INSTITUTE OF ENGINEERING & MANAGEMENT

(School of University of Engineering and Management Kolkata)

DEPARTMENT OF ELECTRICAL ENGINEERING

SEMESTER WISE CURRICULAM

3rd YEAR- 5th SEMESTER

Syllabus for B. Tech Admission Batch 2024

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus

University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2024

Syllabus Structure:

Sl No	Type of Course	Course Code	Course Name	L	T	P	S	Total Contact Hours	Credit Points
1	Professional Core Courses	PCCEE501	Electrical Machines-II	3	1	0	0	4	3
2	Professional Core Courses	PCCEE502	Power system-I	3	1	0	0	4	3
3	Professional Core Courses	PCCEE503	Control System	3	1	0	0	4	3
4	Humanities and social sciences including Management	HSMCEE571	Engineering Economics	3	0	0	0	3	3
5	Professional Elective Courses	PECEE501	A. Industrial Automation and SCADA B. Electromagnetic Waves	3	0	0	0	3	3
6	Open Elective Courses	OECEE501	A. Database Management System B. Analog and Digital Communication	2	0	0	0	2	2
7	Humanities and social sciences including Management	ESPEE501	Essential Studies for Professionals V	2	0	0	0	2	0.5
8	Professional Core Courses	PCCEE591	Electrical Machines Laboratory - II	0	0	3	0	3	1
9	Professional Core Courses	PCCEE592	Power System Laboratory - I	0	0	3	0	3	1
10	Professional Core Courses	PCCEE593	Control System Lab	0	0	3	0	3	1
11	Professional Elective Courses	PECEE501	A. Industrial Automation and SCADA lab B. Electromagnetic Waves	0	0	3	0	3	1
12	Humanities and social sciences including Management	SDP581	Skill Development for Professionals V			0	2	2	0.5
13	Project. Seminar and Industrial Training	PWEE581	Mini Project III			0	1	1	1
14	Massive Open Online Courses (MOOCs)	MOOCs	Massive Open Online Courses (MOOCs)						
15	Industry and Foreign Certification (IFC)	IFC	Industry and Foreign Certification (IFC)						
16	Mandatory Additional Requirements (MAR)	MAR581	Mandatory Additional Requirements (MAR)						
Total Credit Points of Semester				**19**	**3**	**12**	**3**	**37**	**23**

Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Electrical Machines-II **Credit: 3** **Lecture Hours: 40**

Subject Code: PCCEE501

List of Faculty Members handling the Subject –

1. Somnath Hazra
2. Ankit Ray Ghatak

Pre-requisite: Electrical Machines-I

Relevant Links:

Study Material Coursera NPTEL LinkedIn **LESSON PLAN_PCCEE501**

Course Objectives:

The purpose of learning this course is

1. To understand the arrangement of windings of AC machines
2. To understand the principle of production of pulsating and revolving magnetic fields
3. To understand the principle of operation and characteristics of three phase Induction machines
4. To understand the principle of operation and characteristics of single phase Induction machines
5. To understand the principle of operation and characteristics of synchronous machine
6. To understand the principle of operation and characteristics of special electromechanical devices
7. To solve problems of Induction machines, synchronous machines and special electro-mechanical devices

Detailed syllabus

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Fundamentals of AC machine windings:**	Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil -active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding-concentrated and distributed, Sinusoidal distributed winding, winding distribution factor	***International Academia:*** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/pages/syllabus/ ***AICTE-prescribedsyllabus:***https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** IS 13107:1991 Guide for measurement of winding resistance of an ac machine during operation at alternating voltage. **Simulation Software:** MATLAB.	3	1. Demonstration of Cut Section models of different electrical machines. 2. To make connection diagram to full pitch & fractional slot winding of 18 slot squirrel cage Induction motor for 6 poles & 4 pole operation.
2	**Pulsating and revolving magnetic fields:**	Constant magnetic field, pulsating magnetic field -alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.	***International Academia***: https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/pages/syllabus/ ***AICTEprescribedsyllabus:***https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** IS/ IEC Specification No. 60034-1: 2004 for Rotating Electrical Machines. **Simulation Software:** MATLAB.	3	MATLAB experiment on analysis of different field systems

3	**Induction Machines:**	Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.	***International Academia***: https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/pages/syllabus/ ***AICTEprescribedsyllabus:***https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** IS Specification No. 325: 1996 regarding Specification for three-phase induction motors. IS Specification No. 4029: 1967 regarding Guide for testing three phase induction motors. **Simulation Software:** MATLAB.	12	1. Different methods of starting of a 3 phase Cage Induction Motor & their comparison [DOL, Auto transformer & Star-Delta] 2. Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [voltage control & frequency control]. 3. Speed control of 3 phase slip ring Induction motor by rotor resistance control. 4. Load test on wound rotor Induction motor to obtain the performance characteristics. 5. To study the performance of Induction generator
4	**Single-phase induction motors:**	Constructional features double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications	***International Academia:*** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/pages/syllabus/ ***AICTEprescribedsyllabus:***https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** IS Specification No. 7572: 1974 regarding Guide for Testing Single-phase AC and Universal Motors. **Simulation Software:** MATLAB.	5	1. Load test on single phase Induction motor to obtain the performance characteristics. 2. Determination of equivalent circuit parameters of a single-phase Induction motor.

5	**Synchronous machines:**	Constructional features, cylindrical rotor synchronous machine -generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine –two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators – synchronization and load division.	***International Academia:*** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/pages/syllabus/ ***AICTEprescribedsyllabus:***https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** IS Specification No. 7132: 1973 regarding Guide for testing of synchronous machines. **Simulation Software:** MATLAB.	12	1. Determination of regulation of Synchronous machine by Synchronous Impedance method. 2. To determine the direct axis resistance [Xd] & quadrature reactance [Xq] of a 3 phase synchronous machine by slip test. 3. Parallel operation of 3 phase Synchronous generators.
6	**Special Electromechanical devices:**	Principle and construction of switched Reluctance motor, Permanent magnet synchronous machines, Linear Induction motor.	***International Academia:*** ***AICTEprescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE/EE/EEE/ME/BSC104/mOD4/pg211.pdf ***Industry Mapping:*** IEEE 1812: 2023regarding IEEE Guide for Testing Permanent Magnet Machines. **Simulation Software:** MATLAB.	5	Mini Projects to be given.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO1. Describe the arrangement of winding of AC machines.
CO2. Explain the principle of operation and0 solve numerical problems of Induction machines, Synchronous machines and special machines.
CO3. Estimate the parameters, characteristics and efficiency of Induction machines and Synchronous machines.
CO4. Select appropriate methods for starting, braking and speed control of Induction machines

Suggested Learning Resources:

Text Books:

Name of the Text Book	Author Name	Edition	Publisher Name	Chapter No.	Module No. and Name of the proposed Syllabus
Electrical Machines	Prithwiraj Purkait & Indrayudh Bandopadhyay	1st	Oxford University Press	2	Module 1 - Fundamentals of AC machine windings
				8,9,10	Module 2- Pulsating and revolving magnetic fields
				8,9,10	Module 3- Induction Machines
				14	Module 4- Single-phase Induction motors
				15	Module 6- Special Electromechanical devices
Electric Machines	DP Kothari & IJ Nagrath	4th	McGraw Hill	8	Module 5- Synchronous Machines

Reference Books:

1. Electric Machinery & Transformer, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
2. Electric Machinery & Transformes, Irving L. Kosow, PHI
3. Electric Machinery, A.E.Fitzgerald, Charles Kingsley,Jr. & Stephen D. Umans, 6th Edition, Tata McGraw Hill Edition.
4. Electrical Machines, R.K. Srivastava, Cengage Learning
5. Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition
6. Electric Machines, Charles A. Gross, CRC press.
7. Problems in Electrical Engineering, Parker smith, 9th Edition, CBS publishers & distributors.

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Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Power System-I **Credit: 3** **Lecture Hours: 42**

Subject Code: PCCEE502

List of Faculty Members handling the Subject –

1. Debashis Jana
2. Ranjita Chowdhury

Pre-requisite: Basic Electrical Engineering; Electric Circuit Theory; Electromagnetic field theory.

Relevant Links: Study Material Coursera1234 nptel **LESSON PLAN_PCCEE502**

Course Objectives:

The purpose of learning this course is

1. To understand the basic concept of power system with grid interconnections, restructuring and Micro-grids.
2. To model the performance and characteristics of various power system components
3. To study and evaluate the effect of faults in power system and the basic protection schemes with circuit breakers and relay systems. .
4. To understand the concepts of HVDC transmission and application of renewable energy in power generation.

Detailed syllabus

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Basic Concepts**	Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems).Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.	**Academia Mapping:** a) https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/ b) **https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf** **Industry Mapping:** MATLAB, PSIM, ETAP	4	1. Mini project has to be given on power system model preparation.
2	**Power System Components**	Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady-state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations. Synchronous Machines: Steady-state performance characteristics .Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators.	**Academia Mapping:** a) https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/ b) https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf **Industry Mapping:** MATLAB, PSIM,	16	1. Determination of the generalized constants A.B, C, D of long transmission line and regulation of a 3-Φ transmission line model. 2. Study of distribution system by network analyzer. 3. Measurement of earth resistance by earth tester. 4. Determination of dielectric strength of insulating oil.

		Typical waveform under balanced terminal short-circuit conditions–steady-state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.	ETAP		5. Determination of breakdown strength of solid insulating material. 6. Determination of parameter of 3-Φ transmission line model by power circle diagram. 7. Study of different types of insulator. 8. Study of active and reactive power control of alternator. 9. Study and analysis of an electrical transmission line circuit with the help of software. 10. Determination of dielectric constant, tan delta, resistivity of transformer oil.
3	**Fault Analysis and Protection Systems**	Method of Symmetrical Components (positive, negative and zero sequences).Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding. Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application. Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams. Typical waveform under balanced terminal short-circuit conditions–steady-state, transient and sub-transient equivalent circuits.	**Academia Mapping:** a) https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/ b) **https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf** **Industry Mapping:** MATLAB, PSIM, ETAP	14	1. Calculation of different faults using MATLAB and ETAP

4	**Introduction to DC Transmission & Renewable Energy Systems**	DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC).LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of a cand dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.	**Academia Mapping:** a) https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/ b) https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf **Industry Mapping:** MATLAB, PSIM, ETAP	8	1. Mini project has to be given on converter based model.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO1. Understand the basic concept of power system with grid interconnections, restructuring and Micro-grids.
CO2. Realize the concepts of various power system components with their performance and characteristics.
CO3. Evaluate fault currents for different types of faults and the basic protection schemes with circuit breakers and relay systems.
CO4. Appreciate the concepts of DC power transmission and renewable energy generation

Suggested Learning Resources:

Text Books

Name of the Text Book	Author Name	Edition	Publisher Name	Chapter No.	Module No. and Name of the proposed Syllabus
Power System Engineering,	D P Kothari, I J. Nagrath	3rd	McGraw Hill	1,22,24,28	Module1- Basic Concepts
				2,3,4,5,17,19,20	Module2- Power System Components
				10,11,12,15,16	Module3- Fault Analysis and Protection Systems
				21,28	Module4-Introduction to DC Transmission & Renewable Energy Systems

Reference Books

1. J.Grainger and W.D.Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2. O.I.Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. B.M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G.Strbac, “Electric Power Systems”, Wiley, 2012.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
EE502.1	3	1	2								
EE502.2	3	3	3	3	2						
EE502.3	2	2	1	1	1						
EE502.4	2	3	3	2	1						
EE502.5	3	3	3	2	2						
EE502.6	3	3	3	3	3						

Lesson Plan:
Module 1: Basic Concepts **Year 2025 (Faculty: DEBASHIS JANA)**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.
2	Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems:
3	Single-line diagrams, per unit system of representation, transmission and distribution voltage levels and topologies (meshed and radial systems).
4	Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

Module 2: Power System Components, Year 2025 (Faculty: DEBASHIS JANA, RANJITA CHOWDHURY)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Overhead Transmission Lines, Electrical and Magnetic Fields around conductors

2	Parameters of transmission lines
3	Estimation of Inductance for 1 phase and 3 phase transmission lines
4	Estimation of Capacitance for 1 phase and 3 phase transmission lines
5	Cables: general construction, types, dielectric stress in a cable, grading of cables
6	Capacitance of a cable, dielectric loss in a cable and its laying,
7	Capacitance and Inductance calculations for simple configurations.
8	Sinusoidal Steady-state representation of Lines
9	Short lines, phasor representation, calculation of efficiency, voltage regulation
10	Medium length lines, phasor representation, calculation of efficiency, voltage regulation
11	Long transmission lines, Characteristics of transmission lines
12	Travelling-wave Equations and long lines
13	Power Transfer, Voltage profile and Reactive Power.
14	Ferranti effect, Surge Impedance, Surge Impedance Loading
15	Series and Shunt Compensation of transmission lines.
16	Corona in transmission line: causes, effects and power loss calculation.

Module 3: Fault Analysis and Protection Systems, Year 2025 (Faculty: RANJITA CHOWDHURY**)**

WORKING DAY	**LESSON PLAN – DESCRIPTION**
1	Faults in power system: Types, causes, effects.
2	Method of Symmetrical Components (positive, negative and zero sequences).
3	Representation of generators, lines and transformers in sequence networks
4	Sequence network construction, Typical waveform under balanced terminal short-circuit conditions–steady-state, transient and sub-transient equivalent circuits.
5	Short circuit capacity and its computation
6	Balanced and Unbalanced Faults-LG, LL and LLG faults
7	Unbalanced faults contd.
8	Computation of Fault Currents. Neutral Grounding.
9	Switchgear: Types, applications and governing parameters of Circuit Breakers.
10	Relays: application, type, construction, operating principle, relay equation
11	Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional

12	Protection contd. Distance protection, differential protection and their application.
13	Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination.
14	Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

Module 4: Introduction to DC Transmission & Renewable Energy Systems**, Year 2025 (Faculty: DEBASHIS JANA and RANJITA CHOWDHURY)**

WORKING DAY	**LESSON PLAN – DESCRIPTION**
1	DC Transmission Systems: Line-Commutated Converters (LCC)
2	Voltage Source Converters (VSC), LCC and VSC based dc link.
3	Real Power Flow control in a dc link. Comparison of a c and dc transmission.
4	Solar PV systems: I-V and P-V characteristics of PV panels.
5	Power electronic interface of PV to the grid.
6	Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines
7	Permanent Magnetic Synchronous Generators and Induction Generators.
8	Power Electronics interfaces of wind generators to the grid.

Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Control Systems Credit: 3 Lecture Hours: 41

Subject Code: PCCEE503

Study material	Coursera	nptel	LinkedIn Learning	Infosys Springboard

List of Faculty Members handling the Subject –

1. Arijita Das
2. Arunima Mahapatra

Pre-requisite: Mathematics, Signals and Systems, Electric Circuit Theory

Course objectives:

The purpose of learning this course is

1. To find mathematical representation of LTI systems
2. To find time response of LTI systems of different orders
3. To findthe frequency response of LTI systems of different orders
4. To understand stabilityof differentLTI systems
5. To analyze LTIsystems with state variables
6. To solve problems of mathematical modelling and stability of LTI systems

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	TEXT BOOK	Mapped Chapter
1	Introduction to control problem	Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems. Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Feedback and Automatic control, Servomechanisms and Regulators, Linear and Nonlinear systems	4	Determination of Step response for first order & Second order system with unity feedback with the help of CRO & calculation of control system specification , Time constant, % peak overshoot, settling time etc. from the response.	Linear control Systems, B. S.Manke, Khanna Publishers	1,2,3,4,5
2	Mathematical modelling of dynamic systems	Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. Control system components: Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tacho-generators. Actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system, Synchros, Resolvers, Position encoders.	10	Familiarization with MAT-Lab control system tool box, MAT-Lab-simulink tool box & PSPICE	Linear control Systems, B. S.Manke, Khanna Publishers	6

			DC and AC tacho-generators. Actuators.				
3	Time domain analysis	Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location. Routh-Hurwitz criteria and applications. Error Analysis: Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Error Analysis: Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.	6	Simulation of Step response & Impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB& PSPICE. Study of a practical position control system obtaining closed step responses for gain setting corresponding to over-damped and under-damped responses. Determination of rise time and peak time using individualized components by simulation. Determination of un-damped natural frequency and damping ration from experimental data.	Linear control Systems, B. S.Manke, Khanna Publishers	7
4	Stability Analysis	Root locus techniques, construction of Root Loci for simple systems. Effects of gain on the movement of Pole and Zeros. Frequency domain analysis of linear system: Bode plots, Polar plots, Nichols chart, Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin. Determination of margins in Bode plot. Nichols chart. M-circle and M-Contours in Nichols chart.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Root Locus, Bode Plot, Polar plot, Nyquist criteria	10	Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box for 2nd order system& determination of different control system specification from the plot. Determination of approximate transfer functions experimentally from Bode plot.	Linear control Systems, B. S.Manke, Khanna Publishers	8

5	Control System performance measure	Improvement of system performance through compensation. Lead, Lag and Lead-lag compensation, PI, PD and PID control. Microprocessor and FPGA based control system, Instrumentation in control system, Digital control system and applications of control system.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Controller Tuning, FPGA, Digital control system and applications of control system.	6	Determination of PI, PD and PID controller action of first order simulated process. Evaluation of steady state error, setting time, percentage peak overshoot, gain margin, phase margin with addition of Lead, Lag, Lead-lag compensator. Design of Lead, Lag and Lead-Lag compensation circuit for the given plant transfer function. Analyze step response of the system by simulation.	Linear control Systems, B. S.Manke, Khanna Publishers	9
6	State variable Analysis	Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Concepts of state variables. State space model	5	Determination of Transfer Function of a given system from State Variable model and vice versa. Analysis of a physical system by State variable and to obtain step response for the system by simulation. Study of State variable analysis using simulation tools. To obtain step response and initial condition response for a single input, two-output system in SV form by simulation	Linear control Systems, B. S.Manke, Khanna Publishers	15

Course outcome:

After completion of this course, the learners will be able to

CO1. Develop mathematical model of mechanical, electrical, thermal, fluid system and different control system components like servomotors, synchros, potentiometer, tacho-generators etc.

CO2. Analyze stability of LTI system using routh-hurtwitz (RH) criteria, root locus techniques in time domain and bode plot and nyquist technique in frequency domain.

CO3. Design different control law or algorithms like proportional control, proportional plus derivative(PD) control, proportional plus integration(PI) control, and proportional plus integration plus derivative (PID) control and compensators like lag, lead, lag-lead for LTI systems.

CO4. Apply state variable techniques for analysis of linear, nonlinear and discrete-time systems.

Suggested Learning Resources:

Text books:

1. Linear control Systems, B.S.Manke, Khanna Publishers

Reference books:

1. Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 8th Edition,PHIModern Control Engineering, K. Ogata, 4th Edition, Pearson Education
2. Control System Engineering, I. J. Nagrath & M. Gopal. New Age International Publication.
3. Control System Engineering, D. Roy Choudhury, PHI
4. Control System Design, C. Goodwin Graham, F. Graebe F. Stefan, Salgado. E. Mario, PHI

CO-PO mapping

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

Lesson Plan:
Module 1: Introduction to control problem **Year 2025 (Faculty: ARIJITA DAS)**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Concept of feedback and Automatic control, Effects of feedback
2	Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems
3	Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function.

Module 2: Mathematical modelling of dynamic systems, Year 2025 (Faculty: ARIJITA DAS)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Block diagram representation of control systems. Block diagram algebra.
2	Block diagram representation of control systems. Block diagram algebra.
3	Signal flow graph. Mason's gain formula.
4	Signal flow graph. Mason's gain formula.
5	Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system.
6	Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tacho-generators. Actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.

Module 3: Time domain analysis, Year 2025 (Faculty: ARIJITA DAS)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio.
2	Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio.
3	Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location.
4	Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location.
5	Routh-Hurwitz criteria and applications. Error Analysis
6	Routh-Hurwitz criteria and applications. Error Analysis
7	Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.
8	Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.

Module 4: Stability Analysis, Year 2025 (Faculty: ARUNIMA MAHAPATRA)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Effects of gain on the movement of Pole and Zeros.
2	Frequency domain analysis of linear system: Bode plots
3	Frequency domain analysis of linear system: Bode plots
4	Frequency domain analysis of linear system: Polar plots, Nichols chart
5	Frequency domain analysis of linear system: Polar plots, Nichols chart
6	Determination of margins in Bode plot. Nichols chart. M-circle and M-Contours in Nichols chart.
7	Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin.
8	Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin.
9	Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin.
10	Root locus techniques, construction of Root Loci for simple systems.
11	Root locus techniques, construction of Root Loci for simple systems.

Module 5: Control System performance measure, Year 2025 (Faculty: ARUNIMA MAHAPATRA)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Improvement of system performance through compensation. Lead, Lag and Lead-lag compensation
2	PI, PD and PID control
3	PI, PD and PID control
4	PI, PD and PID control
5	Digital control system and applications of control system.
6	Digital control system and applications of control system.
7	Microprocessor and FPGA based control system, Instrumentation in control system

Module 6: State variable Analysis, Year 2025 (Faculty: ARUNIMA MAHAPATRA)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Concepts of state variables. State space model. Diagonalization of State Matrix.
2	Diagonalization of State Matrix. Solution of state equations
3	Eigenvalues and Stability Analysis. Concept of controllability and observability.
4	Eigenvalues and Stability Analysis. Concept of controllability and observability.

5	Discrete-time systems. Difference Equations.
6	State-space models of linear discrete-time systems. Stability of linear discrete-time systems

University of Engineering and Management
Institute of Engineering & Management, Salt Lake Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Engineering Economics **Credit: 3** **Lecture**

Hours: 26 Subject Code: HSMCEE571

Pre-requisite: High school mathematics

Relevant Links:

Study Material	Nptel	Coursesera	Linkedin

Course Objectives:

The purpose of learning this course is-

1. An ability to account for the time value of money in economic analyse and ability to make economic decisions using present worth, annual worth, future worth, and capitalized cost;
2. An ability to calculate rates of return on investments and ability to calculate benefit-cost ratios of public works projects.
3. An ability to make economic decisions involving mortgages, car loans, bonds, stocks, and rent-to-own purchases.
4. An ability to calculate annual depreciation amounts for tangible assets using straight-line, declining balance, and MACRS depreciation.

Detailed syllabus

Modulenumber	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Economic Decisions Making –**	Overview, Problems, Role, Decision making process.	***International Academia:*** https://ocw.mit.edu/courses/esd-70j-engineering-economy-module-fall-2009/ ***AICTE-prescribed syllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping: N/A***	2	No corresponding lab
2	**Engineering Costs & Estimation** –	Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	**International Standards**: https://ocw.mit.edu/courses/esd-70j-engineering-economy-module-fall-2009/ ***AICTE prescribed syllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping: N/A***	4	No corresponding lab

3	**Cash Flow, Interest and Equivalence:**	Cash Flow – Diagrams, Categories & Computation, Time Value Of Money, Debt repayment, Nominal & Effective Interest.	***International Standards***: https://ocw.mit.edu/courses/esd-70j-engineering-economy-module-fall-2009/ ***AICTE prescribed syllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping: N/A***	2	No corresponding lab
4	**Present Worth Analysis**:	End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives.	***International Standards:*** https://ocw.mit.edu/courses/esd-70j-engineering-economy-module-fall-2009/ ***AICTE prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping: NA***	2	No corresponding lab
5	**Cash Flow & Rate Of Return Analysis** –	Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate Of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks.	***International Standards:*** ***https://ocw.mit.edu/courses/esd-70j-engineering-economy-module-fall-2009/*** ***AICTE prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping: NA***	4	No corresponding lab

6	**Uncertainty In Future Events -**	Estimates And Their Use In Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options.	***International Standards:*** ***https://ocw.mit.edu/courses/esd-70j-engineering-economy-module-fall-2009/*** ***AICTE prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping: NA***	2	No corresponding lab
7	**Depreciation -**	Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances.	***International Standards:*** ***https://ocw.mit.edu/courses/esd-70j-engineering-economy-module-fall-2009/*** ***AICTE prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping: NA***	4	No corresponding lab
8	**Replacement Analysis -**	Replacement Analysis Decision Map, Minimum Cost Life Of A New Asset, Marginal Cost, Minimum Cost Life Problems.	***International Standards:*** ***AICTE prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping: NA***	2	No corresponding lab

9	**Inflation And Price Change** –	Definition, Effects, Causes, Price Change With Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.	***International Standards:*** ***AICTE prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping: NA***	2	No corresponding lab
10	**Accounting** –	Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	***International Standards:*** ***https://ocw.mit.edu/courses/esd-70j-engineering-economy-module-fall-2009/*** ***AICTE prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping: NA***	2	No corresponding lab

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO1. Apply knowledge of mathematics, economics, and engineering principles to solve engineering problems.
CO2. Understand the major capabilities and limitations of cash flow analysis for evaluating proposed capital investments.
CO3. Account for time value of money using engineering economy factors and formulas,
CO4. Understand the implications and importance of considering taxes, depreciation, and inflation

Suggested Learning Resources:

Text Books

Name of the Text Book	Author Name	Edition	Publisher Name	Chapter No.	Module No. and Name of the proposed Syllabus

Economics for Engineers	H L Bhatia, S N Maheswari	Third Edition	Vikas Publishing House	1,2	Module 1: Introduction to Engineering Economy, Time value of money, Cash flow diagrams, Interest and Interest rate, Discrete compounding and payment.
				3	Module 2: Interest formulae for discrete compounding and discrete payments- Gradient series factors, Nominal & Effective interest.
				4,5	Module 3: Economic equivalence, Methods of comparison of alternatives.
				5	Module 4: Replacement analysis, Economic life of the asset.
				6	Module 5: Depreciation and Depletion.
				3	Module 6: Elements of cost, Break even analysis, Economic order quantity.
				3,7	Module 7: Cost estimation, Decision under risk and uncertainty.
				12	Module 8: Effect of taxation on economic studies, Income tax analysis.

Reference Books

1. Engineering Economy, Sullivan and Wicks: Pearson
2. Engineering Economics, R.PaneerSeelvan: PHI
3. Engineering Economics Analysis, Michael R Lindeburg: Professional Pub.

Module-wise Lecture Plan (26 Hours)

Lecture No.	Module	Topic / Subtopic	CO Mapping	Teaching Method
1	Module 1	Introduction to Engineering Economics: Overview and Scope	CO1	Chalk & Talk / PPT

2	Module 1	Economic Decision Making Process and Engineering Applications	CO1	Discussion & Examples
3	Module 2	Engineering Costs: Fixed, Variable, Marginal and Average Costs	CO1	PPT + Numerical
4	Module 2	Sunk Cost, Opportunity Cost, Recurring and Non-recurring Costs	CO1	Problem Solving
5	Module 2	Cash Cost vs Book Cost, Life Cycle Cost Analysis	CO1	Case Study
6	Module 2	Cost Estimation Models: Per Unit and Segmenting Models	CO1	Numerical Examples
7	Module 2	Cost Indexes, Power Sizing Model, Learning Curve	CO1	Tutorial
8	Module 3	Cash Flow Diagrams and Cash Flow Categories	CO2	PPT + Numerical
9	Module 3	Time Value of Money, Debt Repayment Concepts	CO2, CO3	Problem Solving
10	Module 4	Present Worth Analysis and Economic Criteria	CO2, CO3	Numerical Examples
11	Module 4	Inflation, Deflation and Tax Effects in Economic Analysis	CO4	Discussion
12	Module 5	Annual Cash Flow Analysis and Salvage Value	CO2	PPT + Numerical
13	Module 5	Rate of Return and Internal Rate of Return (IRR)	CO2	Numerical Examples
14	Module 5	Incremental Analysis and Alternative Selection	CO2	Tutorial
15	Module 5	Future Worth Analysis	CO3	Problem Solving
16	Module 5	Benefit-Cost Ratio Analysis	CO3	Numerical Examples
17	Module 5	Sensitivity Analysis and Break-Even Analysis	CO3	Case Study
18	Module 5	Economic Analysis in Public Sector Projects	CO4	Discussion
19	Module 6	Probability Concepts and Range of Estimates	CO4	PPT
20	Module 6	Risk, Return and Economic Decision Trees	CO4	Case Study
21	Module 7	Depreciation Fundamentals and Property Types	CO4	Chalk & Talk
22	Module 7	Straight Line and Declining Balance Depreciation Methods	CO4	Numerical Examples
23	Module 7	Tax Regulations and Capital Allowance Methods	CO4	Discussion

24	Module 7	Depreciation Problems and Applications	CO4	Tutorial
25	Module 8,9,10	Replacement Analysis and Inflation & Price Change	CO4	PPT + Numerical
26	Module 10	Accounting Concepts: Balance Sheet, Income Statement, Financial Ratios	CO4	Discussion & Quiz

CO–PO Mapping

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

University of Engineering and Management
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University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Industrial Automation and SCADA **Credit: 3**

Lecture Hours: 35 **Subject Code: PECEE501A**

Pre-requisite: Basic of Electrical and Electronics Engineering, Electrical Machine.

Relevant Links

Study Material	coursera	nptel	LinkedIn Learning

Course Objectives:

1. To provide students with a fundamental understanding of industrial automation systems and SCADA architecture used in modern industries.
2. To introduce students to the principles, working, and applications of PLCs, HMIs, and industrial communication systems.
3. To enable students to understand the configuration and operation of SCADA systems for real-time monitoring and control of industrial processes.
4. To equip students with knowledge of sensors, actuators, and industrial networking used in automated control systems and industrial applications.

Course Outcome:

1. Students will be able to understand the fundamental concepts of industrial automation systems and measurement techniques used in engineering applications.
2. Students will be able to explain the working principles, construction, and applications of various electrical and electronic measuring instruments.
3. Students will be able to apply modern tools and software used in instrumentation and automation-based engineering projects.

4. Students will be able to identify and analyze different types of sensors and transducers and their applications in industrial automation systems.

Module No	Description	Mapping with Industry and international academia	Lecture Hours	Corresponding Lab assignment	Text Book	Mapped Chapter
1	**UNIT–I: Introduction to Automation**: History and development of PLCs, significance and long-term applicability of PLC technology, concept and definition of PLC, different categories/types of PLCs, importance of PLCs in industrial automation, key characteristics and functions of PLC systems.	**AICTE Syllabus:** https://www.aicte.gov.in/downloads/msyllabus/UG/ELECTRICAL%20Engg%20Final.pdf **International Academia:** https://web.stanford.edu/class/archive/ee/ee392m/ee392m.1056/Lecture1_Intro.pdf	6	Exp- 1	Industrial Automation Technologies by Chanchal Dey Sunit Kumar Sen	Chapter 1
2	**Unit 2: Programmable Logic Controller (PLC):** Invention of PLC, Sustainability of PLC, Definition of PLC, Classification of PLC's, Role of PLC in Automation, Feature of a PLC, I/O devices of PLC, PLC programming devices, PLC Selection criteria. Introduction to RTUs**:** Role, architecture, communication protocols, and applications in industrial automation and power system monitoring.	**AICTE Syllabus:** https://www.aicteindia.org/sites/default/files/Model_Curriculum/UG-1/ug-vol2.pdf **International Academia:** https://web.stanford.edu/class/archive/ee/ee392m/ee392m.1056/Lecture2_Intro.pdf	6	Exp- 2	Industrial Automation Technologies by Chanchal Dey Sunit Kumar Sen	Chapter 2
3	**Unit 3: Design and operation of PLC:** Design and operation of PLC, Architecture of PLC, Central Control Unit of PLC, Functional modes of PLC, PLC Program structure and execution, Programming devices for PLC. Ladder diagram.	**AICTE Syllabus:** https://www.aicte.gov.in/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf **International Academia:** https://web.stanford.edu/class/archive/ee/ee392m/ee392m.1056/Lecture3_Intro.pdf	8	Exp- 2,3	Industrial Automation Technologies by Chanchal Dey Sunit Kumar Sen	Chapter 2,3

4	**Unit 4: PLC Programming** Variables and Data types, Register, Timer, On delay timer, off delay timer, pulse timer, Counter, Up counter, Down counter, Arithmetic functions-Addition(ADD), Subtraction(SUB), Division(DIV), Square root(SQRT), Data handling functions MOVE(MV), Block Transfer(BT), TABLE AND REGISTER MOVE.	**AICTE Syllabus:** https://aicte.gov.in/sites/default/files/Final_Updated_UG_R_&_AI_Curriculum.pdf **International Academia:** https://triplc.com/documents/PLCProgramming.pdf	**9**	**Exp-4,5**	**Industrial Automation Technologies by Chanchal Dey Sunit Kumar Sen**	**Chapter 3**
5	**Unit 5: SCADA System:** Introduction, Different SCADA System Topologies. SCADA Architectures, Functions of SCADA- Data acquisition, Data communication. Integration of SCADA, RTUs, communication networks, and smart grid technologies.	**AICTE Syllabus:** https://aicte.gov.in/sites/default/files/Final_Updated_UG_R_&_AI plc_Curriculum.pdf **International Academia:** https://web.stanford.edu/class/archive/ee/ee392m/ee392m.1056/Lecture5_Intro.pdf	**6**	**Exp-9,10**	**Industrial Automation Technologies by Chanchal Dey Sunit Kumar Sen**	**Chapter 4**

Suggested learning:

Text Books:

1. Industrial Automation Technologies by Chanchal Dey Sunit Kumar Sen, CRC Press.

Reference Books:

1. Industrial Automation Hand Book by Frank. Lamb Tata Mcgraw Hill India
2. Introduction to Industrial Automation by Stamatios Manesis George Nikolakopoulos CRC Press.
3. Programmable Logic Controllers by John Webb, Ronald A. Reis. PHI.

Lesson Plan:

Module No	Title	Hours	Faculty
1	Introduction to Automation	6	Dr. Debasis Chatterjee
2	Programmable Logic Controller (PLC)	6	Dr. Debasis Chatterjee
3	Design and Operation of PLC	8	Dr. Tanmay Sinha Roy
4	PLC Programming	9	Dr. Tanmay Sinha Roy
5	SCADA System	6	Dr. Debasis Chatterjee

Module 1: Introduction to Automation	Faculty: **Dr. Debasis Chatterjee**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	History and development of PLCs. Significance and long-term applicability of PLC technology in modern industries.
2	Concept and definition of PLC. Comparison of PLC-based control versus traditional relay-based control systems.
3	Different categories and types of PLCs (Micro, Small, Medium, Large, Very Large). Classification based on size and I/O count.
4	Importance of PLCs in industrial automation. Key characteristics of PLC systems: ruggedness, reliability, real-time operation.
5	Functions of PLC systems: logic control, sequencing, timing, counting, arithmetic, and communication.
6	Module 1 Review and Discussion. Overview of industrial automation landscape and role of PLCs in Industry 4.0.

Total Hours for Module 1: 6 hours | **Text Book Reference:** Industrial Automation Technologies by Chanchal Dey & Sunit Kumar Sen – Chapter 1

Module 2: Programmable Logic Controller (PLC)	Faculty: **Dr. Debasis Chatterjee**

WORKING DAY	LESSON PLAN – DESCRIPTION

1	Invention of PLC – historical background. Sustainability of PLC technology in evolving industrial environments.
2	Definition and formal description of PLC as per IEC 61131 standard. Classification of PLCs: Fixed/Compact, Modular, Rack-mounted, Soft PLCs.
3	Role of PLC in automation. Features of a PLC: scan cycle, deterministic operation, multi-tasking, fault diagnostics.
4	I/O devices of PLC: Digital Input/Output, Analog Input/Output, Special Function modules. Field devices – sensors and actuators connected to PLC.
5	PLC programming devices: handheld programmers, laptop with software (TIA Portal, RSLogix, CX-Programmer). Communication interfaces.
6	PLC selection criteria: I/O count, memory, scan speed, communication protocols, environmental rating, vendor support, and cost.

Total Hours for Module 2: 6 hours | **Text Book Reference:** Industrial Automation Technologies by Chanchal Dey & Sunit Kumar Sen – Chapter 2

Module 3: Design and Operation of PLC	Faculty: **Dr. Tanmay Sinha Roy**

WORKING DAY	**LESSON PLAN – DESCRIPTION**
1	Design and operation of PLC: internal architecture overview. Role of each major component in overall system operation.
2	Architecture of PLC in detail: CPU, Memory (ROM/RAM/EEPROM), I/O section, Power Supply, Communication ports.
3	Central Control Unit (CPU) of PLC: processor types, clock speed, memory addressing, watchdog timer, and self-diagnostics.
4	Functional modes of PLC: STOP mode, RUN mode, PROGRAM mode. Transitions between modes and their effects on outputs.
5	PLC scan cycle in detail: Input Scan → Program Execution → Output Scan → Housekeeping. Scan time calculation and optimization.
6	PLC program structure: Organization Blocks (OB), Function Blocks (FB), Functions (FC), Data Blocks (DB). Program execution sequence.
7	Programming devices for PLC. IEC 61131-3 programming languages: LD, FBD, ST, IL, SFC. Introduction to Ladder Diagram (LD).
8	Ladder Diagram (LD) in detail: Normally Open (NO) contact, Normally Closed (NC) contact, output coil, parallel and series logic. Simple ladder program examples.

Total Hours for Module 3: 8 hours | **Text Book Reference:** Industrial Automation Technologies by Chanchal Dey & Sunit Kumar Sen – Chapter 3

Module 4: PLC Programming	Faculty: **Dr. Tanmay Sinha Roy**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Variables and Data types in PLC: BOOL, INT, DINT, REAL, WORD, DWORD, STRING, TIME, DATE. Global vs. local variables.
2	Registers in PLC: Input Image Register (I), Output Image Register (Q), Data Register (MW/DB), Accumulator (ACC), Auxiliary Flags (M).
3	Timers in PLC: On-Delay Timer (TON) – concept, timing diagram, ladder symbol, and application examples.
4	Off-Delay Timer (TOF) and Pulse Timer (TP) – concept, timing diagrams, ladder symbols, and applications. Comparison of all three timer types.
5	Counters in PLC: Up Counter (CTU) – concept, ladder symbol, preset value, count value, output activation. Application example: product counting on conveyor.
6	Down Counter (CTD) – concept, ladder symbol. Combined use of CTU and CTD. Reset function for counters. Practical counting applications.
7	Arithmetic functions in PLC programming: ADD (Addition), SUB (Subtraction), DIV (Division), SQRT (Square Root). Examples with register values.
8	Data handling functions: MOVE (MV), Block Transfer (BT), Table and Register Move. Use in recipe management and batch control applications.
9	Module 4 Review: Integrated ladder programming exercise using timers, counters, arithmetic, and data functions. Introduction to HMI integration with PLC.

Total Hours for Module 4: 9 hours | **Text Book Reference:** Industrial Automation Technologies by Chanchal Dey & Sunit Kumar Sen – Chapter 4

Module 5: SCADA System Year 2025	Faculty: **Dr. Debasis Chatterjee**

WORKING DAY	LESSON PLAN – DESCRIPTION

1	Introduction to SCADA: definition, full form, purpose, and role in industrial monitoring and control. Differences between PLC, DCS, and SCADA.
2	Different SCADA System Topologies: First Generation (Monolithic), Second Generation (Distributed), Third Generation (Networked), Fourth Generation (IoT/Cloud-based).
3	SCADA Architectures: Field Instrumentation → RTU/PLC → Communication Network → Master Terminal Unit (MTU) → HMI. Block diagram explanation.
4	Functions of SCADA – Data Acquisition: tag/point concept, real-time data collection, historian database, alarm management, trending and reporting.
5	Data Communication in SCADA: Message-Based Polling Mode – concept, request-response cycle, advantages and disadvantages. Protocol examples.
6	Standard Polling Mode (Report by Exception): concept, dead-band, efficiency comparison with message-based polling. Module 5 Review and Case Study: SCADA in a water treatment plant.

Total Hours for Module 5: 6 hours | **Text Book Reference:** Industrial Automation Technologies by Chanchal Dey & Sunit Kumar Sen – Chapter 5

CO-PO mapping

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

Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Electromagnetic Waves **Credit:3** **Lecture Hours: 43**

Subject Code: PECEE501B

Pre-requisite: Electromagnetic Fields

Relevant Links: Study Material Coursera NPTEL LinkedIn Learning

Course Objectives:

The purpose of learning this course is to-

1. Understand transmission lines operation.
2. Understand the concept of plane wave problems for various boundary conditions.
3. Understand the wave propagation in lossy and low loss dielectric media.
4. Understand the field distributions in a rectangular wave-guide
5. Understand the radiation by antennas

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO1. Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
CO2. Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
CO3. Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
CO4. Understand and analyse radiation by antennas.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours
1	**Transmission Lines**	Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.	***International Academia:*** ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:***	6
2	**Maxwell's Equations**	Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.	***International Academia:*** ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:***	6
3	**Uniform Plane Wave**	Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.	***International Academia:*** ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:***	7
4	**Plane Waves at Media Interface**	Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection. Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, lossy media interface, Reflection from conducting boundary.	***International Academia:*** ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:***	7
5	**Waveguides**	Parallel plane wave guide: Transverse Electric (TE)mode, transverse Magnetic(TM)mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic(TEM)mode, Analysis of wave guide-general approach, Rectangular wave guides.	***International Academia:*** ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:***	7

6	**Antennas**	Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz-dipole, Near-field, Far-field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.	***International Academia:*** ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:***	7

Suggested Learning Resources:

1. D.K.Cheng,"FieldandWaveElectromagnetics",Addison-Wesley,1989.
2. C.A.Balanis,"AdvancedEngineeringElectromagnetics",JohnWiley&Sons,2012.
3. C.A. Balanis, " Antenna Theory: Analysis and Design", John Wiley &Sons,2005.

Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Database Management Systems **Credit:3** **Lecture Hours: 36**
Subject Code: OECEE501A

Pre-requisite: Fundamental concepts of set theory and designing.
Relevant Links: Study material Coursera NPTEL Linkedin Learning InfosysSpringboard

Course Objectives:

1. To introduce database systems, data models, database languages and the diagrammatic approach to design database systems.
2. To introduce the logical and mathematical formulation concept on database systems and further extend these concept towards learning database implementation languages.
3. To develop understanding on relational database design.
4. To understand the internal operations on a database systems and the storage architecture of data concepts.

Course Outcomes:

CO1: Students will have a proper understanding on database system and design.
CO2: Students will learn the concepts of database designing using logical and mathematical concepts like relational algebra and calculus which further will be extended to learning of SQL.
CO3: Students will gather the understanding of relation database design through the concept of normalization.
CO4: Students will learn the internals of DBMS through proper understanding of transaction and further the storage architecture of data for a database system.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Introduction to database systems and Entity-Relationship Model**	Concept & Overview of DBMS, Data Models Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS E-R modelling - Basic concepts, Design Issues, Mapping Constraints Keys, Entity-Relationship Diagram Weak Entity Sets, Extended E-R features	***International Academia:*** 1. https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/ 2. https://ocw.mit.edu/courses/6-5830-database-systems-fall-2023/ ***AICTE-prescribed syllabus:*** ***https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf*** ***Industry Mapping:*** ***Star UML Downloading link*** https://staruml.io/download/ Diagram design online using Draw.io https://app.diagrams.net/	10L	Designing of E-R modelling using Star UML or any other standard designing software.

2	**Introduction to Relational Model and SQL & Integrity Constraints**	Structure of relational Databases, Relational Algebra operations, examples and exercise Relational Calculus - operations, examples and exercise Extended Relational Algebra Operations, Views, Modifications Of the Database Concept of database languages - DDL, DML, DCL Basic Structure, Set operations, Aggregate Functions, Null Values Domain Constraints, Referential Integrity Constraints, assertions, views Joins Nested Sub-queries Stored procedures and triggers, Overview of Query Optimization	***International Academia:*** 1. https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/ 2. https://ocw.mit.edu/courses/6-5830-database-systems-fall-2023/ ***AICTE-prescribed syllabus:*** ***https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf*** ***Industry Mapping:*** ORACLE10g https://www.oracle.com/in/database/technologies/xe-downloads.html	14L	Queries on the following – 1. Tablecreation. 2. Data insertion, deletion, updation in table. 3. Aggregation functions on data. 4. Concepts of keys in table. 5. Concept of Joins. 6. Sub-quries & Nested subqueries. 7. PL SQL programming. 8. Stored procedures and triggers – concept.

3	**Relational Database Design**	Functional Dependency, Different anomalies in designing a Database Armstrong axioms, closure of attribute set Equivalence of functional dependency Canonical Cover Keys, types of keys, finding no. of candidate keys Normalization using functional dependencies –1NF,2NF,3NF,BCNF,multivalued dependencies – concept of4NF, 5NF Decomposition using normal forms Lossless or Lossy decomposition	***International Academia:*** 1. https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/ 2. https://ocw.mit.edu/courses/6-5830-database-systems-fall-2023/ ***AICTE-prescribed syllabus:*** ***https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf*** ***Industry Mapping:*** ORACLE10g https://www.oracle.com/in/database/technologies/xe-downloads.html	10L	

4	**Internals of RDBMS And File Organization & Index Structures**	Concept of transactions and schedules, ACID properties Transaction processing, Concurrency control – conflict and view serializability Recovery Management : transaction model properties, state serializability, lock base protocols, two phase locking File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes Dynamic Multilevel Indexes using B tree and B+ tree	***International Academia:*** 1. https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/ 2. https://ocw.mit.edu/courses/6-5830-database-systems-fall-2023/ ***AICTE-prescribed syllabus:*** ***https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf*** ***Industry Mapping:*** ORACLE10g https://www.oracle.com/in/database/technologies/xe-downloads.html	12L	

Text Books:

Name of the Text Book	Author Name	Edition	Publisher Name	Chapter No.	Module No. and Name of the proposed Syllabus
Database System Concepts	Silberschatz, Korth and Sudarshan	6th and 7th	McGraw-Hill	1, 2, 3, 4, 6, 7, 8, 11, 14, 15, 16	Module 1- Introduction to database systems and Entity-Relationship Model
Fundamentals of Database Systems	Elmasri and Navathe	6th	Pearson	1, 2, 3, 5, 6, 7, 8, 14, 15, 16, 17, 20, 21	Module 2 - Introduction to Relational Model and SQL & Integrity Constraints
Database Management System (DBMS): A Practical Approach	Chopra Rajiv,	3rd and 5th	S. Chand Publishing.	1, 4, 5, 6, 7, 8	Module 3 - Relational Database Design Module 4 - Internals of RDBMS And File Organization & Index Structures

Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Analog and Digital Communication **Credit: 2** **Lecture Hours: 40**

Subject Code: OECEE501B

Pre-requisite: Analog and Digital Electronics.

Relevant Links: Study Material NPTEL LinkedIn Learning

Course Objectives:

The purpose of learning this course is to-

1. Need for modulation and calculate the antenna size for different carrier frequencies
2. Compare between the different demodulation methods,
3. Identify the type of modulation, calculate the side-band frequencies
4. Calculate the Noise temperature & SNR for different systems
5. Sound knowledge on various digital communication systems.

Course Outcomes:

At the end of this course, students will be able to

CO1. Develop the generation and detection technique of analog communication system and analyze the different multiplexing techniques.
CO2. Examine the signal-to-noise ratio (SNR) performance of analog communications systems
CO3. Demonstrate the theory of probability and identify various complex program of communication system.
CO4. Execute the operation of different error control coding schemes for the reliable transmission of digital representation of signals and information over the channel.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours
1	**Review of signals and systems**	Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.	***International Academia:*** https://ocw.mit.edu/courses/6-011-introduction-to-communication-control-and-signal-processing-spring-2010/ ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:*** MATLAB	10
2	**Review of probability and random process.**	Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.	***International Academia:*** https://ocw.mit.edu/courses/6-011-introduction-to-communication-control-and-signal-processing-spring-2010/ ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:*** MATLAB	8

3	**Pulse modulation.**	Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers	***International Academia:*** https://ocw.mit.edu/courses/6-011-introduction-to-communication-control-and-signal-processing-spring-2010/ ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:*** MATLAB	8
4	**Elements of Detection Theory**	Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.	***International Academia:*** https://ocw.mit.edu/courses/6-011-introduction-to-communication-control-and-signal-processing-spring-2010/ ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:*** MATLAB	10
5	**Digital Modulation tradeoffs**	Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.	***International Academia:*** https://ocw.mit.edu/courses/6-011-introduction-to-communication-control-and-signal-processing-spring-2010/ ***AICTE-prescribedsyllabus:***(https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:*** MATLAB	4

Suggested Learning Resources:

Text Books

Name of the Text Book	Author Name	Edition	Publisher Name	Chapter No.	Module No. and Name of the proposed Syllabus
Fundamentals of communication system	Proakis J. G. and Salehi M	Year 2005	Pearson Education	Chapter 3 & 4	Module 1: Review of signals and systems
				Chapter 5	Module 2: Review of probability and random process
				Chapter 7	Module 3: Pulse modulation
				Chapter 10	Module 4: Elements of Detection Theory
Modern digital and analog communication systems	B.P Lathi and Zhi Ding	4^{th} Edition	Oxford Publication	Chapter 9	Module 5: Digital Modulation tradeoffs

Reference Books

1. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
2. Wozencraft J. M. and Jacobs I. M., "Principles of Communication Engineering", John Wiley, 1965.
3. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.

Lesson Plan:

Module 1: Review of Signals and Systems (10 Hours)

Day	Topic
1	Introduction to Communication Systems and Need for Modulation
2	Frequency Domain Representation of Signals
3	Amplitude Modulation (AM): Principles and Mathematical Analysis
4	Double Sideband Suppressed Carrier (DSB-SC) Modulation
5	Single Sideband (SSB) Modulation
6	Vestigial Sideband (VSB) Modulation
7	Angle Modulation: Frequency Modulation (FM) and Phase Modulation (PM)

8	Mathematical Representation of FM Signals
9	Mathematical Representation of PM Signals
10	Spectral Characteristics and Comparison of Angle Modulation Techniques

Module 2: Review of Probability and Random Process (8 Hours)

Day	Topic
11	Introduction to Random Processes in Communication Systems
12	Gaussian Noise Characteristics
13	White Noise and Noise Models
14	Noise Analysis in Amplitude Modulation Systems
15	Noise Analysis in Frequency Modulation Systems
16	Pre-emphasis and De-emphasis Techniques
17	Threshold Effect in Angle Modulation
18	Numerical Problems on Noise Figure, Noise Temperature and SNR

Module 3: Pulse Modulation (8 Hours)

Day	Topic
19	Sampling Theorem and Sampling Process
20	Pulse Amplitude Modulation (PAM)
21	Pulse Code Modulation (PCM)
22	Quantization and Encoding in PCM
23	Differential Pulse Code Modulation (DPCM)
24	Delta Modulation (DM)
25	Noise Considerations in PCM Systems
26	Time Division Multiplexing (TDM) and Digital Multiplexers

Module 4: Elements of Detection Theory (10 Hours)

Day	**Topic**
27	Detection of Signals in Noise

28	Optimum Detection and Matched Filter Concept
29	Coherent Communication Systems
30	Probability of Error Analysis
31	Baseband Pulse Transmission
32	Inter-Symbol Interference (ISI)
33	Nyquist Criterion for Zero ISI
34	Phase Shift Keying (PSK)
35	Frequency Shift Keying (FSK)
36	Quadrature Amplitude Modulation (QAM), Continuous Phase Modulation (CPM) and Minimum Shift Keying (MSK)

Module 5: Digital Modulation Trade-offs (4 Hours)

Day	**Topic**
37	Optimum Demodulation of Digital Signals
38	Maximum Likelihood Sequence Detection and Viterbi Receiver
39	Equalization Techniques
40	Synchronization and Carrier Recovery Techniques

Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Electrical Machines Laboratory-II **Credit:1** **Lecture Hours: 33**

Subject Code: PCCEE591

Pre-requisite: Electrical Machine -I Laboratory

Course Objective(s):

The purpose of learning this course is to-

1. To understand the arrangement of windings of AC machines.
2. To understand the principle of production of pulsating and revolving magnetic fields.
3. To understand the principle of operation and characteristics of three phase Induction machines.
4. To understand the principle of operation and characteristics of single phase Induction machines.
5. To understand the principle of operation and characteristics of synchronous machine.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO1. Identify appropriate equipment and instruments for the experiment.

CO2. Test the instrument for application to the experiment.

CO3. Construct circuits with appropriate instruments and safety precautions.

CO4. Validate different characteristics of three phases Induction Motor, Single Phase Induction Motor, Alternator and Synchronous Motors.

Laboratory Experiments

Module No	Description	Lecture Hours
1	Application of different starter for starting of a 3 phase Cage Induction Motor [DOL, Auto transformer & Star-Delta].	**3**
2	Winding connection diagram of squirrel cage Induction motor for 6 poles & 4 pole operation in full pitch & fractional slot winding diagram.	**3**
3	Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [voltage control & frequency control] for industrial application.	**3**
4	Test of single-phase induction motor for centrifugal pump application.	**3**
5	Study the equivalent circuit of single-phase induction motor for different domestic application.	**3**
6	Evaluate the performance characteristics of wound rotor Induction motor for industrial hoist application.	**3**
7	Study the equivalent circuit of synchronous machine for analyzing the machine performance using industrial testing procedure [Direct axis resistance (Xd) & Quadrature reactance (Xq)].	**3**
8	Performance verification of Induction generator for wind mill application.	**3**
9	Determination of voltage regulation of Synchronous machine by Synchronous Impedance method at different power factor.	**3**
10	PLC and AC Drive based speed control of induction motor with Human Machine Interface.	**3**
11	Evaluate the optimize performance criteria for different industrial load application of Synchronous motor using V-curve method.	**3**

Virtual Lab. Details:

Sl No.	Experiment Name	Web-Link/Software Used
1	Application of different starter for maintaining the stable operation of a 3 phase Cage Induction Motor [DOL, Auto transformer & Star-Delta].	http://vemjitg.vlabs.ac.in/Stator%20Resistance%20Starter(intro).html http://vem-iitg.vlabs.ac.in/Auto%20Transformer%20Starting(intro).html http://vem-iitg.vlabs.ac.in/Star%20Delta%20Starting(intro).html
2	Speed control of 3 phase slip ring Induction motor by resistance control. rotor	https://ems-iitr.vlabs.ac.in/exp/speed-control-slip-ring/
3	Determination of voltage regulation of Synchronous machine by Synchronous Impedance method at different power factor.	https://em-coep.vlabs.ac.in/exp/open-circuit-phase-alternator/simulation.html https://em-coep.vlabs.ac.in/exp/short-circuit-phase-alternator/simulation.html
4	Evaluate the optimize performance criteria for different industrial load application of Synchronous motor using V-curve method.	https://em-coep.vlabs.ac.in/exp/synchronous-motor/simulation.html

CO-PO Mapping:

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

Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Power System Laboratory - I **Credit: 1** **Lecture Hours: 33**

Subject Code: PCCEE592

Pre-requisite: Basic Electrical and Electronics Engineering Laboratory, Electric Circuit Theory Laboratory.

Course Objective(s):

The purpose of learning this course is-

1. To analyse two port circuit behavior.
2. Understand the behaviour of a synchronous machine and to determine its parameters.
3. Analyse the transmission line circuit
4. Calculate the breakdown strength of solid and liquid insulating materials.

Course Outcomes:

At the end of this course, students will be able to

CO1. Analyze experimental results obtained from simulation of different lines and their corresponding effects.
CO2. Understand the behaviour of a synchronous machine and to determine its parameters.
CO3. Evaluate the breakdown strength of solid and liquid insulating materials.
CO4. Understand the planning of load dispatch economically and optimally.

Laboratory Experiments

Module No	Description	Lecture Hours
1	(a) Determination of the generalized constants A.B, C, D of long transmission line (b) Modeling and performance analysis of transmission lines using MATLAB.	3
2	Study on Economic load dispatch.	3
3	Measurement of earth resistance by earth tester.	3
4	Dielectric strength test of insulating oil	3
5	Determination of breakdown strength of solid insulating material.	3
6	Different parameter calculation by power circle diagram	3
7	Study of different types of insulator.	3
8	Active and reactive power control of an alternator	3
9	(a) Study and analysis of an electrical transmission line circuit with PSPICE. (b) Digital twin based ABCD parameter calculation using CLAUDE AI.	3
10	(c) Verification of Ferranti effect in a long transmission line. (d) An AI assisted digital twin framework for Real time monitoring, prediction and control of the Ferranti effect in transmission line using CLAUDE AI.	3
11	(a) Study of DC distribution system with network analyzer. (b) Modeling and performance analysis of DC distribution system using MATLAB.	3

CO-PO Mapping

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

Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Control System Lab **Credit: 1** **Lecture Hours: 36**

Subject Code: PCCEE593

Course Objective(s):

The purpose of learning this course is to-

1. Mathematically model various systems and study their responses.
2. Successfully use modern IT tools to study the characteristics of different systems.
3. Study stability of various control systems.
4. To work effectively in a team

Detailed Syllabus

Module No.	Description	Lecture Hours
1	Familiarization with the MATLAB control system tool box, MATLAB-simulink tool box & PSPICE	3
2	Determination of Step response for first order & Second order system with unity feedback with the help of CRO &calculation of control system specification, Time constant, % peak overshoot, settling time etc. from the response.	3
3	Simulation of Step response & Impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB& PSPICE.	3

4	Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box for 2nd order system& determination of different control system specification from the plot.	3
5	Determination of PI, PD and PID controller action of first order simulated process.	3
6	Design a PID controlled 2nd order RLC circuit using MATLAB and CLAUD.AI based digital twin dash board.	3
7	Determination of approximate transfer functions experimentally from Bode plot.	3
8	Evaluation of steady state error, setting time, percentage peak overshoot, gain margin, phase margin with addition of Lead, Lag, Lead-lag compensator.	3
9	Transient Analysis of a 2nd order system using CLAUDE AI based digital twin dashboard	3
10	Study of a practical position control system obtaining closed step responses for gain setting corresponding to over-damped and under-damped responses. Determination of rise time and peak time using individualized components by simulation. Determination of un-damped natural frequency and damping ration from experimental data.	3
11	Design of Lead, Lag and Lead-Lag compensation circuit for the given plant transfer function. Analyze step response of the system by simulation.	3
12	Determination of Transfer Function of a given system from State Variable model and vice versa. Analysis of a physical system by State variable and to obtain step response for the system by simulation.	3
13	Study of State variable analysis using simulation tools. To obtain step response and initial condition response for a single input, two-output system in SV form by simulation	3
14	Design a DC Motor position control using PID controller dashboard of CLAUDE AI.	3

Course Outcomes:

At the end of this course, students will be able to demonstrate

1. Mathematically model electrical and mechanical systems and derive their transfer functions and use relevant IT tools such as MAT-Lab control system tool box, MAT-Lab- Simulink tool box & PSPICE for simulation and finding out solution of a problem. Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
2. Evaluate the stability of different control systems and design various controllers (P, I, PID etc) for a given application.
3. Validate step response & impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB & PSPICE.

4. To build leadership quality working in a team to construct the experiment, identify the variables and finding out the solution of a given problem using appropriate IT tools and interpret the experimental data to generate a proper report.

Suggested Learning Resources:

1. Control System Design, C. Goodwin Graham, F. Graebe F. Stefan, Salgado. E. Mario, PHI
2. Modeling & Control of dynamic system, Macia&Thaler, Thompson

CO and PO Mapping:

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

Syllabus for B.Tech Admission Batch **2024-2028**

Subject Name: **Industrial Automation and SCADA Laboratory** Credit: **1**
Lecture Hours: **30** Subject Code: **PECEE591A**

Course Objective(s):

1. To provide hands-on experience in configuring and operating PLC-based industrial automation systems.
2. To develop practical understanding of SCADA system setup, monitoring, and real-time process control.
3. To train students in designing and implementing I/O interfacing using sensors, actuators, and industrial devices.
4. To enable students to program PLCs using ladder logic and other industrial programming languages.
5. To familiarize students with industrial communication protocols and data acquisition techniques used in automation systems.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Demonstrate practical skills in PLC programming and configuration for industrial applications.
CO2: Develop and implement SCADA-based monitoring and control systems for real-time processes.
CO3: Design and test I/O interfacing circuits involving sensors, actuators, and industrial equipment.
CO4: Apply ladder logic programming to solve basic automation and control problems.

Detailed Syllabus:

Module No.	Description
1	Study of PLC hardware architecture and I/O modules.
2	Basic PLC programming using Ladder Logic (AND, OR, NOT operations), AI tools generated Ladder Logic, Function Block Diagrams (FBD from natural language descriptions
3	PLC-based logic implementation of start/stop motor control and Timer and counter applications in PLC programming
4	PLC Based Filling Pump and Distribution Pump related programming with Interlocking. Single input ON/OFF programming.
5	Implementation of single output and double output Pulsating nature along with two Switch Agitator.
6	PLC Based Traffic Signal Control system. Machine Learning-Based Fault Diagnosis in PLC-Controlled Systems
7	Use of Jump to Label, Jump to Subroutine and Real Time Clock. Deep Learning-Based Predictive Maintenance Using PLC Data
8	Use of Analog Comparator in Temperature monitoring. Using 0-10 Volt or 4 to 20 mA current Injector.
9	Introduction to SCADA system configuration and interface design.
10	Design and implementation of a mini automated plant work simulation using PLC and SCADA integration

Suggested Learning Resources:

1. Programmable Logic Controllers: Frank D. Petruzella, McGraw-Hill Education.
2. Programmable Logic Controllers: Principles and Applications, John W. Webb & Ronald A. Reis, Pearson Education.
3. Industrial Automation and Process Control: Jon Stenerson, Prentice Hall.
4. SCADA: Supervisory Control and Data Acquisition: Stuart A. Boyer, ISA (International Society of Automation).

CO-PO mapping

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