SEMESTER 4

ELECTRICAL AND COMPUTER ENGINEERING

SEMESTER S4

MATHEMATICS FOR ELECTRICAL SCIENCE– 4

(Group B)

Course Code	**GBMAT401**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Basic calculus	**Course Type**	Theory

Course Objectives:

1. To familiarize students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.
2. To expose the students to the basics of random processes essential for their subsequent study of analog and digital communication

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Random variables, Discrete random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Binomial distribution, Poisson distribution, Poisson distribution as a limit of the binomial distribution, Joint pmf of two discrete random variables, Marginal pmf, Independent random variables, Expected value of a function of two discrete variables. **[Text 1: Relevant topics from sections 3.1 to 3.4, 3.6, 5.1, 5.2]**	**9**

2	Continuous random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Uniform, Normal and Exponential distributions, Joint pdf of two Continuous random variables, Marginal pdf, Independent random variables, Expectation value of a function of two continuous variables. **[Text 1: Relevant topics from sections 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2]**	**9**
3	Confidence Intervals, Confidence Level, Confidence Intervals and One-side confidence intervals for a Population Mean for large and small samples (normal distribution and *t*-distribution), Hypotheses and Test Procedures, Type I and Type II error, *z* Tests for Hypotheses about a Population Mean (for large sample), *t* Test for Hypotheses about a Population Mean (for small sample), Tests concerning a population proportion for large and small samples. **[Text 1: Relevant topics from 7.1, 7.2, 7.3, 8.1, 8.2, 8.3, 8.4]**	**9**
4	Random process concept, classification of process, Methods of Description of Random process, Special classes, Average Values of Random Process, Stationarity- SSS, WSS, Autocorrelation functions and its properties, Ergodicity, Mean-Ergodic Process, Mean-Ergodic Theorem, Correlation Ergodic Process, Distribution Ergodic Process. **[Text 2: Relevant topics from Chapter 6]**	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the concept, properties and important models of discrete random variables and to apply in suitable random phenomena.	**K3**
CO2	Understand the concept, properties and important models of continuous random variables and to apply in suitable random phenomena.	**K3**
CO3	Estimate population parameters, assess their certainty with confidence intervals, and test hypotheses about population means and proportions using *z*-tests and the one-sample *t*-test.	**K3**
CO4	Analyze random processes by classifying them, describing their properties, utilizing autocorrelation functions, and understanding their applications in areas like signal processing and communication systems.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO2	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probability and Statistics for Engineering and the Sciences	Devore J. L	Cengage Learning	9th edition, 2016
2	Probability, Statistics and Random Processes	T Veerarajan	The McGraw-Hill	3rd edition, 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probability, Random Variables and Stochastic Processes,	Papoulis, A. & Pillai, S.U.,	McGraw Hill.	4th edition, 2002
2	Introduction to Probability and Statistics for Engineers and Scientists	Ross, S. M.	Academic Press	6th edition, 2020
3	Probability and Random Processes	Palaniammal, S.	PHI Learning Private Limited	3rd edition, 2015
4	Introduction to Probability	David F. Anderson, Timo, Benedek	Cambridge	1st edition, 2017

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/105/117105085/
2	https://archive.nptel.ac.in/courses/117/105/117105085/
4	https://archive.nptel.ac.in/courses/117/105/117105085/

SEMESTER S4

ELECTRICAL MACHINES

Course Code	**PCEOT402**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. At the end of the course the student will be able to explain the working and analyse the performance of DC machines, transformers, synchronous machines and induction machines

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Constructional details of dc machines - armature winding - lap and wave (concepts only) (1 hour) DC Generator - principle of operation – emf equation – numerical problems (1 hour) Classification of DC generator – separately excited & self-excited – steady-state equations – numerical problems (1 hour) DC shunt generator - no-load (open circuit) characteristics – critical field resistance, critical speed, voltage buildup - load characteristics – armature reaction - cross magnetising & demagnetising effect (concepts only) (3 hours)	**12**

	Power flow diagram – losses and efficiency – maximum efficiency – numerical problems (1 hour) DC motor – back emf – torque equation – numerical problems (1 hour) Classification of DC motors – steady-state equations – numerical problems (1 hour) Characteristics of shunt and series motors (1 hour) Starting of DC motors (concepts only) Power flow diagram – losses and efficiency – numerical problems (1 hour) Testing - Swinburne's test – numerical problems (1 hour)	
2	Single phase transformers – constructional details - principle of operation - EMF equation - ideal and practical transformer – numerical problems (2 hours) Operation on no load and on load - phasor diagram at different load conditions - equivalent circuit - voltage regulation – numerical problems (2 hours) Losses and efficiency - maximum efficiency – numerical problems (2 hours) Testing of transformers - OC test, SC test – numerical problems (1 hour) Autotransformer – saving of copper – numerical problems (1hour) 3- phase transformer – construction - different connections of 3-phase transformers - Y-Y, Δ-Δ, Y-Δ, Δ-Y - numerical problems (2 hours)	**10**
3	Principle of Operation of 3-phase synchronous generator – classification - constructional features - EMF equation – coil-span factor and distribution factor (sinusoidal flux distribution only) – numerical problems (3 hours) Synchronous generator on no-load – open circuit characteristics – synchronous generator on load – armature reaction – effect of armature reaction (2 hours) Equivalent circuit - phasor diagram – voltage regulation – predetermination of voltage regulation by emf and mmfmethod – numerical problems (2 hours) Parallel operation - synchronous generator on infinite bus-bar – conditions – methods of synchronisation – dark lamp method - bright	**11**

	lamp method (2 hours) Synchronous motor – rotating magnetic field (no derivation) - principle of operation – starting methods (2 hours)	
4	3-phase induction motor – principle of operation - classification - constructional features – torque equation - torque-slip characteristics – numerical problems (3 hours) Phasor diagram - equivalent circuit (1 hour) Power flow diagram - losses and efficiency – numerical problems (1 hour) No-load and blocked-rotor tests – determination of equivalent circuit parameters – numerical problems (1 hour) Starting of induction motors – types of starters – DOL starter, autotransformer starter, star-delta starter, rotor resistance starter (no design) – numerical problems (3 hours) Single-phase induction motors – double revolving field theory –torque slip characteristics – types – split-phase, capacitor-start induction-run, permanentcapacitor types – applications (2 hours)	**11**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the constructional details of DC machines and analyse the performance DC generator under various load conditions	**K3**
CO2	Explain the working and analyse the performance DC motor under various load conditions	**K3**
CO3	Analyse the performance of 1-phase and 3-phase transformers and auto-transformers	**K3**
CO4	Analyse the performance of synchronous generator under various load conditions	**K3**
CO5	Explain the working and starting methods of synchronous motor	**K2**
CO6	Describe the constructional details and analyse the performance of 3-phase and 1-phase induction motors.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**										**3**
CO2	**3**	**3**										**3**
CO3	**3**	**3**										**3**
CO4	**3**	**3**										**3**
CO5	**3**	**3**										**3**
CO6	**3**	**3**										**3**

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electrical Machinery	P.S. Bimbhra	Khanna Publishers	7th edition 2021
2	Electric Machines	D P Kothari & I J Nagrath	Tata McGraw Hill	5th edition 2017
3	Theory & Performance of Electrical Machines	J.B. Gupta	S K Kataria	15th edition 2022

SEMESTER S4

COMPUTER ORGANIZATION AND ARCHITECTURE

Course Code	**PCEOT403**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Digital Electronics and Logic System Design (PBEOT304)	**Course Type**	Theory

Course Objectives:

1. The course introduces the principles of computer organization and the basic architectural concepts.
2. To be understand memory systems in digital computer.
3. To better with IO devices communication with processor.
4. To understand control logic design.
5. To be clear with pipeline concepts.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Basic Structure of computers** –functional units - basic operational concepts - bus structures. Memory locations and addresses -memory operations, Instructions and instruction sequencing,addressing modes. **Basic processing unit** – fundamental concepts – instruction cycle – execution of a complete instruction -single bus and multiple bus organization.	**10**
2	**Register transfer logic:** Inter register transfer – arithmetic, logic and shift micro-operations.	

	Processor logic design: - processor organization – Arithmetic logic unit - design of arithmetic circuit - design of logic circuit – Design of arithmetic logic unit - status register – design of shifter - processor unit – design of accumulator(Basic Concept Only).	**11**
3	**Control Logic Design:** Hardwired control-microprogrammed control-Microinstructions, Microprogram Sequencing. **Arithmetic algorithms:** Signed-Operand multiplication, Booth Algorithm, fast multiplication-bit pair recoding of multipliers. **Pipelining:** Basic principles**,** classification of pipeline processors, instruction and arithmetic pipelines (Design examples not required), hazard detection and resolution.	**12**
4	**Memory system:** Types of memory(**Concepts only),**Virtual memory**,** Content addressable memory, cache memories - mapping functions. **I/O organization:** Characteristics of I/O devices, Data transfer schemes - Programmed controlled I/O transfer, Interrupt controlled I/O transfer. Organization of interrupts - vectored interrupts – Servicing of multiple input/output devices – Polling and daisy chaining schemes. Direct memory accessing (DMA)	**11**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	**Assignment/ Microproject**	**Internal Examination-1 (Written)**	**Internal Examination- 2 (Written)**	**Total**
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the relevance of functional units, memory locations and addressing modes in a digital computer.	**K2**
CO2	Illustrate the register transfer logic,Processor logic design.	**K2**
CO3	Explain the implementation aspects of arithmetic algorithms and pipelining concept in a digital computer.	**K3**
CO4	Demonstrate the control signals required for the execution of a given instruction.	**K3**
CO5	Illustrate the organization of different types of memories and I/O organization.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1						2		3
CO2	3	2	2	1						2		3
CO3	3	2	2	1						2		3
CO4	3	2	2	1						2		3
CO5	3	2	2	1						2		3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Organization	Hamacher C., Z. Vranesic and S. Zaky,	McGraw Hill	5/e,2011
2	Digital Logic & Computer Design	Mano M. M	PHI	2004
3	Computer System Architecture	Mano M. M	PHI	2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Organization and Design	Patterson D.A. and J. L. Hennessy	Morgan Kaufmann Publishers	5/e,2013
2	Computer Organization and Architecture: Designing for Performance	William Stallings	Pearson,	9/e, 2013.
3	Computer Organization and Design	Chaudhuri P	Prentice Hall	2/e, 2008.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=msqxkEKFg8I&list=PLgHucKw979AvcnTpPNZMZyORdL5HvTr9m,, https://www.youtube.com/watch?v=k_QgyvsqtwA&list=PLgHucKw979AvcnTpPNZMZyORdL5HvTr9m&index=12
2	https://www.youtube.com/watch?v=0B-y1RPDXjs&list=PL59E5B57A04EAE09C&index=17
3	https://www.youtube.com/watch?v=AgoC0mlL6eQ&list=PLdS3u59E0DKjUKPcnCYxVxssEkX2zo-kV&index=8 https://www.youtube.com/watch?v=6CCwWCstDGc&list=PL1A5A6AE8AFC187B7&index=9https://www.youtube.com/watch?v=IQql2ojVzsU&list=PLEAYkSg4uSQ3dmkbCah82ek0KJnpz_DxL&index=5
4	https://www.youtube.com/watch?v=Wfau1WC5m4c

SEMESTER S4

OBJECT ORIENTED PROGRAMMING USING JAVA

Course Code	**PBEOT404**	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GBEST204 Programming in C	Course Type	Theory

Course Objectives:

1. To introduce the basic concepts of object-oriented design techniques.
2. To give a thorough understanding of basics of Java programming.
3. To provide basic exposure to the Exception handling and Multithreaded programming etc.
4. To impart the techniques of Swing in Java and database connectivity.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** **Approaches to Software Design** - Functional Oriented Design, Object Oriented Design, Case Study of Automated Fire Alarm System. **Object Modeling Using Unified Modeling Language (UML)** – Basic Object-Oriented concepts, UML diagrams, Use case Diagram, Class diagram. **Introduction to Java** - Java Buzzwords, Java program structure, Java compiler, Bytecode, Java Virtual Machine (JVM), Comments, Lexical Issues.	**9**

2	**Core Java Fundamentals:** **Primitive Data types** - Integers, Floating Point Types, Characters, Boolean. Type Conversion and Casting, Variables, Arrays, Strings. **Operators** - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence. **Control Statements** - Selection Statements, Iteration Statements and Jump Statements. **Object Oriented Programming in Java** - Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods, Constructors, this Keyword, Method Overloading. Inheritance - Super Class, Sub Class, Method Overriding-super Keyword. **Input/Output** - I/O Basics, Reading Console Input, Writing Console Output.	**9**
3	**More features of Java:** **Packages** - Defining Package, Importing Packages. **Access Control**-public, private, protected. **Exception Handling** - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw, throws and finally. **Multithreaded programming**-Thread model, Creating threads, Creating multiple threads, thread synchronization.	**9**
4	**Graphical User Interface and Database support of Java:** **Swings fundamentals** - Swing Key Features, Model View Controller (MVC), Components and Containers, Swing Packages, Swing Layout Managers. **Event Handling in Swings:** Delegation event model, event handling using swing components-JFrame, JLabel, JButton, JTextField. **Java DataBase Connectivity (JDBC)-** JDBC architecture, Creating and Executing Queries – create table, delete, insert, select.	**9**

Course Assessment Method

(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Write Java programs using the object-oriented concepts - classes, objects, constructors, data hiding, inheritance and polymorphism.	K2
CO2	Utilise datatypes, operators, control statements, object-oriented class, concepts, I/O basics in Java to develop programs.	K3
CO3	Illustrate how robust programs can be written in Java using packages, exception handling mechanism and Multithreaded programming.	K3
CO4	Write Graphical User Interface based application programs by utilising Swing in Java and database connectivity.	K3

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-		-
CO3	3	3	3	2	2	-	-	-	-	-	-	-
CO4	2	3	3	3	3	-	-	-	-	2	2	-

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Java: The Complete Reference.	Herbert Schildt	Tata McGraw Hill	8th edition, 2011
2	Fundamentals of Software Engineering	Rajib Mall	PHI	4th edition, 2014
3	Java How to Program, Early Objects	Paul Deitel, Harvey Deitel	Pearson	11th Edition, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Programming JAVA a Primer	BalagurusamyE	McGraw Hill	5/e, 2014.
2	Object Oriented Systems Development using the Unified Modeling Language	Ali Bahrami	McGraw-Hill Int.	2017
3	Introduction to Java Programming	Y. Daniel Liang	Pearson	7/e, 2013.

4	Core Java: An Integrated Approach	Nageswararao R.	Dreamtech Press	2008
5	Java in A Nutshell	Flanagan D	O'Reilly	5/e, 2005.
6	Object Oriented Design with UML and Java	Barclay K.J. Savage,	Elsevier	2004
7	Head First Java	Sierra K.	O'Reilly	2/e, 2005.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106105191
2	https://onlinecourses.nptel.ac.in/noc20_cs08/preview

PBL Course Elements

L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**

   - Clarity and feasibility of the project plan
   - Research and background understanding
   - Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**

   - Individual contribution to the presentation
   - Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**

   - Active participation and individual contribution
   - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**

   - Adherence to the project timeline and milestones
   - Application of theoretical knowledge and problem-solving

- Final Result

5. **Final Presentation (5 Marks)**

    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions

6. **Project Quality, Innovation, and Creativity (3 Marks)**

    - Overall quality and technical excellence of the project
    - Innovation and originality in the project
    - Creativity in solutions and approaches

SEMESTER S4

ELECTRONIC INSTRUMENTATION

Course Code	**PEEET411**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCEET205	**Course Type**	Theory

Course objectives:

1. The objective of this course is to impart comprehensive understanding in the field of electronic instrumentation, industrial instrumentation and communication systems.

SYLLABUS

Module	Syllabus	Contact Hours
1	Functional elements of electronic instrumentation system – Calibration methods: Static, Dynamic, Field, Traceable, Master. Transducers- Classification-Criteria for selection- Static and dynamic characteristics- Zeroth and first order instruments and time responses. Resistive transducers for liquid level and humidity Inductive transducers- types and basic principles- LVDT- synchro Capacitive transducers- types and basic principles- Thickness measurement Piezoelectric transducers- Hall effect transducers-Basic principle and applications Electronic IC for sensor applications, Micro Electromechanical system (MEMS)	**10**

	Advantages and Applications, MEMS micro sensors and actuators, MEMS accelerometers Signal conditioning for instrumentation systems: Voltage to Current Converter, Transducer bridges: null type and deflection bridges, AC bridges using push pull transducers	
2	Amplifiers: Instrumentation amplifiers- charge amplifiers- isolation amplifier Role of filters: Low pass, high pass, band pass and band rejection filters, Introduction to digital filters Data Transmission- Types of Telemetry System- Modulation methods: Pulse modulation, Pulse amplitude modulation, Pulse code modulation General telemetry systems- Cable transmission of analog and digital data- Fibre optic data transmission Principles of time division and frequency division multiplexing- Radio-wireless communication, WLAN architecture. Protocols: Field Bus, Profibus , HART	**10**
3	Display methods and devices: Different types of display –display system building blocks. Data Presentation Element: Recorders-Strip Chart Recorder, Potentiometric Recorder, X-Y Recorder. Magnetic recorder, Digital recorders- Data logger Experiments and statistical analysis: Performance of experiment- characteristics of experimental data- description of dispensed data- type of probability distribution-probability error	**9**
4	Introduction to Process Control - Block diagram of the process control loop. Analog and Digital DAS: Programmable logic controllers (PLC), Organization- Hardware details- I/O- Power supply- CPU- Standards Programming aspects- Ladder programming- realization of AND, OR, NAND, NOR and XOR logic, the concept of latching, Introduction to Timer/Counters, Numerical Exercises based on Timers and Counters. SCADA and DCS systems: SCADA: Introduction, SCADA Architecture, Common System Components, Supervision and Control, HMI, RTU and Supervisory Stations, Protocols-IEC	**10**

	60870-5-101 and DNP3. Distributed Control System: Introduction, DCS Architecture, Control modes.	

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the sensors/transducers suitable for individual instrumental applications.	**K3**
CO2	Design the signal conditioning circuits for industrial instrumentation and automation.	**K3**
CO3	Understand the concepts of data transmission methods applicable to electronic instrumentation systems.	**K2**
CO4	Develop the logic for the process control applications using PLC programming	**K3**
CO5	Analyze the performance of measurement systems using statistical methods	**K4**
CO6	Describe the fundamental concepts of DCS and SCADA systems	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	-	-	2	-	-	-	-	-	2
CO3	3	3	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	-	2	-	-	-	-	-	-	2
CO5	3	2	-	-	2	-	-	-	-	-	-	2
CO6	3	2	3	-	3	2	-	-	-	-	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	A course in Electrical and Electronic Measurements & Instrumentation	K. Sawhney	Dhanpat Rai & Co.	2011
2	A course in Electrical & Electronic Measurement & Instrumentation	J. B. Gupta	S K Kataria & Sons	14th Ed., 2014
3	Electrical Measurements & Measuring Instruments	Golding E.W and Widdis	Wheeler Pub.	
4	Electronic Instrumentation	H. S. Kalsi	McGraw Hill, New Delhi	4th Ed., 2019
5	Principles of Electrical Measurement	S Tumanski	Taylor & Francis.	
6	Electronic Instrumentation and Measurements	David A Bel	Oxford	
7	Programmable Logic Controllers	William Bolton	Elsevier India Pvt. Ltd	5th edition,
8	SCADA: Supervisory Control and Data Acquisition	Stuart A. Boyer,	International Society of Automation,	4th edition, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Electronics Instrumentation	Cooper W.D	Prentice Hall of India	
2	Basic Electrical Measurements	Stout M.B	Prentice Hall	
3	Electronic Measurements & Instrumentation	Oliver & Cage	McGraw Hill	
4	Doebelin's Measurements Systems	E.O Doebelin and D.N Manik	McGraw Hill Education (India) Pvt. Ltd.	6th Ed.
5	Electrical and Electronics Measurements and Instrumentation	P.Purkait, B.Biswas, S.Das and C. Koley	McGraw Hill Education (India) Pvt. Ltd.,	2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/105/108105153/ https://archive.nptel.ac.in/courses/108/108/108108147/
2	https://archive.nptel.ac.in/courses/108/105/108105153/
3	https://archive.nptel.ac.in/courses/108/105/108105153/
4	https://archive.nptel.ac.in/courses/108/108/108108147/ https://archive.nptel.ac.in/courses/106/105/106105166/

SEMESTER S4

RENEWABLE ENERGY SOURCES

Course Code	**PEEET412**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	NIL	**Course Type**	Theory

Course objectives:

1. To understand energy scenario, energy sources and their utilization
2. To explore society's present needs and future energy demands
3. To study the principles of renewable energy conversion systems
4. To be exposed to energy conservation methods

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** Principles of renewable energy; energy and sustainable development, fundamentals and social implications. Worldwide renewable energy availability, renewable energy availability in India, types of renewable energy. **Wind Energy:** Properties of wind, availability of wind energy in India, wind velocity and power from wind (numerical problems); major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and multi-blade system. Vertical axis - Savonius and Darrieus types.	9

2	**Solar Energy:** Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements - Pyrheliometers, Pyranometer, Sunshine Recorder. Solar Thermal systems: concentrating and non-concentrating collectors - Flat plate collectors; Solar tower electric power plant. Photovoltaic system for electric power generation – Classification of PV system - Principle of Solar cell, advantages, disadvantages and applications of solar photovoltaic system.	**9**
3	**Biomass Energy:** Introduction; Principle of biomass energy generation - Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome type biogas plant; Urban waste to energy conversion; Biomass gasification (Downdraft). **Tidal Power:** Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, classification of tidal power plants - harnessing tidal energy, advantages and limitations.	**9**
4	**Ocean Thermal Energy Conversion:** Principle of working, classification, OTEC power stations in the world, environmental impacts associated with OTEC. Introduction to geothermal energy **Green Energy:** Introduction, Fuel cells: Classification of fuel cells – Hydrogen energy; Operating principles, Zero-energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the environmental aspects of renewable energy resources in comparison with various conventional energy systems, their prospects and limitations.	**K1**
CO2	Understand the concepts of wind energy.	**K1**
CO3	Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation.	**K2**
CO4	Understand the concept of biomass energy resources and conversion principles of tidal energy.	**K2**
CO5	Acquire the basic knowledge of ocean thermal energy conversion. Understand the principle of green energy and hydrogen energy.	**K1**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**										**2**
CO2	**3**	**3**										**2**
CO3	**3**	**3**										**2**
CO4	**3**	**3**										**2**
CO5	**3**	**3**										**2**

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Non-conventional energy sources	G. D. Rai	Khanna	4th edition 2023
2	Renewable energy systems	Thomas E. Kissell, David M. Buchla, Thomas L. Floyd,	Pearson	2017
3	Non-Conventional Energy Resources	Sawhney G. S.	PHI Learning	2012
4	Renewable energy systems	Thomas E. Kissell, David M. Buchla, Thomas L. Floyd,	Pearson	Pearson 2017

SEMESTER S4

MATHEMATICS FOR MACHINE LEARNING

Course Code	PEEET413	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	NIL	Course Type	Theory

Course objectives:

1. The purpose of this course is to introduce mathematical foundations of basic Machine Learning concepts among learners, on which Machine Learning systems are built.
2. Concepts in this course help the learners to understand the mathematical principles in Machine Learning and aid in the creation of new Machine Learning solutions, understand and debug existing ones, and learn about the inherent assumptions and limitations of the current methodologies.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**LINEAR ALGEBRA**: Systems of Linear Equations – Matrices, Solving Systems of Linear Equations. Vector Spaces –Vector Spaces, Linear Independence, Basis and Rank. Linear Mappings – Matrix Representation of Linear Mappings, Basis Change, Image and Kernel.	**9**
2	**ANALYTIC GEOMETRY, MATRIX DECOMPOSITIONS:** Norms, Inner	

	Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Orthogonal Projections – Projection into One Dimensional Subspaces, Projection onto General Subspaces, Gram-Schmidt Orthogonalization. Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation.	**9**
3	**VECTOR CALCULUS**: Differentiation of Univariate Functions - Partial Differentiation and Gradients, Gradients of Vector Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients. Back propagation and Automatic Differentiation – Gradients in Deep Network, Automatic Differentiation. Higher Order Derivatives- Linearization and Multivariate Taylor Series.	**9**
4	**Probability and Distributions** : Construction of a Probability Space - Discrete and Continuous Probabilities, Bayes' Theorem. Summary Statistics and Independence – Gaussian Distribution - Conjugacy and the Exponential Family - Change of Variables/Inverse Transform. **Optimization** : Optimization Using Gradient Descent - Gradient Descent With Momentum. Constrained Optimization and Lagrange Multipliers - Convex Optimization - Linear Programming **-** Quadratic Programming.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Make use of the concepts, rules and results about linear equations, matrix algebra, vector spaces, eigenvalues & eigenvectors and orthogonality & diagonalization to solve computational problems	**K3**
CO2	Perform calculus operations on functions of several variables and matrices, including partial derivatives and gradients	**K3**
CO3	Utilize the concepts, rules and results about probability, random variables, additive & multiplicative rules, conditional probability, probability distributions and Bayes' theorem to find solutions of computational problems	**K3**
CO4	Train Machine Learning Models using unconstrained and constrained optimization methods	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1									2
CO2	3	2										2
CO3	3	2	1									2
CO4	3	2										2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mathematics for Machine Learning	Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong	Cambridge University Press (freely available at https:// mml - book.github.io)	

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Linear Algebra and Its Applications,	Gilbert Strang		4th Edition
2	Linear Algebra Done Right	Axler, Sheldon	Springer	2015
3	Introduction to Applied Linear Algebra	Stephen Boyd and Lieven Vandenberghe	Cambridge University Press	2018
4	Pattern Recognition and Machine Learning	Christopher M Bishop	Springer	2006
5	Convex Optimization	Stephen Boyd and Lieven Vandenberghe	Cambridge University Press	2004
6	Learning with Kernels – Support Vector Machines, Regularization, Optimization, and Beyond	Bernhard Scholkopf and Smola, Alexander J Smola	MIT Press	2002
7	Information Theory, Inference, and Learning Algorithms	David J. C MacKay	Cambridge University Press	2003
8	Machine Learning: A Probabilistic Perspective	Kevin P Murphy	MIT Press	2012
9	The Nature of Statistical Learning Theory	Vladimir N Vapnik	Springer	2000

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	archive.nptel.ac.in/courses/111/107/111107137 onlinecourses.nptel.ac.in/noc24_cs38/
2	archive.nptel.ac.in/courses/111/107/111107137 onlinecourses.nptel.ac.in/noc24_cs38/
3	archive.nptel.ac.in/courses/111/107/111107137 onlinecourses.nptel.ac.in/noc24_cs38/
4	archive.nptel.ac.in/courses/111/107/111107137 onlinecourses.nptel.ac.in/noc24_cs38/

SEMESTER S4

THEORY OF COMPUTATION

Course Code	**PEEET414**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course objectives:

1. Introduce the concept of formal languages.
2. Discuss the Chomsky classification of formal languages with discussion on grammar and automata for regular, context-free, context sensitive and unrestricted languages.
3. Discuss the notions of decidability and halting problem.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to formal language theory– Alphabets, Strings, Concatenation of strings, Languages , Regular Languages - Deterministic Finite State Automata (DFA) (Proof of correctness of construction not required), Nondeterministic Finite State Automata (NFA), Equivalence of DFA and NFA, Regular Grammar (RG), Equivalence of RGs and DFA.	**9**
2	Regular Languages -Regular Expression (RE), Equivalence of REs and DFA, Homomorphisms, Necessary conditions for regular languages, Closure Properties of Regular Languages, DFA state minimization (No proof	

	required).Context Free Grammar (CFG)- CFG representation of Context Free Languages (proof of correctness is required), derivation trees and ambiguity, Normal forms for CFGs	**9**
3	Context-Free Languages -Nondeterministic Pushdown Automata (PDA), Deterministic Pushdown Automata (DPDA), Equivalence of PDAs and CFGs (Proof not required), Pumping Lemma for Context-Free Languages (Proof not required), Closure Properties of Context Free Languages	**9**
4	Context Sensitive Languages - Context Sensitive Grammar (CSG), Linear Bounded Automata. Turing Machines - Standard Turing Machine, Robustness of Turing Machine, Universal Turing Machine, Halting Problem, Recursive and Recursively Enumerable Languages. Chomsky classification of formal languages	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	**Assignment/ Microproject**	**Internal Examination-1 (Written)**	**Internal Examination- 2 (Written)**	**Total**
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Classify a given formal language into Regular, Context-Free, Context Sensitive, Recursive or Recursively Enumerable	**K2**
CO2	Design finite state automata, regular grammar, and regular representations for regular languages.	**K3**
CO3	Design push-down automata and context-free grammar representations for given context-free languages.	**K3**
CO4	Design Turing machines as language acceptors or transducers.	**K3**
CO5	Explain the notion of decidability.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	-	-	-	-	-	3
CO2	3	3	3	2	-	-	-	-	-	-	-	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3
CO4	3	3	3	2	-	-	-	-	-	-	-	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Automata and Computability,	Dexter C. Kozen	Springer	1999

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Automata Theory, Languages, and Computation	John E Hopcroft, Rajeev Motwani and Jeffrey D Ullman	Pearson Education	3/e, 2007
2	Introduction To Theory of Computation,	Michael Sipser	Cengage Publishers	2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=77nkSUsQqJk
2	https://www.youtube.com/watch?v=77nkSUsQqJk
3	https://www.youtube.com/watch?v=77nkSUsQqJk
4	https://www.youtube.com/watch?v=77nkSUsQqJk

SEMESTER S4

SOLID STATE DEVICES

Course Code	**PEEET417**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	GYEST104	**Course Type**	Theory

Course objectives:

1. To design various analog circuits using discrete electronic devices.
2. To design and analyze different electronic circuits for various applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Wave shaping circuits**: First order RC low pass and high pass filters, Differentiator and Integrator, Diode clipping circuits, Diode clamping circuits, Voltage multipliers **Transistor biasing: Concept** of DC and AC load lines, Types -Fixed bias circuit, Self-bias, voltage divider bias, Bias stabilization. **Switching Circuits:** Astable, Bistable and Monostable multivibrators, Schmitt Trigger.	**11**
2	**BJT amplifiers:** RC coupled amplifier –Design, Voltage gain and frequency response. Small signal analysis of CE configuration - small signal hybrid-pi model for mid and low frequency (Gain, Input and output impedance). High frequency equivalent circuits of BJT, Miller effect, Analysis of high frequency response of CE amplifier.	**11**

	Multistage amplifiers - Cascade and Cascode amplifiers: Design, Effect on gain and bandwidth.	
3	**MOSFETs** - MOSFET as an amplifier, Biasing of p-channel and n-channel MOSFET circuits, Small signal equivalent circuit, Small signal Voltage gain, current gain, input and output impedances of CS configuration, CS stage with diode connected load. **Feedback topologies:** Effect of positive and negative feedback on gain, frequency response and distortion, Feedback topologies and its effect on input and output impedance, Feedback amplifier circuits using BJT in each feedback topologies (Analysis of only Voltage series feedback circuit is required)	**11**
4	**Oscillators:** Introduction, Barkhausen criterion, Classification of oscillators - RC phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators (working principle and design equations of the circuits only). Analysis of RC phase shift oscillator. **Power amplifiers:** Classification, Transformer coupled class A power amplifier, push pull class B and class AB power amplifiers, complementary symmetry class B and class AB power amplifiers, Class C power amplifier efficiency and distortion (no analysis required). **Regulated power supplies:** Load and line regulation, Series voltage regulator, shunt voltage regulator, Short circuit protection and fold back protection.	**11**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Design and analyze the RC circuits and BJT biasing circuits	**K4**
CO2	Perform small signal and high frequency analysis of BJT amplifier circuits using equivalent models	**K3**
CO3	Design and analyze MOSFET amplifier circuits	**K4**
CO4	Design and analyze feedback amplifiers and oscillators	**K4**
CO5	Design power amplifiers and voltage regulator circuits	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**2**									**3**
CO2	**3**	**3**	**-**									**3**
CO3	**3**	**3**	**2**									**3**
CO4	**3**	**3**	**2**									**3**
CO5	**3**	**1**	**2**									**3**

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Devices and Circuit Theory	Robert Boylested and L. Nashelsky	Pearson	11/e,2017.
2	Microelectronic circuits	Sedra A S. and K. C. Smith	Oxford University Press	6/e,2013
3	Electronic Devices and Circuits	David A Bell	Oxford University Press	5/e,2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic circuits, Analysis and Design	Neamen D.	McGraw Hill	3/e,2007
2	Microelectronic Circuits – Analysis and Design	Rashid M. H	Cengage Learning	2/e,2011
3	Fundamentals of Microelectronics	Razavi B.	Wiley	2015
4	Integrated Electronics	Millman J. and C. Halkias	McGraw Hill	2/e, 2010

SEMESTER S4

ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS

Course Code	**PEEOT411**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	GYEST104	**Course Type**	Theory

Course Objectives:

1. The basic objective of this course is to introduce the concepts of electrical measurement systems and instrumentation.
2. Explain the principle of operation and construction of basic instruments for the measurement of basic circuit parametersand magnetic quantities.
3. To measure the passiveparameters using bridge circuits, sensors and transducers.
4. Modern digital instrumentation systems are also introduced through this course.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Functional Elements of Measurements Systems**- Block Schematic and brief operation of building blocks. **Standards of Measurements**- Static characteristics (accuracy, precision, linearity, resolution), Need for calibration, Types of errors	**9**

	Instruments- Classification; Operating Forces and Torques: deflecting, controlling and damping torques- Gravity and spring control; air, fluid friction and eddy current damping. **Measurement of Voltage and Current**- Moving Coil and Moving Iron types. Range Extension – shunts and multipliers **(Include simple problems of range extension)**	
2	**Magnetic Measurement**- Flux Meter, Determination of BH Curve - Hysteresis Loop (Method of Reversal). **Measurement of Resistance**, Wheatstone's Bridge, Kelvin's Double Bridge (Simple Problems), Loss of Charge Method, Measurement of Earth Resistance. **Measurement of Inductance**- Maxwell's Inductance Bridge, Measurement of Capacitance - Schering's Bridge, Measurement of Frequency- Wien Bridge (Include Simple Problems). Q-meter, LCR Meters **(Description only).**	**7**
3	**Measurement of Power and Energy**: Measurement of Power using Dynamometer type wattmeter, Three phase Power Measurement using Two Wattmeter Method (Include Phasor Diagrams and Expressions, Include simple problems of two wattmeter method) Measurement of Energy Using Induction type Energy Meter, Two Element Energy Meter. **Instrument Transformers**-CT and PT- Principle of Operation- Range Extension.((**Description Only)** Basic Principles of Electronic Multimeter, Digital Voltmeter. Digital Energy Meter, TOD Meter, Smart Metering, Bidirectional Meters **(Description Only)**	**10**
4	**Block Schematic of electronic instrumentation system** – role of sensors and transducers – Classification of Temperature transducers-Principle of operation of Thermistors and RTD – Classification of flow transducers- Principle of operation of Electromagnetic and ultrasonic types	**10**

	Strain gauge: Basic working principle, types and applications; Measurement of angular speed and luminous intensity – Principles of Digital Data Acquisition systems-Role of Signal conditioning systems (Basic Principles only)- Phasor Measurement Unit (Block Schematic and Description Only) CRO, DSO and Harmonic Analysers: Block Diagram, Basic Principles and applications only **Virtual Instrumentation Systems**: Block schematic and Description onlyIOT and Data analytics for Industrial Process- Case study on Smart Grid	

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Classify various parameters and errors associated with measuring instruments.	**K2**
CO2	Apply suitable methods for the measurement of current, voltage, power and energy.	**K3**
CO3	Use suitable methods for the measurement of magnetic quantities, resistance, inductance and capacitance.	**K3**
CO4	Describe the working principle, selection criteria and applications of various sensors and transducers in relation to measurements systems.	**K2**
CO5	Explain the operation of digital measurement systems.	**K2**
CO6	Discuss the applications of modern instrumentation schemes for industrial process	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	-	-	2	-	-	-	-	-	2
CO3	3	3	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	-	2	-	-	-	-	-	-	2
CO5	3	2	-	-	2	-	-	-	-	-	-	2
CO6	3	2	3	-	3	2	-	-	-	-	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	A course in Electrical and Electronic Measurements & Instrumentation	A. K. Sawhney	DhanpatRai& Co.	2011
2	A course in Electrical & Electronic Measurement & Instrumentation	J. B. Gupta	S K Kataria& Sons	14th Ed., 2014
3	Electrical Measurements & Measuring Instruments	Golding E.W and Widdis	Wheeler Pub.	
4	Electronic Instrumentation	H. S. Kalsi	McGraw Hill, New Delhi	4th Ed., 2019
5	Principles of Electrical Measurement	S Tumanski	Taylor & Francis.	
6	Electronic Instrumentation and Measurements	David A Bell	Oxford	

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Electronics Instrumentation	Cooper W.D	Prentice Hall of India	
2	Basic Electrical Measurements	Stout M.B	Prentice Hall	
3	Electronic Measurements & Instrumentation	Oliver & Cage	McGraw Hill	
4	Doebelin's Measurements Systems	E.O Doebelin and D.N Manik	McGraw Hill Education (India) Pvt. Ltd.	6th Ed.
5	Electrical and Electronics Measurements and Instrumentation	P.Purkait, B.Biswas, S.Das and C. Koley	McGraw Hill Education (India) Pvt. Ltd.,	2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/105/108105153/
2	https://archive.nptel.ac.in/courses/108/108/108108147/
3	https://archive.nptel.ac.in/courses/108/105/108105153/
4	https://archive.nptel.ac.in/courses/108/105/108105153/
5	https://archive.nptel.ac.in/courses/108/108/108108147/
6	https://archive.nptel.ac.in/courses/106/105/106105166/

SEMESTER S4

ECONOMICS FOR ENGINEERS

(Common to All Branches)

Course Code	**UCHUT346**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	6

2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	**6**
3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators-SENSEX and NIFTY	**6**
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	**6**

Course Assessment Method

(CIE: 50 marks , ESE:50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	**Assignment/ Case Study / Microproject**	**Internal Examination-1 (Written)**	**Internal Examination- 2 (Written)**	**Total**
10	**15**	**12.5**	**12.5**	**50**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● Minimum 1 and Maximum 2 Questions from each module. ● Total of 6 Questions, each carrying 3 marks **(6x3 =18marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. **(4x8 = 32 marks)**	**50**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	**K2**
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	**K3**
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	**K2**
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	-	-	1	-
CO2	-	-	-	-	-	1	1	-	-	-	1	-
CO3	-	-	-	-	1	-	-	-	-	-	2	-
CO4	-	-	-	-	1	1	-	-	-	-	2	-

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7^{TH} Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	**UCHUT347**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of ethics** - Personal vs. professional ethics, Civic Virtue, Respect for others, **Profession and Professionalism,** Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, **Technology and digital revolution**-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, **High technologies: connecting people and places**-accessibility and social impacts, **Managing conflict**, Collective bargaining, **Confidentiality**, Role of confidentiality in moral integrity, **Codes of Ethics**. **Basic concepts in Gender Studies** - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, **Gender disparity and discrimination in education**,	**6**

	employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations**, Ethical values and practices in connection with gender** - equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	
2	**Introduction to Environmental Ethics:** Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). **Sustainable Engineering Principles:** Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. **Ecosystems and Biodiversity:** Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. **Landscape and Urban Ecology:** Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	**6**
3	**Hydrology and Water Management:** Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. **Zero Waste Concepts and Practices:** Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. **Circular Economy and Degrowth:** Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. **Mobility and Sustainable Transportation:** Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	**6**
4	**Renewable Energy and Sustainable Technologies:** Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. **Climate Change and Engineering Solutions:** Basics of climate change science, Impact of climate change on natural and	**6**

	human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. **Environmental Policies and Regulations:** Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. **Case Studies and Future Directions:** Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	

Course Assessment Method
(CIE: 50 marks , ESE: 50)

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis**: Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts**: Ability to apply course concepts to real-world problems and local contexts.
- **Creativity**: Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills**: Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	**K3**
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	**K4**
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	**K5**
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	**K4**
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						3	2	3	3	2		2
CO2		1				3	2	3	3	2		2
CO3						3	3	2	3	2		2
CO4		1				3	3	2	3	2		2
CO5						3	3	2	3	2		2

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessmen	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S4

ELECTRICAL MACHINES LAB

Course Code	**PCEOL407**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	**Course Type**	Lab

Course Objectives:

1. Provide practical experience in operation and testing of DC machines, transformers, synchronous machines and induction machines.

Expt. No.	**Experiments**
1	**Open circuit characteristics of DC shunt generator (CO1)** Objectives: a) Predetermine the OCC at different speeds b) Determine the critical field resistance c) Determine the maximum voltage built up with given shunt field resistance d) Determine the critical speed for a given shunt field resistance
2	**Load test on DC shunt generator (CO1)** Objectives: Determine the external and internal characteristics

3	**Brake test on DC shunt motor (CO2)** Objectives: Plot the following characteristics a) Performance characteristics b) Electrical characteristics c) Mechanical characteristics
4	**Brake test on DC series motor (CO2)** Objectives: Plot the following characteristics a) Performance characteristics b) Electrical characteristics c) Mechanical characteristics
5	**Swinburne's test on a DC shunt machine (CO3)** Objectives: a) Predetermine the efficiency while DC machine is acting as generator and motor b) Plot the efficiency curves while DC machine is acting as generator and motor
6	**OC and SC tests on single-phase transformer (CO4)** Objectives: a) Predetermine the voltage regulation and efficiency at different loads and power factors. b) Determine the equivalent circuit referred to LV side and HV side c) Plot the voltage regulation vs power factor curves at full-load. d) Plot the efficiency curve at 0.8power factor. e) Determine the power factor at which the voltage regulation is zero f) Determine the load at which maximum efficiency occurs and the maximum efficiency.
7	**Load test on single-phase transformer (CO4)** Objectives: Determine the voltage regulation and efficiency at different loads and at unity power factor.

8	**Load test on a 3-phase squirrel cageinduction Motor (CO5)** *Objectives:* Start the motor using auto transformer or star-delta starterand plot the performance characteristics
9	**Load test on a 3-phase Slip Ring Induction Motor (CO5)** *Objectives:* Start the motor using auto transformer or rotor resistance starter and plot the performance characteristics
10	**No load and block rotor tests on a three-phase Squirrel Cage Induction Motor (CO5)** *Objectives:* Determine the equivalent circuit parameters
11	**Load Test on a single-phase Induction Motor (CO5)** *Objectives:* Perform load test on single-phase induction motor and plot the performance characteristics
12	**Regulation of a three phase Alternator by emf and mmf methods (CO6)** *Objectives:* Predetermine the regulation of alternator by emf and mmf methods at 0.8pf lag, upf and 0.8pf lead
13	**Synchronization of a 3-phase synchronous generator (CO6)** *Objectives:* Synchronize the alternator by dark lamp or bright lamp method
NOTE: A minimum of TWELVE experiments are mandatory out of the thirteen listed	

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyze the performance of DC generators by conducting load/no-load tests	**K3**
CO2	Sketch the performance characteristics of DC shunt and series motors	**K3**
CO3	Investigate the losses and efficiency in DC machines by conducting no-load tests	**K3**
CO4	Examine the performance of single-phase transformers by conducting load/no-load tests	**K3**
CO5	Analyze the performance of single-phase and 3-phase induction motors by conducting load/no-load tests	**K3**
CO6	Analyze the performance of isolated/grid connected 3-phase synchronous generators.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2					3	2		3
CO2	3	2	2	2					3	2		3
CO3	3	2	2	2					3	2		3
CO4	3	2	2	2					3	2		3
CO5	3	2	2	2					3	2		3

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electrical Machinery	P.S. Bimbhra	Khanna Publishers	7th edition 2021
2	Electric Machines	D P Kothari & I J Nagrath	Tata McGraw Hill	5th edition 2017

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**

    - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**

    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

    - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S4

OBJECT ORIENTED PROGRAMMING (JAVA) LAB

Course Code	**PCEOL408**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Programming in C (GBEST204)	**Course Type**	Lab

Course Objectives:

1. To introduce Object Oriented Concepts-constructors, inheritance, method overloading, & overriding and polymorphism in Java.

2. To practice robust application programs in Java using exceptional handling and threads.

3.To design and deploy applications using Java.

Expt. No.	**Experiments**
(A) Basic programs using data types, operators and control statements in Java:	
1	Write a basic Java program to print any string to console.
2	Write a java program to find the average of the three numbers entered by the user.
3	Write a Java program to find the frequency of a given character in a string. **
4	Write a Java program to multiply two given matrices. **
(B) Utility programs in java:	

5	Write a menu driven Java program to (1) create a vector containing the name of 5 students (2) insert an element to third position (3) insert another 3 elements to the end of the vector (4) delete an element from 2nd position (5) delete all elements from the vector**
6	Write a Java program that reads a line of integers, and then displays each integer, and the sum of all the integers [Use String Tokenizer class of java. util] **
7	Write a Java program that selects a random element from a given array of strings. The array should be populated with at least five different color names.[Use Random class of java.util]
8	Write a Java program that displays the calendar for a specified month and year. The program should take the month and year as input and print the calendar for that month, showing the correct days of the week for each date.
(C) Object Oriented Programming Concepts: Problems on the use of constructors, inheritance, method overloading & overriding, polymorphism:	
9	Write a java program to create class Student with instance variables rollno and name. Create two student objects and initialize the value to these objects by invoking the insert Record method. Display the state (data) of the objects by invoking the display Information() method. **
10	Write a java program to create class Student with instance variables id and name. Create two student objects and initialize the value to these objects by invoking parameterized constructor.

11	Write a Java program to calculate the area of different shapes namely circle, rectangle, and triangle using the concept of method overloading. **
12	Write a Java program which creates a class named 'Employee' having the following members: Name, Age, Phone number, Address, Salary. It also has a method named 'printSalary( )' which prints the salary of the Employee. Two classes 'Officer' and 'Manager' inherits the 'Employee' class. The 'Officer' and 'Manager' classes have data members 'specialization' and 'department' respectively. Now, assign name, age, phone number, address and salary to an officer and a manager by making an object of both of these classes and print the same. (Exercise to understand inheritance). **
13	Write two Java classes Employee and Engineer. Engineer should inherit from Employee class. Employee class to have two methods display() and calcSalary(). Write a program to display the engineer salary and to display from Employee class using a single object instantiation(i.e., only one object creation is allowed). display () only prints the name of the class and does not return any value. Ex. “Name of class is Employee.” calcSalary() in Employee displays “Salary of employee is 10000” and calcSalary() in Engineer displays “Salary of employee is 20000.” **
(D) Exception handling and multi-threading applications:	
14	Write a Java program that shows the usage of try, catch, throws and finally. **
15	Write a Java program that shows thread synchronization. **
16	Write a Java program that implements a multi-threaded program which has two threads. First thread displays “java is simple” every 1 second and second thread displays “Java is robust” every two second.
(E) Graphics Programming and Java DataBase Connectivity (JDBC):	

17	Write a Java program that works as a simple calculator. Arrange Buttons for digits and the + - * % operations properly. Add a text field to display the result. Handle any possible exceptions like divide by zero. Use Java Swing. **
18	Write a Java program using Swing to create a frame with two text fields, two labels and a button. The interface has to accept a number in the first text field. On pressing the button, factorial of the number should be displayed in the second text field.
19	Write a Java program to display all records from a table using Java Database Connectivity (JDBC). **

****Mandatory**

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	**Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)**	**Internal Examination**	**Total**
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Implement the Object-Oriented concepts- constructors, inheritance, method overloading and overriding and polymorphism in Java.	**K3**
CO2	Implement robust application programs in Java using exceptional handling	**K3**
CO3	Implement application programs in Java using multithreading and database connectivity.	**K3**
CO4	Implement GUI based application programs by utilizing event handling features and Swing in Java.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**3**	**3**	**3**	**3**	**-**	**-**	**2**	**-**	**2**	**2**	**-**

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Java: The Complete Reference.	Herbert Schildt	Tata McGraw Hill	8th Edition, 2011
2	Java How to Program, Early Objects	Paul Deitel, Harvey Deitel	Pearson	7th Edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Java Programming	Y. Daniel Liang	Pearson	7th Edition, 2013.
2	Operating System Concepts	Abraham Silberschatz, Peter B Galvin, Greg Gagne	Wiley India	9th Edition, 2015.
3	Core Java: An Integrated Approach	Nageswara Rao R.	Dreamtech Press	2008
4	Java in A Nutshell	Flanagan D	O'Reilly	5/e, 2005.
5	Object Oriented Design with UML and Java	Barclay K.J. Savage,	Elsevier	2004
6	Head First Java	Sierra K.	O'Reilly	2/e, 2005.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106105191
2	https://www.guru99.com/java-tutorial.html
3	https://www.programiz.com/java-programming
4	https://www.w3schools.com/java/default.asp

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**

    - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**

    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

    - Completeness, clarity, and accuracy of the lab record submitted