Dr. B. C. Roy Engineering College, Durgapur
An Autonomous Institute
(approved by AICTE & affiliated to MAKAUT)

Programme Code: 016
Programme : B.Tech in Electrical Engineering
Year (Semester) : 2nd Year (4th Semester)

Sl. No.	Broad Category	Course Category	Course Code	Course Name	Contact Hours/Week				Credits
					L	T	P	Total	
A. Theory									
1	ENGG	Major	EE-212	Electrical Machines-I	3	0	0	3	3
2	ENGG	Major	EE-213	Electrical and Electronic Measurements	3	0	0	3	3
3	ENGG	Minor	EE-214	Analog Electronics	3	0	0	3	3
4	ENGG	Minor	EE-215	Microprocessor and Microcontroller	3	0	0	3	3
5	ENGG	Minor	EE-216	Power Plant Engineering	3	0	0	3	3
6	ENGG	Minor	EE-217	Object Oriented Programming	3	0	0	3	3
7	HUM	Value Added Courses	EE-218	Indian Constitution	2	0	0	2	1
TOTAL Theory					20	0	0	20	**19**
B. Practical/Sessional									
1	ENGG	Major	EE-219	Electrical Machines-I Laboratory	0	0	2	2	1
2	ENGG	Major	EE-220	Electrical and Electronic Measurements Laboratory	0	0	2	2	1
3	ENGG	Minor	EE-221	Analog Electronics Laboratory	0	0	2	2	1
4	ENGG	Minor	EE-222	Microprocessor and Microcontroller Laboratory	0	0	2	2	1
5	ENGG	Minor	EE-223	Object Oriented Programming using Java Laboratory	0	0	2	2	1
TOTAL Practical/Sessional					0	0	10	10	**5**
Total of Semester					20	0	10	30	**24**

ELECTRICAL MACHINES-I

Course Code: EE-212

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1. **Course Prerequisite:**
   1. Basic Electrical.
   2. Network Theory.
   3. Electromagnetic Field theory.

2. **Course Learning Objectives:**
   The course learning objectives (CLOs) for an Electrical Machines course typically cover the fundamental concepts, principles, analysis, and application of electrical machines in electrical engineering. Here are some typical course learning objectives for an Electrical Machines course:
   1. Understand the Principles of Electrical Machines.
   2. Analyse the Operation of Induction Machines and Synchronous Machines.
   3. Understand the Concept of Power and Efficiency in Electrical Machines.
   4. Study of Starting, Speed Control, and Protection Techniques.
   5. Apply the Knowledge to Real-World Applications.

3. **Course Name: Electrical Machines-I**
   Course Code: EE-212
   Hours per Week: 3
   Credits: 3

   Course Content:

Module	Topics	40L
1	**DC Machines**: Armature winding: Lap winding, wave winding, equalizer rings.	6
	Generator: Construction of dc machines, Emf equation, types of generators, losses, efficiency, armature reaction, commutation, interpoles, compensating windings, dc generator characteristics, voltage build-up of a dc shunt generator, parallel operation of dc generators.	8
	Motor: DC motor principle, counter Emf, speed and torque equations, load characteristics, speed control, starting of dc motors, three-point and four-point starters, testing of dc machines.	8
2	**Transformer**: Single-phase transformer: Construction and types, principle of operation, Emf equation, transformer on no-load, transformer on load, equivalent resistance, magnetic leakage, equivalent circuit, phasor diagram, open and short circuits tests, voltage regulation, losses, efficiency, all-day efficiency, separation of hysteresis and eddy current losses, parallel operation, auto transformer.	10
	Three-phase transformer: Three-phase transformer connections and vector groups, equivalent circuit, determination of equivalent circuit parameters, parallel operation, three phase to two-phase conversion and vice-versa, tap-changers on transformers, testing of transformers, cooling.	8

4. Text Books:

T1. A. E. Fitzgerald, C. Kingsley and S. Umans, Electric Machinery, McGraw-Hill Co. Inc.

T2. D. P. Kothari and I. J. Nagrath, Electrical Machines, Tata McGraw-Hill.

T3. Dr. P. S. Bimbhra, Electrical Machinery.

T4. Dr. P. S. Bimbhra, Generalized Theory of Electrical Machines.

5. Reference Books:

R1. M.G. Say, Alternating Current Machines, Pitman Publishing.

R2. Alexander S. Langsdorf, Theory of Alternating Current Machinery, Tata McGraw-Hill.

6. Course Outcome:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Able to understand the fundamental principles and classification of electromagnetic machines.	Design	Understand
CO2	Ability to design an armature winding	Determine	Understand, Analyse
CO3	Able to learn about the constructional details and principle of operation of dc machines.	Understand	Understand, Apply
CO4	Acquire knowledge about the working of dc machines as generators and motors.	Determine	Understand, Apply, Analyse
CO5	Acquire knowledge about the constructional details, principle of operation of transformers	Analysis	Analyse
CO6	Acquire knowledge about testing and applications of dc machines & transformers.	Implement	Evaluate

7. Mapping of course outcomes to module / course contents:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	2	3	3	3	-	-
2	2	-	-	-	3	3

8. Mapping of the Course outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	1	-	-	-	-	-	-	1
CO2	2	3	2	2	-	-	-	-	-	-	1
CO3	3	3	3	3	-	-	-	-	-	-	1
CO4	3	3	3	3	-	-	-	-	-	-	1
CO5	2	3	3	3	-	-	-	-	-	-	1
CO6	3	3	3	3	-	-	-	-	-	-	1

9. Mapping to PSO:

	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	1
CO2	3	3	-	1
CO3	3	3	-	1
CO4	3	2	-	1
CO5	3	3	-	1

ELECTRICAL AND ELECTRONIC MEASUREMENTS

Course Code: EE-213

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1. Course Prerequisite:

1. Basic Electrical Engineering
2. Network Theory

2. Course Learning Objectives:

This course covers the fundamental concepts of measurement, including the definitions and explanations of accuracy, precision, resolution, speed of response, measurement errors, and loading effects. It emphasizes the application of measurement techniques for electrical parameters by describing methods for measuring power and energy using instruments and explaining the measurement of resistance, capacitance, and inductance with bridges and potentiometers. Learners will understand and analyze various measuring instruments, including the working principles of analog meters, instrument transformers, digital multimeters, digital voltmeters, and digital frequency meters, as well as the principles and applications of signal generators, strain gauges, LVDTs, and temperature transducers. The course also focuses on utilizing oscilloscopes for measurement applications by explaining their building blocks, principles of operation, and demonstrating measurement techniques for voltage, current, frequency, and phase. In addition, it develops problem-solving skills by applying mathematical techniques to solve numerical problems related to analog meters, instrument transformers, and the measurement of power, energy, resistance, inductance, and capacitance. Finally, it explores the applications of measurement and instrumentation by identifying and specifying the uses of analog and digital measuring instruments, sensors, and transducers across various industries.

3. Course Content:

Course Name: Electrical and Electronic Measurements
Course Code: EE-213
Hours per Week: 3
Credits: 3

Module	Topics	36L
1.	**Fundamentals of Measurement:** • Introduction to Measurement Systems, Methods of measurement, classification of instruments, Measurement system and its components Measurement Parameters and Errors. • Definition of accuracy, precision, resolution, speed of response. Errors in measurement: classification and causes. • Loading effect due to shunt and series-connected instruments	4
2.	**Analog Measuring Instruments:** • Analog Meters: General features, construction and principle of operation. Torque equation and working of: Moving coil, Moving iron, Electrodynamometer,	9

	Induction instruments. • Brief idea regarding Electrostatic, Thermoelectric and Rectifier-type instruments, Basic of frequency meter, measurement of Q-factor • Extension of instrument ranges using multipliers **Instrument Transformers:** • Disadvantages of shunts and multipliers • Advantages and working principles of Current Transformers (CT) and Potential Transformers (PT) • Errors in instrument transformers	
3.	**Measurement of Power:** • Power Measurement. Working principles of Electrodynamic and Induction-type wattmeter, Wattmeter errors and their compensation, Measurement of power using only ammeters and voltmeters, Measurement of power using one, two and three wattmeter method, Reactive power measurement with wattmeter and VAR meter **Measurement of Energy:** • Energy Measurement, Construction, theory and applications of AC energy meters, Meter constant, Testing and calibration of energy meters, Phantom Loading **Measurement of Resistance:** • Resistance Measurement, Classification of resistance, Measurement of medium, low and high resistances • Use of Megger for insulation resistance measurement	8
4.	**Potentiometers:** • Potentiometer, basic working, construction and application • Measurement of voltage, current and power • Calibration of voltmeter, ammeter and wattmeter • DC Crompton's potentiometer,Polar and Co-ordinate type potentiometer **AC Bridge:** • Basic Bridge balance equation, Types and range of detectors • Measurement of self-inductance and mutual inductance with bridges and phasor representation • Measurement of capacitance and frequency with bridges and phasor representation	5
5.	**Oscilloscopes and Electronic Instruments:** • Cathode Ray Oscilloscope (CRO), Measurement of voltage, current, frequency, and phase using CRO	5

	• Frequency limitations, Sampling and Storage Oscilloscope, Double beam CRO **Electronic Instruments:** • Advantages of digital meters over analog meters, Digital voltmeter: resolution and sensitivity • Digital multimeter, Digital frequency meter.	
6.	**Sensors and Transducers:** Introduction to Sensors & Transducers, Working principles and applications of: • Strain Gauge • Linear Variable Differential Transformer (LVDT) • Temperature transducers • Flow measurement using magnetic flow meters	5

4. Text Books:

T1: Electrical Measurement & Measuring Instruments, E.W. Golding & F.C. Wides, Wheeler Publishing.
T2: Sensors & Transducers, D. Patranabis, PHI, 2nd edition.
T3: Modern Electronic instrumentation & Measuring instruments, A.D. Heltric & W.C. Copper, Wheeler Publication.
T4: A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.

5. Reference Books:

R1: Electronic Instruments, H.S. Kalsi, Tata Mc-Graw hill, 2nd Edition.

R2: Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw hill.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Understand Fundamental Concepts of Measurement explaining the principles of measurement systems, classification of instruments and key measurement parameters such as accuracy, precision, resolution and errors.	Analyze, Identify	Understand
CO2	Analyze and Operate Analog Measuring Instruments, describe the construction, working principles and torque equations of various analog meters including moving coil, moving iron, electrodynamometer and induction instruments, explain the operation and advantages of instrument transformers (CT and PT) and their role in measurement applications.	Identify	Understand, Apply
CO3	Measure Electrical Power, Energy and Resistance, demonstrate the measurement of power using electrodynamic and induction-type wattmeter and analyze wattmeter errors, explain the construction and working of AC energy meters and their testing procedures, apply various techniques for measuring low, medium and high resistances using Megger and other instruments.	Identify	Understand, Apply
CO4	Apply Potentiometers and AC Bridges for Measurement, utilize DC and AC potentiometers for precise measurement applications, measure self and mutual inductance, capacitance and frequency using AC bridges.	Identify	Understand, Apply

CO5	Application of Oscilloscopes and Digital Instruments for Electrical Measurements, operate cathode ray oscilloscopes (CRO) to measure voltage, current, frequency and phase, explain the principles of digital storage oscilloscopes (DSO), differentiate between analog and digital meters and utilize digital voltmeters, digital multimeters, digital frequency meters and signal generators effectively.	Identify	Apply
CO6	Understand and Apply Sensors and Transducers in Measurement, explain the working principles and applications of various sensors and transducers including strain gauges, LVDTs, temperature transducers and magnetic flow meters for industrial measurement applications.	Analyze	Understand, Apply

7. Mapping of course outcomes to module / course content:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	1
2	2	3	-	-	-	-
3	2	2	3	3	-	-
4	2	-	2	3	-	-
5	2	-	-	-	3	-
6	1	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	2	-	-	-
CO2	1	2	3	-	2	-	-	2	-	-	1
CO3	2	3	2	3	3	-	-	3	-	-	2
CO4	2	2	3	3	2	-	-	3	-	-	2
CO5	1	3	2	2	-	-	-	1	-	-	-
CO6	2	3	2	3	3	-	-	3	-	-	2

9. Mapping to PSO:

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	3	2	2
CO3	2	3	1	3
CO4	1	3	2	3
CO5	3	2	1	1
CO6	2	2	1	1

ANALOG ELECTRONICS

Course Code: EE-214

1. **Course Pre-requisites:**
   1. Basic Electronics Engineering
   2. Basic Electrical Engineering

2. **Course Learning Objectives:**
   This course aims to provide a comprehensive understanding of analog electronics, focusing on the analysis and design of amplifier circuits using BJTs and MOSFETs. It explores the principles of feedback in amplifiers, the design of oscillators, and the application of operational amplifier circuits in signal processing. Students will also study filters, power amplifiers, and special function circuits like VCOs and PLLs, gaining insights into their real-world applications. By the end of the course, learners will be equipped with the knowledge to analyze, design, and implement various analog circuits for practical and industrial applications.

3. **Course Name: ANALOG ELECTRONICS**
   Course Code: EE-214
   Hours per Week: 3
   Credits: 3
   Course Contents:

Module	Topics	38L
1.	**BJT as an amplifier**: Small signal model, common-emitter (CE), common-base (CB) and common-collector (CC) amplifiers; Small signal equivalent circuits - gain, input and output impedances, high-frequency equivalent circuit	6
2.	**MOSFET as an amplifier**: Small signal model, common-source (CS), common-gate (CG) and common-drain (CD) amplifiers; small signal equivalent circuits - gain, input and output impedances, high frequency equivalent circuit	6
3.	**Feedback amplifier**: Concept of Feedback, Negative & Positive feedback, Feedback amplifier types	4
4.	**Oscillators**: Barkhausen criterion, Colpitt's, Hartley's, Phase shift, Wien bridge, and Crystal oscillators, 555 timer as an astable multivibrator	7
5.	**Operational amplifier Circuits**: Schmitt Trigger, Instrumentation Amplifier, Log & Antilog amplifier, Precision rectifier, Voltage-to-current & Current-to-voltage converter	5
6.	**Filters**: Concepts of filtering, Types of filters, Special Filter Class: Butterworth filter	3
7.	**Power amplifier**: Class A, B, AB, C & their Conversion efficiency	4
8.	**Special function circuits**: VCO & PLL	3

4. Text Books:

1. **A.S. Sedra, K.C. Smith, T.C. Carusone, & V. Gaudet** – Microelectronic Circuits, 8th International Edition, Oxford University Press.
2. **D. Roy Chowdhury & S.B. Jain** - Linear Integrated Circuit, 2nd Edn., New Age International Publishers.

5. Reference Books:

1. **Sergio Franco -** Design with Operational Amplifiers & Analog Integrated Circuits**,** 3rd edition, TMH.
2. **R.L. Boylestad & L. Nashelsky** - Electronic Devices and Circuit Theory, 11th Edition, Pearson.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Analyze the small-signal models of BJTs and MOSFETs and determine parameters such as voltage gain, input impedance, and output impedance for different amplifier configurations.	Analyze	Analysis
CO2	Evaluate the impact of negative and positive feedback on amplifier performance and classify different types of feedback amplifiers based on their characteristics.	Evaluate	Evaluation
CO3	Design various oscillator circuits, including Colpitts, Hartley, Phase Shift, Wien Bridge, and Crystal oscillators, by applying the Barkhausen criterion.	Design	Synthesis
CO4	Implement operational amplifier-based circuits such as Schmitt Triggers, Instrumentation Amplifiers, Precision Rectifiers, and Log-Antilog amplifiers for signal processing applications.	Implement	Application
CO5	Differentiate between various types of filters and power amplifiers, and determine their frequency response, efficiency, and suitability for specific applications.	Differentiate	Comprehension, Analysis
CO6	Apply the concepts of Voltage-Controlled Oscillators (VCO) and Phase-Locked Loops (PLL) in communication and control system applications.	Apply	Application

7. Mapping of Course Outcomes to module / course content:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	3	-	-	-	-	-
3	-	3	-	-	-	-
4	-	-	3	-	-	-
5	-	-	-	3	-	-
6	-	-	-	-	3	-
7	-	-	-	-	3	-
8	-	-	-	-	-	3

8. Mapping of the Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	1	-	-	-	-	-	-	-
CO2	3	1	1	1	-	-	-	-	-	-	-
CO3	3	1	1	1	-	-	-	-	-	-	-
CO4	3	1	1	1	-	-	-	-	-	-	-
CO5	3	1	1	1	-	-	-	-	-	-	-
CO6	3	1	1	1	-	-	-	-	-	-	-

9. Mapping to PSO:

	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-
CO2	3	-	-	-
CO3	3	-	-	-
CO4	3	-	-	-
CO5	3	-	-	-
CO6	3	-	-	-

MICROPROCESSOR & MICROCONTROLLER

Course Code: EE-215

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1. **Course Prerequisite:**
   1. Analog Electronics
   2. Digital Electronics

2. **Course Learning Objectives:**
   This course covers the architecture, programming, and applications of the microprocessor, microcontrollers. It provides a hands-on approach to interfacing various peripherals and developing embedded systems using the microcontroller.

3. **Course Name: MICROPROCESSOR AND MICROCONTROLLER**
   Course Code: EE-215
   Hours per Week: 3
   Credits: 3
   Course Content:

Module	Topics	40L
1.	Overview of microprocessors (8085, 8086, etc.) and microcontrollers (8051, PIC, AVR). Harvard vs. Von-Neumann Architecture. History and evolution of microprocessor.	01
2.	Organization & Architectural Features of Microprocessor 8085; The Instruction Set: Instruction format, addressing modes; Assembly language programming of 8085.	09
3.	Microprocessor Interfacing of memory devices; Data transfer techniques and I/O ports; Interfacing of keyboard and display devices; Programmable Interrupt and DMA controllers; Interfacing of sensors, transducers, actuators, A/D & D/A Converters, Analog Signal Conditioning Circuits, Data acquisition systems; Standard Interfaces – RS232.	10
4.	History and evolution of microcontrollers, Applications of microcontrollers, 8051 family of microcontrollers, Architecture of the 8051 microcontroller : CPU, Memory organization - ROM, RAM, Special Function Registers, I/O Ports, Timer/Counters, Serial Communication, Interrupts.	06
5.	Introduction to Assembly language, 8051 instruction set, Data transfer instructions, Arithmetic instructions, Logical instructions, Control instructions, Bit manipulation instructions, Addressing modes, Writing and debugging Assembly programs	07
6.	Interfacing Microcontroller: Programming Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation, Designing embedded systems with 8051, Case studies of embedded system applications.	07

4. Text Books:

1. Gaonkar R., Microprocessor Architecture, Programming, and Applications with the 8085.
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C by Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay.
3. Programming and Customizing the 8051 Microcontroller by Myke Predko.
4. The 8051 Microcontroller by Kenneth J. Ayala.

5. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Describe architecture and operation of Microprocessor 8085 and Microcontroller 8051	Analyze, Identify	Understand, Remember
CO2	Ability to understand the Assembly Language Programming concept of Microprocessor 8085 and Microcontroller 8051.	Identify Select	Understand, Apply, Analyze
CO3	Design various applications using its peripherals.	Identify	Analyze, Apply
CO4	Develop microprocessor/ microcontroller based systems.	Analyze	Understand, Apply, Analyze
CO5	Compare microprocessor, microcontroller, PIC and ARM processors	Identify Select	Understand, Apply
CO6	I/O Interfacing and Programming and applications Case studies.	Implement	Evaluate

6. Mapping of course outcomes to module / course content:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	3	-
2	3	3	-	-	-	-
3	2	-	3	-	-	3
4	3	3	-	-	-	-
5	2	-	3	3	-	3
6	2	3	-	3	3	3

7. Mapping of the Course outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	0	0	0	1	0	0	0	0	0	0
CO2	3	2	2	0	0	0	0	0	0	0	0
CO3	3	2	1	0	0	0	0	0	0	0	0
CO4	3	2	1	0	0	0	0	0	0	0	0
CO5	3	3	1	0	2	0	0	0	0	0	0
CO6	3	3	3	3	3	0	0	0	0	0	0

8. Mapping to PSO:

	PSO1	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	2	1
CO2	3	3	2	1
CO3	3	3	2	1
CO4	2	3	2	1
CO5	3	2	2	1
CO6	3	2	2	1

POWER PLANT ENGINEERING

Course Code: EE-216

1. Course Prerequisite:

- Heat Transfer
- Fluid Mechanics
- Electrical Engineering

2. Course Learning Objectives:

The objective of these courses to equip students with the skills needed to design, analyze, and operate power plants efficiently while understanding their environmental and economic implications.

3. Course Name: Power Plant Engineering

Course Code: EE-216
Hours per Week: 3
Credits: 3

Module	Topics	40L
1	**Unit1:** Introduction to power plants & their importance, power plants concepts, types **Unit2:** Heat Cycles: Working of Rankine cycle, reheats cycle regenerative cycle, reheat regenerative cycles and plot them on P-v and T-s diagram.	06
2	**Boilers:** Water Tube & Fire Tube boilers, Circulating Principles, Forced Circulation, Critical pressure, Super heaters, Re heaters, attemperators, economizer, induced draught, forced draught and secondary air Fans, Boiler performance analysis and heat balance. Combustion Systems, Environmental Protection – ESP, Cyclone Separator, Dust Collector etc	12
3	**Steam Turbine & Nozzle:** Thermodynamics of compressible fluid-flow, equation and continuity – Isentropic flow through nozzles. Turbines: Rotary Thermodynamic devices – Steam turbines & their classifications – Impulse & Reaction type Turbines, , velocity diagram, Blade efficiency, optimum velocity ratio, multi-staging, velocity & pressure compounding, losses in turbines, erosion of turbine blades, turbine governing, performance analysis of turbine, Condensing system	12
4	**Gas Turbine Power Plant:** Gas turbine Analysis – Regeneration - Reheating, Isentropic efficiency Combustion efficiency	06
5	**Economic Analysis of Power Plants:** Cost of electrical energy. Selection of type of generation. Performance and load deviation of power plants.	04

4. Text Book:

T1: Engineering Thermodynamics, P.K. Nag, 6th Edition , Mc Graw Hill Education Pvt. Ltd.
T2: Power Plant Engineering, P K Nag, 4th Edition, Mc Graw Hill Education Pvt. Ltd.
T3: Thermal Engineering , P.S. Ballaney, 25th Edition, , Khanna publishers.
T4: Power Plant Engineering, Domkundwar, Arora, Dhanpat Rai & Co.
T5: Applied Thermodynamics, Onkar Singh, New Age International Publishers.

5. Reference Books:

R1: Thermodynamics , Cengel , 6th Edition, Tata Mc Graw- Hill Education.
R2: Power Plant Technology, M. M. Ei-Wakil, 1st Edition, Tata McGraw Hill.
R3: Heat and Thermodynamics, M W Zemansky & R.H.Dittman , 8th Edition, McGraw Hill.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	**Describe** the fundamental of power plant cycle	Describe	Remember
CO2	**Exposure** to operation of different types of boilers, turbines, and Gas turbines	Exposure	Understand
CO3	**Analyze** the performance of boilers, turbines, and Gas turbines	Analyze	Apply
CO4	**Describe** the economic analysis of power plants	Describe	Remember

7. Mapping of course outcomes to module / course content:

Module	CO1	CO2	CO3	CO4
1	3	1	1	1
2	2	3	3	-
3	2	3	3	-
4	2	3	3	-
5	-	1	1	3

8. Mapping of the Course outcomes to Program Outcomes:

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

9. Mapping to Program Specific Outcome (PSO):

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	2	1	1
CO3	3	2	1	1
CO4	3	2	1	1

OBJECT ORIENTED PROGRAMMING

Course Code: EE-217

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1. **Course Prerequisite:**

   Basic knowledge of programming (preferably in C or any procedural language).
   Understanding of data structures, including arrays, linked lists, stacks, and queues.
   Familiarity with algorithmic problem-solving and logic development.
   Basic knowledge of memory management concepts.

2. **Course Learning Objectives:**

   After completing this course, students will be able to:

- **Understand** the fundamental principles of Object-Oriented Programming (OOP), including abstraction, encapsulation, polymorphism, and object identity.
- **Analyze** and **specify** Abstract Data Types (ADTs) and implement them using concrete state space, invariants, and abstraction functions.
- **Apply** OOP principles in software design, including the use of design patterns like Iterator and Model-View-Controller (MVC).
- **Develop** GUI-based applications using Java's Swing and Scala frameworks.
- **Implement** object-oriented programming features such as memory management, exception handling, and command-based method invocation.
- **Evaluate** the efficiency, scalability, and maintainability of OOP-based software solutions.

3. **Course Name: Object Oriented Programming**
   Course Code: EE-217
   Hours per Week: 3
   Credits: 3

Course Contents:

Module	Topics	36L
1	Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example.	8
2	Features of Object-oriented programming. Encapsulation, object identity, polymorphism - but not inheritance.	8
3	Inheritance in OO design. Design patterns. Introduction and classification. The iterator pattern.	6
4	Model-view-controller pattern. Commands as methods and as objects. Implementing OO language features. Memory management.	6
5	Generic types and collections GUIs. Graphical programming with Scale and Swing. The software development process	8

4. Text Books:

T1: Rambaugh, James Michael, Blaha– "Object Oriented Modelling and Design" – Prentice Hall, India.
T2: Ali Bahrami– "Object Oriented System Development"– Mc Graw Hill.
T3: Patrick Naughton, Herbert Schildt– "The complete reference-Java2"– TMH.
T4: R.K Das– "Core Java For Beginners"– VIKASPUBLISHING.

5. References:

R1: Deitel and Deitel– "Java How to Program"– 6th Ed.– Pearson.

R2: Ivor Horton's Beginning Java 2 SDK– Wrox.

R3: E. Balagurusamy– " Programming With Java: A Primer"– 3rd Ed.–TMH.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Specify simple abstract data types and design implementations, using abstraction functions to document them.	Analyze, Specify	Analyze
CO2	Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.	Apply, Develop	Apply
CO3	Design and implement reusable and maintainable software using object-oriented principles and design patterns like Model-Vind Iterator.	Design, Implement	Create
CO4	Design applications with an event-driven graphical user interface. Demonstrate proficiency in GUI-based programming using Java Swing and Scala while managing memory efficiently in object-oriented languages.	Demonstrate, Implement	Apply

7. Mapping of course outcomes to module/course content:

Module	CO1	CO2	CO3	CO4
1	3	-	-	-
2	-	3	-	-
3	-	-	3	-
4	-	-	3	3
5	-	-	-	3

8. Mapping of CO to PO:

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

9. Mapping to PSO:

	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1
CO2	3	2	2	2
CO3	2	3	3	3
CO4	2	2	3	3

INDIAN CONSTITUTION

Course Code: EE-218

1. **Course Pre-requisites: NIL**

2. **Course Learning Objectives:**
   The course helps the students to know about the historical evolution of the Indian constitution. It tells about the structure and hierarchy of the Indian government the executive, the legislature and judiciary. The students gather knowledge about the President election, powers, jurisdiction, the Prime Minister Election, powers, jurisdiction, Governor Election, powers, jurisdiction, Chief Minister election, powers, jurisdiction. Students also gather knowledge of district and panchayat level administration

3. **Course Name: INDIAN CONSTITUTION**
   Course Code: EE-218
   Hours per Week: 2
   Credits: 1

   Course Contents:

Module	Topics	35L
1.	**Indian Constitution:** Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.	5
2.	**Union government and its administration:** Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. **State government and its administration:** Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions.	10
3.	**Supreme court:** Organization of supreme court, procedure of the court, independence of the court, jurisdiction and power of supreme court. **High court:** Organization of high court, procedure of the court, independence of the court, jurisdiction and power of supreme court. **Subordinate courts:** constitutional provision, structure and jurisdiction. National legal services authority, Lok adalats, family courts and gram analysis. **Public interest litigation (PIL):** meaning of PIL, features of PIL, scope of PIL, principle of PIL, guidelines for admitting PIL.	10
4.	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.	10

4. Text Books:

T1: Indian polity - M, Laxmikanth, MC Graw Hill education Publishers.

5. References:

R1: Introduction to the constitution of India - DD Basu, Lexis Nexis Books Publication ltd, India

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Different features of Indian constitution.	Represent, Identify	Understand, Remember
CO2	Power and functioning of Union, state and local self-government.	Analyze, Evaluating	Understand, Apply, Evaluating
CO3	Structure, jurisdiction and function of Indian Judiciary	Understand, Analyze	Understand, Apply
CO4	Basics of PIL and guideline for admission of PIL.	Analyze, Evaluating	Understand, Apply, Analyze
CO5	Functioning of local administration starting from block to Municipal Corporation.	Understand, Remember	Evaluate
CO6	Identify authority to redress a problem in the profession and in the society.	Design	Create

7. Mapping of course outcomes to module/course content:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	-	-	-	-
2	2	3	2	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	2	2

8. Mapping of CO to PO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	-	-	-	-	-	-	1
CO2	3	3	1	1	-	2	-	-	-	-	-
CO3	-	3	1	1	-	-	-	-	-	-	-
CO4	-	-	-	2	-	2		2	2	2	-
CO5					-	2	2	2	2	2	-
CO6					-	2	2	2	2	2	-

9. Mapping to PSO:

	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	2
CO2	-	1	1	1
CO3	3	2	-	-
CO4	3	-	2	1
CO5	3	-	1	2
CO6	3	-	-	2

ELECTRICAL MACHINES-I LABORATORY

Course Code: EE-219

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1. **Course Prerequisite:**
   1. Basic Electrical Engineering
   2. Electromagnetic Field Theory

2. **Course Learning Objectives:**
   The goal of the Electrical Machine -I Laboratory is to give students knowledge and practical experience for different motors using different experiments. The characteristics, performances analysis and speed control of DC machines and also the different tests on 3phase and single phase transformer are regarded as important learning topics in this lab.

3. **Course Name: Electrical Machine-I Laboratory**
   Course Code: EE-219
   Hours per Week: 2
   Credits: 1

   Course Content:

Sl. No	Laboratory Experiment
1.	Determination of the characteristics of a separately excited DC generator.
2.	Determination of the characteristics of a DC shunt motor
3.	Study of methods of speed control of DC motor
4.	Determination of the characteristics of a compound DC generator (short shunt)
5.	Determination of speed of DC series motor as a function of load torque.
6.	Swinburn test of DC motor to calculate the efficiency
7.	To perform Hopkinson's test and determine losses and efficiency of DC machine.
8.	Determination of equivalent circuit of a single-phase transformer and efficiency.
9.	Polarity test on a single-phase transformer and different connections of 3 phase transformer
10.	To obtain efficiency and voltage regulation of single-phase transformer by Sumpner's test
11.	Study the different cut sections of DC machine and transformer (Extra)

4. **Text Books:**

1. Electrical Machine I: P.S Bimbhra (Khanna Publication)
2. Electrical Machine : Ashfaq Hussain (Dhanpat Publication)
3. Electrical Machine : J. B Gupta (Katson Publisher)
4. Electrical Machine: Kothari & Nagrath (Mcgrawhill)

5. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Identify appropriate equipment and instruments for the experiment.	Identify	Understand,
CO2	Test the instrument for application to the experiment.	Testing	Application
CO3	Construct circuits with appropriate instruments and safety precautions.	Construction	Understand, Apply
CO4	Validate different characteristics, performances of DC machine and speed control of DC motor.	Analysis	Understand, Analysis
CO5	Validate different characteristics of Transformer.	Analysis	Understand, Analysis

6. Mapping of course outcomes to module / course content:

Exp. No	CO1	CO2	CO3	CO4	CO5
1	3	1	-	-	-
2	1	2	3	-	-
3	1	2	3	-	-
4	1	2	3	-	-
5	1	2	-	3	-
6	1	2	-	-	3
7	1	2	-	-	3
8	1	2	-	3	-
9	1	2	-	3	-
10	1	2	-	3	-
11	1	2	-	3	-

7. Mapping of the Course outcomes to Program Outcomes:

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

8. Mapping to PSO:

	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	1
CO2	2	3	-	1
CO3	2	3	1	1
CO4	3	3	1	1
CO5	3	3	1	1

ELECTRICAL AND ELECTRONIC MEASUREMENTS LABORATORY

Course Code: EE-220

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1. Course Prerequisite:

1. Basic Electrical Engineering
2. Network Theory

2. Course Learning Objectives:

The goal of the Electrical and Electronics Measurement Laboratory is to give students knowledge and practical experience in design, analysis and implementation for measuring different electrical and electronic quantities. The measurement of voltage, current, power, energy, phase, frequency, resistance, inductance and capacitance are regarded as important learning topics in this lab. The assessment and modification of the precision and accuracy of the AC energy meter, as well as the moving iron and dynamometer-type ammeter, voltmeter, and wattmeter using a potentiometer, are also demonstrated in this course.

3. Course Name: Electrical and Electronic Measurements Laboratory

Course Code: EE-220
Hours per Week: 2
Credits: 1
Course Content:

Sl. No	Laboratory Experiment
1.	Instrument workshop- Observe the construction of PMMC, Dynamometer type of instruments, Oscilloscope and Digital multimeter.
2.	Calibration of moving iron and electrodynamometer type ammeter/voltmeter by potentiometer.
3.	Calibration of dynamometer type wattmeter by potentiometer.
4.	Calibration of AC energy meter.
5.	Measurement of resistance using Kelvin double bridge.
6.	Measurement of power using Instrument transformer.
7.	Measurement of power in Poly-phase circuits.
8.	Measurement of frequency by Wien Bridge.
9.	Measurement of Self-Inductance by Anderson bridge
10.	Measurement of capacitance by De Sauty Bridge.
11.	Measurement of capacitance by Schering Bridge.

4. Text Books:

T1: Electrical and Electronics measurement Laboratory: A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & Sons.
T2: Electrical Measurements and Measuring Instruments, R.K. Rajput, S. Chand Publications.

5. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Identify appropriate equipment and instruments for the experiment	Identify	Understand, Remember
CO2	Test the instrument for application to the experiment	Select	Understand, Apply, Analyze
CO3	Construct circuits with appropriate instruments and safety precautions	Identify Select	Understand, Apply
CO4	Evaluate and adjust the precision and accuracy of AC energy meter, moving iron and dynamometer type ammeter, voltmeter and wattmeter by potentiometer	Apply, Analyze	Understand, Apply
CO5	Measure voltage, current, power, energy, phase, frequency, resistance, inductance, capacitance	Apply	Apply, Analyze

6. Mapping of course outcomes to module / course content

Exp. No.	CO1	CO2	CO3	CO4	CO5
1	3	1	-	-	-
2	1	2	3	3	3
3	1	2	3	3	3
4	1	2	3	3	3
5	1	1	3	-	3
6	1	1	3	-	3
7	1	1	3	-	3
8	1	1	3	-	3
9	1	1	3	-	3
10	1	1	3	-	3
11	1	1	3	-	3

7. Mapping of the Course outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	-	-	2	-	-	-
CO3	3	2	3	1	-	-	-	2	-	-	-
CO4	3	3	1	2	-	-	-	2	-	-	-
CO5	3	3	1	2	-	-	-	2	-	-	-

8. Mapping to PSO:

	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	1
CO2	2	3	-	1
CO3	2	3	1	1
CO4	3	3	1	1
CO5	3	3	1	1

ANALOG ELECTRONICS LABORATORY

Course Code: EE-221

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1. Course Pre-requisites:

1. Basic Electronics Laboratory
2. Basic Electrical Laboratory

2. Course Learning Objectives:

The Analog Electronics Lab focuses on conducting various laboratory experiments to deepen students' understanding of analog circuits. Students will measure gain, bandwidth, and frequency response of RC coupled amplifiers using BJTs in CE configuration and MOSFET amplifiers. They will also measure OPAMP parameters such as common-mode gain, differential-mode gain, CMRR, and slew rate. The lab includes designing integrators, differentiators, precision rectifiers, V-to-I and I-to-V converters using OPAMPs. Students will explore Schmitt trigger circuits, astable and monostable multivibrators using NE555, and RC phase shift oscillators using OPAMPs. Additionally, they will learn to realize a PLL using a Voltage-Controlled Oscillator (VCO).

3. Course Name: ANALOG ELECTRONICS LABORATORY
Course Code: EE-221
Hours per Week: 2
Credits: 1

Course Contents:

Module	Topics
1.	RC coupled amplifier using BJT in CE configuration-Measurement of gain, BW and plotting of frequency response.
2.	MOSFET Amplifier-Measurement of gain, BW and plotting of frequency response.
3.	Measurement of OPAMP parameters: Common mode gain, differential mode gain, CMRR and slew rate.
4.	Design of integrator and differentiator using OPAMP.
5.	Realization of a V-to-I & I-to-V converter using OPAMP.
6.	Design Precision rectifier using OPAMP.
7.	Study of Schmitt trigger circuit using OPAMP.
8.	Study of Astable and Monostable multivibrators using NE555.
9.	Study of RC Phase shift oscillator using OPAMP.
10.	Realization of a PLL using Voltage Controlled Oscillator (VCO).

4. Text Books:

1. **A.S. Sedra, K.C. Smith, T.C. Carusone, & V. Gaudet** – Microelectronic Circuits, 8th International Edition, Oxford University Press
2. **D. Roy Chowdhury & S.B. Jain** - Linear Integrated Circuit, 2nd Edition, New Age International Publishers.
3. **Sergio Franco -** Design with Operational Amplifiers & Analog Integrated Circuits**,** 3rd edition, TMH.
4. **R.L. Boylestad & L. Nashelsky** - Electronic Devices and Circuit Theory, 11th Edition, Pearson.

5. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To determine the gain, bandwidth and frequency response of BJT and CMOS amplifiers.	Determine	Analysis
CO2	To measure different OPAMP parameter like Common mode gain, differential mode gain, CMRR and slew rate.	Evaluate	Evaluation
CO3	To implement Integrator, Differentiator, V-to-I and I-to-V converter using IC741.	Implement	Application
CO4	To design Astable and Monostable multivibrator using NE 555.	Design	Application
CO5	To implement Schmitt Trigger, Precision Rectifier and Phase Shift oscillator circuit using IC741.	Implement	Synthesis
CO6	Realization of a PLL using Voltage Controlled Oscillator (VCO).	Construct	Application

6. Mapping of course outcomes to module / course content:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	3	-	-	-	-	-
3	-	3	-	-	-	-
4	-	-	3	-	-	-
5	-	-	3	-	-	-
6	-	-	-	-	3	-
7	-	-	-	-	3	-
8	-	-	-	3	-	-
9	-	-	-	-	3	-
10	-	-	-	-	-	3

7. Mapping of the Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	1	-	-	-	-	-	-	-
CO2	3	1	1	1	-	-	-	-	-	-	-
CO3	3	1	1	1	-	-	-	-	-	-	-
CO4	3	1	1	1	-	-	-	-	-	-	-
CO5	3	1	1	1	-	-	-	-	-	-	-
CO6	3	1	1	1	-	-	-	-	-	-	-

8. Mapping to PSO:

	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-
CO2	3	-	-	-
CO3	3	-	-	-
CO4	3	-	-	-
CO5	3	-	-	-
CO6	3	-	-	-

MICROPROCESSOR AND MICROCONTROLLER LABORATORY

Course Code: EE-222

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1. **Course Prerequisite:** i. Analog Electronics
   ii. Digital Electronics

2. **Course Learning Objectives:**
   To understand the architecture of 8085 microprocessor and understanding, apply and develop assembly language programming skills. To understand and design implementation of the interface microprocessors with supporting chips. To understand the architecture of 8051 microcontroller and develop programming skill. To design a microcontroller-based system.

3. **Course Name: Microprocessor and Microcontroller Laboratory**
   Course Code: EE-222
   Hours per Week: 2
   Credits: 1

Course Content:

Modules	Topics
1	Introduction of 8085 Microprocessor and Its Trainer kit.
2	a. Performing assembly language Programming of addition, Subtraction, multiplication, division using 8085 Microprocessors. b. To perform sorting of numbers in 8085 microprocessor. c. Searching for the smallest number in a given array in 8085 microprocessors. d. Find the sum of a series of numbers in 8085 microprocessor.
3	Programming using arithmetic, logical and bit manipulation instructions of 8051
4	Design and program to implement a parallel communication between 8085/8051 using 8255.
5	Design and program to implement Interfacing of 8085/8051 to control stepper motor.
6	Interfacing ADC and DAC to 8085/8051 and show the Corresponding Output in Seven Segment Displays

4. **Text Books**

1. Advanced Microprocessors and Peripheral, Koshor M Bhurchandi, Ajay Kumar Ray, 3rd Edition, MC Graw hill education.
2. Microprocessor Architecture, Programming,and Applications with the 8085, Ramesh S. Gaonkar, Penram International Publishing (India) Pvt. Ltd.
3. The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi & J. G. Mazidi, Pearson Education.
4. The 8051 microcontroller, Ayala, Thomson.

5. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Identify appropriate equipment and instruments for the experiment	Analyze, Identify	Understand, Analyze,
CO2	Familiarization with Trainer kits of microprocessor 8085 and Microcontroller 8051 and MIDE-51 Software.	Analyze, Identify	Understand, Analyze, Apply.
CO3	To construct & apply the assembly level programming of microprocessor 8085 for arithmetic operation, sorting of array, searching for a number in a string and string manipulation	Analyze, Apply	Understand, Analyze, Apply.
CO4	To construct & apply the assembly level programming of microcontroller 8051 using arithmetic, logical and bit manipulation instructions.	Analyze, Apply	Understand, Analyze, Apply.
CO5	To practice the interfacing of microprocessors and microcontroller with peripheral devices for various applications.	Apply	Understand, Analyze, Apply.
CO6	To learn doing a work in a team	Understand	Understand

6. Mapping of course outcomes to module / course content:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	2	-	1	-
2	1	2	3	-	-	-
3	1	-	2	3	-	2
4	1	1	1	3	-	2
5	1	-	-	-	3	2
6	1	1	1	2	3	3

7. Mapping of the Course outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	3	2	-	-	-	-	-	2
CO2	2	2	3	3	2	-	-	-	-	-	2
CO3	2	2	2	3	1	-	-	-	-	-	2
CO4	3	2	3	2	2	-	-	-	-	-	2
CO5	3	2	2	3	3	-	-	-	-	-	2
CO6	-	-	-	-	-	-	1	1	1		3

8. Mapping to PSO:

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	3	1	1
CO3	3	3	2	1
CO4	2	3	2	1
CO5	3	2	2	1
CO6	3	2	2	1

Object Oriented Programming using Java Laboratory

Course Code: EE-223

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1. **Course Pre-requisites:**
   Before enrolling in this lab, students should have:

   1. Basic knowledge of procedural programming (C, loops, functions).
   2. Understanding of data structures (arrays, linked lists).
   3. Basic familiarity with an Integrated Development Environment (IDE) like Eclipse, NetBeans, or Code::Blocks.
   4. Fundamental knowledge of memory management and object-oriented concepts.

2. **Course Learning Objectives:**

   After successful completion of this lab, students will be able to:

   Implement object-oriented programming principles such as **classes, constructors, method overloading, inheritance, and method overriding** in software development.
   Develop modular and reusable code by utilizing **wrapper classes, arrays, interfaces (multiple inheritance, extending interfaces), and packages**.
   Apply advanced OOP techniques, including **multithreading and applet programming**, to build interactive and efficient applications.
   Demonstrate proficiency in **graphical user interface (GUI) programming** using modern development tools like **Swing, JavaFX, or similar frameworks in C++**.

3. **Course Name: Object Oriented Programming using Java Laboratory**
   Course Code: EE-223
   Hours per Week: 2
   Credits: 1

   Course Contents:

Module	Topics	12L
1	Assignments on class, constructor, overloading, inheritance, overriding	04
2	Assignments on wrapper class, arrays	02
3	Assignments on developing interfaces- multiple inheritance, extending interfaces	02
4	Assignments on creating and accessing packages	02
5	Assignments on multithreaded programming	01
6	Assignments on applet programming	01

4. Text Books:

T1: Herbert Schildt, *Java: The Complete Reference*, McGraw Hill.

T2: E. Balagurusamy: Programming with Java

5. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	**Apply** the concepts of class, constructor, overloading, inheritance, and overriding to develop Java programs.	**Apply**	Apply
CO2	**Implement** Java wrapper classes and arrays for effective data handling.	**Implement**	Apply
CO3	**Develop** programs using interfaces, multiple inheritance, and extending interfaces.	**Develop**	Create
CO4	**Design** and access Java packages for modular programming.	**Design**	Create
CO5	**Develop** multithreaded programs to achieve concurrency and synchronization.	**Develop**	Create
CO6	**Design and implement** Java applets for interactive web applications.	**Design and implement**	Create

6. Mapping of course outcomes to module/course content:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

7. Mapping of CO to PO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	2	2	1	-	-	1	-	1
CO2	2	3	3	2	2	1	-	-	1	-	1
CO3	2	2	3	3	2	1	-	-	1	-	1
CO4	3	2	2	3	3	2	-	-	1	-	1
CO5	2	3	2	2	3	3	-	-	1	-	1
CO6	2	3	2	2	2	3	-	-	1	-	1

8. Mapping to PSO:

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	3	2	2	-
CO3	2	3	3	2
CO4	3	2	2	3
CO5	2	2	3	3
CO6	2	2	2	3