	3	4	4	4	3	4	3	4	3	4		3.7
CO4	5	5	4	3	4	4	4	3	4	3	4	4	4		3.9
CO5	5	4	4	3	4	4	4	3	3	3	3	4	4		3.7
CO6	5	4	4	3	4	4	4	3	3	3	3	4	4		3.7
CO7	5	4	4	3	4	4	4	3	4	4	5	4	5		4.1
CO8	5	4	4	3	4	4	4	3	4	4	5	4	5		4.1
														Overall Mean Score for COs	3.8

Result: The Score for this Course is 3.8 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 8**
18PEL4115 **Credits : 6**

Electronics Practical-IV
EMBEDDED SYSTEM-III, SENSORS AND TRANSDUCERS, COMMUNICATION EXPERIMENTS

Any 16 Experiments

1. PID algorithm implementation for temperature control
2. Response study of LM35, RTD, Thermistor
3. Optical coupler study – phototransistor, opto TRIAC, opto SCR,
4. Study of DS18S20 1-wire digital thermometer
5. Study of TSOP 17 photo modules for PCM remote control system
6. Study of MOC3041 zero cross optoisolators
7. TL173L linear hall effect sensor and KMZ51 magnetic field sensor
8. Study of pressure and vibration sensor
9. Study of A1425 analog speed sensor
10. Thermal printer interfacing with microcontroller
11. Study of Heart beat sensor and interfacing with microcontroller.
12. ICM105A VGA CMOS sensor
13. MPU 6050 IMU Sensor interfacing with microcontroller
14. AC bridge for signal conditioning
15. Design of Smart lighting system
16. RTOS-1
17. RTOS-2
18. Optical communication – 1
19. Study of data encryption and decryption using microcontroller.
20. Study of LASER for text and sound data transfer.
21. Current measurement sensor
22. Embedded Software testing
23. Brushless motor interfacing with microcontroller
24. Study of RPM counter
25. PAM, PPM, PCM
26. Wireless data transfer.
27. RF communication for Drone.

Semester IV **Hours/Week: 4**
18PEL4201A **Credits : 4**

INTERNET OF THINGS (IoT) & ARTIFICIAL INTELLIGENCE (AI)

Course Outcomes

1. Able to understand the basic concepts of IoT and network standards.
2. Acquire knowledge on web of things
3. Analyze the revolution of cloud computing.
4. To understand basic knowledge of Artificial Intelligence
5. Creative skills acquire Artificial Intelligence algorithms.
6. Enhance the applications of electronics in the field of IoT.

Unit-I: IoT BASICS AND NETWORK STANDARD (8 hr)

Introduction - Objects or things - Identifier and Enabling technologies of IoT - Wireless standards ZigBee - Wireless HART and ISA100.11a - Wireless sensor Networks and IoT, Integration Approaches - Topology based stack based approaches - Low-power Interoperability for the IPv6 - based Internet of Things 19

Unit-II: WoT (10 Hr)

Machine to machine communication to Internet of things - Internet of things to web of things - Protocols: HTTP and CoAP - Wireless Sensor Networks - node - connecting nodes - networking nodes - Securing communication - Standards and FORA - ESP 8266 based NodeMCU - wireless network connectivity - Arduino like IO access - HTTP Client - HTTP Server - PWM - Blinking Led - Interfacing with sensor

Unit-III : CLOUD COMPUTING (10 hr)

Cloud computing - Properties and characteristics - Service Models - Deployment models - Infrastructure as a service (IaaS) - Platform as a service (PaaS) - Software as a service (SaaS) - Web 2.0 - Web OS - Cloud issues and challenges - cloud provider lock in-Security - Advantages and disadvantages of cloud computing

Unit-IV: INTRODUCTION TO Al (10 hr)

Overview to AI- Applications of AI—Types of Intelligence -Intelligence Composed— Research Areas of AI - Real Life Applications of Research Areas— Task Classification of AI— Agents and Environments. The AI Problems- Ideal Rational Agent- The Structure of Intelligent Agents -The Nature of Environments -Properties of Environment

Unit-V : AI Algorithms **(10 hr)**

Single Agent Path finding Problems - Search Terminology - Brute-Force Search Strategies—Informed (Heuristic)- Local Search Algorithms—Search Strategies - Fuzzy Logic - Fuzzy Logic Systems Architecture— Example of a Fuzzy Logic System - Application Areas of Fuzzy Logic— Natural Language Processing - Components of NLP - Implementation Aspects of Syntactic Analysis - Expert Systems - Development of Expert Systems - Robots - Computer Vision - Application Domains of Computer Vision -Neural Networks— AI Issues .

Book for study

Material prepared by the department

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PEL4201A					Title of the Paper INTERNET OF THINGS AND ARTIFICIAL INTELLIGENCE								Hours 4	Credits 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	PSO6	PSO7	PSO8		
CO1	4	4	3	2	4	4	4	5	1	3	3	4	4		3.5
CO2	4	4	3	2	4	4	4	4	1	4	3	4	4		3.5
CO3	4	5	3	3	4	4	4	5	1	4	3	4	4		3.7
CO4	4	5	3	3	4	4	4	4	1	3	3	4	4		3.5
CO5	4	4	3	3	4	4	4	5	1	3	3	4	4		3.5
CO6	4	4	3	3	4	4	4	4	1	4	3	4	4		3.6
Overall Mean Score for COs															3.6

Result: The Score for this Course is 3.6 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\textbf{Mean Score of COs} = \frac{\text{Totalof Values}}{\text{Total No.of POs \& PSOs}} \qquad \textbf{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 4**
18PEL4201B **Credits : 4**

MODERN COMMUNICATION SYSTEMS

Course Outcomes

1. Ability to understand the basics of modern communication system
2. Knowledge on pulse modulation systems
3. Enhance the concepts of digital modulation techniques
4. To interpret mobile communication techniques
5. Analyze fiber optic communication techniques.
6. To study multiple access techniques

Unit-I: PULSE MODULATION SYSTEMS (10 hr)

The sampling theorem: low pass signals and band pass signals - PAM - Channel bandwidth for PAM signal - Natural sampling - Flat top sampling - PCM - Electrical representation of binary digits - PCM system - Companding - Multiplexing PCM signal -Differential PCM - Delta modulation.

Unit-II: DIGITAL MODULATION TECHNIQUES (8 hr)

Phase shift keying-binary PSK - Differential PSK - Differentially encoded PSK (DEPSK) - Quadrature PSK - M-ary PSK - FSK - Binary FSK - Similarity of BFSK and BPSK - M-ary FSK.

Unit-III: INTRODUCTION TO MOBILE COMMUNICATION (10 hr)

Evolution of Mobile Radio Communications – Mobile radio system around the world – Examples of mobile radio systems: Paging systems – Cordless telephone systems – Cellular Telephone Systems – Trends in Cellular Radio and Personal Communications - Introduction – Cellular concept - System design – fundamental - Coverage and Capacity improvement in Cellular system - Technical Challenges.

Unit-IV: FIBRE OPTIC COMMUNICATION (10 hr)

Need for optical communication - Physical nature of optical fibre -Basic principle involved in optical fibre technology - Fibre classification - Acceptance angle- acceptance cone and numerical aperture of fibre - - Fibre attenuation - Advantages/disadvantages of using optical fibre as communication medium - optical fibre application. LIGHT SOURCES: LED-LASER. Photo Detectors— PIN photo diode- APD photo Transistor -bit error rate - optical Transmitter-optical receiver - Repeater- MUX-DMUX-Line coding.

Unit-V: MULTIPLE ACCESS TECHNIQUES (10 hr)

Motivation for Specialized MAC- SDMA- FDMA- TDMA- CDMA- Comparison of Access mechanisms - Basics of Long Term Evolution network (LTE) - broad band networks- Mobile cloud networks-Satellite Systems: Basics- Routing; Introduction to Ad Hoc networks – definition-characteristics features- applications.

Books for Study

1. Taub and Schilling, “Principles of communication systems”, 2nd edition, New Delhi: Tata McGraw Hill Ltd., 1998.
2. T.S.Rappaport, Wireless Communication Principles (2/e), Pearson, 2002.
3. D. Anuradha, “Optical Fibre and Laser principles and applications”, 2nd edition, New age, 2009

Reference Books

1. Trimothy Pratt, Charles W. Bostian, Jeremy E. Allnutt “Satellite Communications”, John Wiley & Sons, 2002.S. Senturia, “Microsystem Design “ , Kluwer, Springer, 2001.
2. A.F.Molisch, Wireless Communications, Wiley, 2005.
3. G. Keiser, “optical fiber communications”, 2nd edition, Tata McGraw Hill,1991

Unit	Book	Sections
I	1	5.1-5.5, 5.9 - 5.15
II	1	6.2 - 6.6, 6.8 - 6.10
III	2	Chapter 1 & 2
IV	3	2.1 – 2.5, 2.8,2.11,2.12, 4.1 – 4.3
V		Lecture Notes

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PEL4201B				Title of the Paper MODERN COMMUNICATION SYSTEMS								Hours 4	Credits 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	PSO6	PSO7	PSO8	
CO1	5	4	3	4	4	3	5	3	2	3	4	3	4	3.6
CO2	4	4	3	4	4	4	4	4	3	4	4	3	4	3.8
CO3	4	5	3	3	4	4	4	4	4	4	4	3	4	3.8
CO4	5	4	3	3	4	3	5	3	3	3	4	3	4	3.6
CO5	5	4	3	4	4	4	5	2	4	2	4	3	4	3.7
CO6	5	4	3	3	4	3	5	3	4	3	4	3	4	3.7
									Overall Mean Score for COs					3.7

Result: The Score for this Course is 3.7 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester IV | **Hours/Week: -**
18PEL4117 | **Credits : 2**

COMPREHENSIVE EXAMINATIONS

Unit-I: ANALOG AND DIGITAL CIRCUITS AND 8051 MICRO-CONTROLLER

The ideal op-amp - Summing - Scaling and averaging amplifier - Instrumentation amplifier -Integrator - Differentiator - Active filters - First order low pass and high pass butter worth filter - Band pass filter - Band reject filter - All pass filter - Oscillator - Square wave Triangular wave generator - Comparator - Zero crossing detector - Schmitt trigger - Sample and Hold circuit - V to I with floating & grounded load - R and 2R ladder method - Binary weighted resistors. Introduction to sequential circuits - Latches and Flip Flop: SR latch - Timing problems and clocked SR latches - JK latch - Master slave latch - Delay Flip Flop - T Flip Flop - Flip Flop excitation requirements - Registers: Serial load shift registers - Parallel load shift register - Parallel to serial conversion Universal shift registers - Introduction to 8051 microcontroller - flag bits and PSW - Register banks and stack – Memory

Unit-II: SIGNALS AND SYSTEMS

Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, z-transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.

Unit-III: POWER ELCTRONICS AND CONTROL SYSTEM

Chopper-Pulse width modulated IGBT AC chopper - Single-phase voltage source inverters- PWM inverters - Current source inverters series inverters- Single-phase parallel inverters-Principle of cycloconverter operation- DC motor Single phase SCR drive - Three phase SCR drive - IGBT - Induction motor -Synchronous motor control. Basic control system components - Open loop and closed loop systems - Signal flow graphs - transient and steady state analysis of LTI control systems and frequency response -root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation - state equation of LTI control systems.

Unit-IV: SENSORS AND TRANSDUCERS

Introduction to measurement - Direct and indirect measuring methods Transducers – Resistive transducers - Potentiometers - Strain gauges - Types of strain gauges - Resistance thermometers - Variable inductance transducers - Linear variable differential transformer - Capacitive transducers - Peizo electric transducers - Hall Effect transducers - Magneto resistors - Differential amplifier - Voltage follower - Instrumentation amplifier - Wheatstone bridge - AC bridges.

Unit-V: ELECTROMAGNETICS AND COMMUNICATION SYSTEM

Maxwell's equations - conditions at a boundary surface - electromagnetic waves: solution for free space conditions - uniform plane wave propagation - Waveguides: rectangular guides - TM waves in rectangular guides - TE waves in rectangular guides - TEM wave in waveguides - dipole antennas - travelling wave antennas - two elemental array - antenna gain - wave propagation: Ground Wave Propagation - plane earth reflection - wave propagation in the ionosphere.

The sampling theorem - PAM - PCM - Companding - Multiplexing PCM signal - Phase shift keying - binary PSK - Differential PSK - FSK - Binary FSK - Similarity of BFSK and BPSK Physical nature of optical fiber - Basic principle involved in optical fiber technology - Fiber classification - Acceptance angle, acceptance cone and numerical aperture of fiber – Fiber attenuation - LED - LASER - Photo Detectors - PIN photo diode - APD photo Transistor - Repeater- MUX-DMUX-Line coding.

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