



University of Engineering and Management

Institute of Engineering & Management, Salt Lake
Campus

5th Semester Syllabus for B.Tech
(Admission Batch 2024)

Electrical & Electronics Engineering									
B.Tech. 3rd Year Course Structure									
5th Semester									
Sl No	Type of Course	Subject Code	Subject Name	L	T	P	S	Total Contact	Credit Points
Theory									
1	Professional Core Courses	PCEEE501	Electric machine-II	3	0	0		3	3
2	Professional Core Courses	PCEEE502	Power System-I	3	0	0		3	3
3	Professional Core Courses	PCEEE503	Control system	3	0	0		3	3
4	Professional Core Courses	PCEEE504	Power Electronics	3	0	0		3	3
5	Professional Elective Courses	PEEE571	A: Electric Vehicles B: Renewable & Non Conventional Energy	3	0	0		3	3
6	Open Elective Courses	OEEE501	A: AI & Machine Learning/ B: Computer Organization/	3	0	0		3	3
7	Humanities and social sciences including Management	ESP501	Essential Studies For Professionals V	2	0	0		2	0.5
PRACTICAL									
8	Professional Core Courses	PCEEE591	Electric Machine Laboratory-II	0	0	2		2	1
9	Professional Core Courses	PCEEE592	Control System Lab	0	0	2		2	1
10	Professional Core Courses	PCEEE593	Power Electronics Lab	0	0	2		2	1
11	Professional Elective Courses	PEEE591	A: Electric Vehicles Lab/ B: Renewable Lab & Non Conventional Energy	0	0	2		2	1
SESSIONAL									
12	Humanities and social sciences including Management	SDP581	Skill Development For Professionals V				2	2	0.5
13	Project, Seminar and Industrial Training	PWEEE03	Mini Project III				0	1	1
Value Added Courses									
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				20	0	8	2	31	24



University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus

Institute of Engineering & Management, New Town Campus

University of Engineering & Management, Jaipur



Syllabus for B.Tech Admission Batch 2024

Subject Name: Electrical Machine-II

Credit: 3

Lecture Hours: 40

Subject Code: PC-EEE-501

Study Material	Coursera:	Nptel:	LinkedIn Learning	Infosys Springboard
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Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Prof. Nirban Chakraborty

Pre-requisite: PCEEE401

Course Objective:

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 eletromechanical devices

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	Fundamentals of AC machine	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, Air-gap MMF distribution with fixed current through winding-concentrated and distributed, Sinusoidally distributed winding, winding distribution factor.	Academia Mapping: https://ocw.mit.edu/course/s/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf Industry Mapping: MATLAB	2	1. Design of different windings used in Electrical Machines using MATLAB.	Electric Machines, by DP Kothari & IJ Nagrath, 4th Edition, McGraw Hill	Chapter 5
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.	Academia Mapping: https://ocw.mit.edu/course/s/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf Industry Mapping: MATLAB	2		Electric Machines, by DP Kothari & IJ Nagrath, 4th Edition, McGraw Hill	Chapter 5

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. Solution of different problems	Academia Mapping: https://ocw.mit.edu/course/s/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL SYLLABI FOR UG Electrical Engg.pdf Industry Mapping: MATLAB, Induction Machine Set	13	1. Application of different starter for maintaining the stable operation of a 3 phase Cage Induction Motor [DOL, Auto transformer & Star-Delta]. 2. Design of an 18 slot squirrel cage Induction motor for 6 poles & 4 pole operation in full pitch & fractional slot winding diagram. 3. Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [voltage control & frequency control] for industrial application. 4. Evaluate the performance characteristics of wound rotor Induction motor for industrial hoist application. 5. PLC and AC Drive based speed control of induction motor with Human Machine Interface.	Electrical Machines, by Prithwiraj Purkait & Indrayudh Bandopadhyay, 1st Edition, Oxford University Press.	Chapter 8, 9, 10
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4	Single-phase induction motors:	Constructional features double revolving field theory, equivalent circuit, and determination of parameters. Split-phase starting methods and applications	Academia Mapping: https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf Industry Mapping: MATLAB, Single Phase Induction Machine Set	5	1. Test of single phase induction motor for centrifugal pump application.. 2. Design the equivalent circuit of single phase induction motor for different domestic application.	Electrical Machines, by Prithwiraj Purkait & Indrayudh Bandopadhyay, 1st Edition, Oxford University Press.	Chapter 14
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 motor, V-curves. Salient pole machine –two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators – synchronization and load division. Solution of different problems	Academia Mapping: https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf Industry Mapping: MATLAB, Synchronous Machine Set	14	1. Design a equivalent circuit for synchronous machine for analyzing the machine performance using industrial testing procedure [Direct axis resistance (X_d) & Quadrature reactance (X_q)]. 2.Determination of voltage regulation of Synchronous machine by a. Synchronous Impedance method at different power factor. 3. Evaluate the optimize performance criteria for different industrial load application of Synchronous motor using V-curve method.	Electrical Machines, by Prithwiraj Purkait & Indrayudh Bandopadhyay, 1st Edition, Oxford University Press.	Chapter 11, 12, 13

6	Special Electromechanical devices	Principle and construction of switched Reluctance motor, Permanent magnet synchronous machines, Linear Induction motor.	Academia Mapping: https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf Industry Mapping: MATLAB, Induction Machine Set	4	1. Performance verification of Induction generator for wind mill application.	Electrical Machines, by Prithwiraj Purkait & Indrayudh Bandopadhyay, 1st Edition, Oxford University Press.	Chapter 15
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Lesson Plan:

Module 1: Fundamentals of AC machine Year 2026 (Faculty: Dr. NIRBAN CHAKRABORTY)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	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.
2	Winding axis, Air-gap MMF distribution with fixed current through winding-concentrated and distributed, Sinusoidally distributed winding, winding distribution factor.

Module 2: Pulsating and revolving magnetic fields, Year 2026 (Faculty: Dr. NIRBAN CHAKRABORTY)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	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.
2	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.

Module 3: Induction Machines, Year 2026 (Faculty: Dr. NIRBAN CHAKRABORTY)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Construction, Types (squirrel cage and slip-ring).
2	Torque Slip Characteristics, Starting and Maximum Torque.
3	Torque Slip Characteristics, Starting and Maximum Torque.
4	Equivalent circuit. Phasor Diagram, Losses and Efficiency.
5	Equivalent circuit. Phasor Diagram, Losses and Efficiency.
6	Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency).
7	Methods of starting, braking and speed control for induction motors.
8	Methods of starting, braking and speed control for induction motors.
9	Generator operation. Self-excitation
10	Doubly-Fed Induction Machines
11	Solution of different problems
12	Solution of different problems
13	Solution of different problems

Module 4: Single-phase induction motors, Year 2026 (Faculty: Dr. NIRBAN CHAKRABORTY)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Constructional features double revolving field theory.
2	Constructional features double revolving field theory.
3	Equivalent circuit, and determination of parameters
4	Equivalent circuit, and determination of parameters
5	Split-phase starting methods and applications.

Module 5: Synchronous machines, Year 2026 (Faculty: Dr. NIRBAN CHAKRABORTY)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Constructional features, cylindrical rotor synchronous machine -generated EMF
2	Constructional features, cylindrical rotor synchronous machine -generated EMF
3	Equivalent circuit and phasor diagram, armature reaction
4	Equivalent circuit and phasor diagram, armature reaction
5	Equivalent circuit. Phasor Diagram, Losses and Efficiency.
6	Synchronous impedance, voltage regulation
7	Operating characteristics of synchronous motor, V-curves
8	Operating characteristics of synchronous motor, V-curves
9	Operating characteristics of synchronous motor, V-curves
10	Salient pole machine –two reaction theory, analysis of phasor diagram
11	Salient pole machine –two reaction theory, analysis of phasor diagram
12	Power angle characteristics
13	Parallel operation of alternators – synchronization and load division.
14	Solution of different problems

Module 6: Special Electromechanical devices, Year 2026 (Faculty: Dr. NIRBAN CHAKRABORTY)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Principle and construction of switched Reluctance motor
2	Induction Generator
3	Induction Generator
4	Hysteresis motor, Tacho generators.

Course Outcome:

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

CO1. Describe the arrangement of winding of AC machines.

CO2. Explain the principle of operation and 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:

1. Electrical Machines, by Prithwiraj Purkait & Indrayudh Bandopadhyay, 1st Edition, Oxford University Press.
2. Electric Machines, by DP Kothari & IJ Nagrath, 4th Edition, McGraw Hill.

Reference Books:

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

CO-PO Mapping:

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



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



Syllabus for B.Tech Admission Batch 2024-2028
Subject Name: POWER SYSTEM-I Credit: 03 Lecture Hours: 40

Subject Code: PCEEE502

Study Material	Coursera Hyperlinked	Nptel	LinkedIn Learning	Infosys Springboard
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Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Dr. Manas Mukherjee

Pre-requisite: Basic Electrical Engineering Laws, Electrostatic and Electromagnetic Field Theory, Electric Circuit Theory, and Engineering Mathematics

Course objectives:

1. To understand the basic principle of generation of Electricity from different sources
2. To find parameters and characteristics of overhead transmission lines and cables.
3. To find different parameters for the construction of overhead transmission line
4. To determine the performance of transmission lines
5. To understand the principle tariff calculation
6. To solve numerical problems on the topics studied.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	TEXT BOOK	Mapped Chapter
1	Basic Concepts:	Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. <u>Generation</u>: 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.	International Academia: https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/ Industry: Thermal (DVC), hydro and solar power plant	4	-	D. P.Kothari and I. J.Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.	Ch. 1
2	Power System Components:	<u>Overhead transmission line</u>: Choice of frequency, Choice of voltage, Types of conductors, Inductance and Capacitance of a single phase and three phase symmetrical and unsymmetrical configurations. Bundle conductors. Transposition. Concept of GMD and GMR. Influence of earth on conductor capacitance. Overhead line construction: Line supports, Towers, Poles, Sag, Tension and Clearance, Effect of Wind and Ice on Sag, Dampers. <u>Corona</u>: Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona	International Academia : https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/ Industry: Power grid corporation of India ltd: 765 kV Transmission components like transformer, insulator, overhead lines, isolators etc.	19	-	D. P.Kothari and I. J.Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.	Ch. 2, 3, 5, 16, 17, 18, 19

		loss, advantages & disadvantages of Corona. Methods of reduction of Corona. <u>Insulators</u>: Types, Voltage distribution across a suspension insulator string, String efficiency, Arching shield & rings, Methods of improving voltage distribution across Insulator strings, Electrical tests on line Insulators <u>Cables</u>:Types of cables, cable components, capacitance of single core & 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle. <u>Performance of lines</u>:Short, medium (nominal, T) and long lines and their representation. A.B.C.D constants, Voltage regulation, Ferranti Effect, Power equations and line compensation, Power Circle diagrams. Per-unit System and per-unit calculations.					
3	Fault Analysis:	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.	International Academia : https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/ Industry: Fault detection and system restoration	09	-	D. P.Kothari and I. J.Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.	Ch. 9, 10,11
4	Protection system:	Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential	International Academia : https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/	08	-	D. P.Kothari and I. J.Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.	Ch. 14, 15

		protection) and their application. Generation of Overvoltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.	Industry: Distribution & transmission system protection mechanisms, protection components, modern relays & circuit breakers.				
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Course outcome:

- CO1. Understand the basic concept of power system with grid interconnections, restructuring and Micro-grids.
CO2. PCC-EEE502.2: Realize the concepts of various power system components with their performance and characteristics.
CO3. PCC-EEE502.3: Evaluate fault currents for different types of faults and the basic protection schemes with circuit breakers and relay systems.
CO4. PCC-EEE502.4: Appreciate the concepts of DC power transmission and renewable energy generation

Suggested Learning Resources:

Text books:

D. P.Kothari and I. J.Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.

Reference books:

1. A.R.Bergen and V.Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
2. J.Grainger and W.D.Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
3. O.I.Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
4. B.M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G.Strbac, “Electric Power Systems”, Wiley, 2012.

Lesson Plan:**Module 1: Basic Concepts Year 2026, (Faculty : Dr. Manas Mukherjee)**

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	<u>Generation</u> : Conventional and Renewable Energy Sources. Distributed Energy, Resources. Energy Storage
3	Transmission and Distribution Systems: Line diagrams, 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 2026, (Faculty : Dr. Manas Mukherjee)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Power System Components: <u>Overhead transmission line</u> : Choice of frequency, Choice of voltage, Types of conductors.
2	, Inductance and Capacitance of a single phase conductor
3	three phase symmetrical and unsymmetrical configurations. Bundle conductors
4	Transposition. Concept of GMD and GMR.
5	Influence of earth on conductor capacitance.
6	Overhead line construction: Line supports, Towers, Poles,.
7	Sag, Tension and Clearance, Effect of Wind and Ice on Sag. Dampers
8	<u>Corona</u> : Principle of Corona formation, Critical disruptive voltage,
9	Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona.
10	Methods of reduction of Corona. <u>Insulators</u> : Types,
11	Voltage distribution across a suspension insulator string,
12	String efficiency, Arching shield & rings,
13	Methods of improving voltage distribution across Insulator strings, ,
14	Electrical tests on line Insulators
15	<u>Cables</u> : Types of cables, cable components,
16	capacitance of single core & 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle.
17	<u>Performance of lines</u> : Short, medium (nominal, T) and long lines and their representation. A.B.C.D constants, Voltage regulation
18	Ferranti Effect, Power equations and line compensation, Power Circle diagrams. Per-unit System and per-unit calculations.

Module 3: Fault Analysis Year 2026, (Faculty : Dr. Manas Mukherjee)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Fault Analysis: Method of Symmetrical Components (positive, negative and zero sequences).
2	Balanced Faults
3	Unbalanced Faults
4	Representation of generators.
5	lines and transformers in sequence networks
6	Computation of Fault Currents
7	Neutral Grounding

Module 4: Protection system Year 2026, (Faculty : Dr. Manas Mukherjee)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Protection system: Switchgear: Types of Circuit Breakers.
2	Attributes of Protection schemes, Back-up Protection
3	Protection schemes (Over-current, directional, distance protection, differential protection) and their application.
4	Generation of Overvoltages: Lightning and Switching Surges
5	Protection against Over-voltages
6	Insulation Coordination. Propagation of Surges.
7	Voltages produced by traveling surges.
8	Bewley Diagrams.

CO-PO Mapping:

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



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Syllabus for B.Tech Admission Batch 2024-2028

Subject Name: Control Systems
Lecture Hours: 41

Credit: 3
Subject Code: PCEEE503

Study material	Coursera	npTEL	LinkedIn Learning	Infosys Springboard
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List of Faculty Members handling the Subject –

1. Arijita Das

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

Course objectives:

The purpose of learning this course is

1. To find the mathematical representation of LTI systems
2. To find the time response of LTI systems of different orders
3. To find the frequency response of LTI systems of different orders
4. To understand the stability of different LTI systems
5. To analyse LTI systems 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_U_G.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.Mank e,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 tachogenerators. 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_U_G.pdf Industry Mapping: Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system, Synchros, Resolvers, Position encoders. DC and AC tachogenerators. Actuators.	10	Familiarization with MAT-Lab control system tool box, MAT-Lab-simulink tool box & PSPICE	Linear control Systems, B.S.Mank e, Khanna Publishers	6

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.%20IUG.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.	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.%20IUG.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.	Linear control Systems, B.S.Manke, Khanna Publishers	8
					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 undamped natural frequency and damping ratio from experimental data.		

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_U_G.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. Design of a DC motor speed controller using PID tuning method.	Linear control Systems, B.S.Mank e, 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_U_G.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.Mank e, 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-hurwitz (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, PHI
2. Modern Control Engineering, K. Ogata, 4th Edition, Pearson Education
3. Control System Engineering, I. J. Nagrath & M. Gopal. New Age International Publication.
4. Control System Engineering, D. Roy Choudhury, PHI
5. Control System Design, C. Goodwin Graham, F. Graebe F. Stefan, Salgado. E. Mario, PHI

Lesson Plan:**Module 1: Introduction to control problem Year 2026 (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 2026 (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 2026 (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 2026 (Faculty: ARIJITA DAS)

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	Root locus techniques, construction of Root Loci for simple systems.
10	Root locus techniques, construction of Root Loci for simple systems.

Module 5: Control System performance measure, Year 2026 (Faculty: ARIJITA DAS)

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	Digital control system and applications of control system.
5	Digital control system and applications of control system.
6	Microprocessor and FPGA based control system, Instrumentation in control system

Module 6: State variable Analysis, Year 2026 (Faculty: ARIJITA DAS)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Concepts of state variables. State space model. Diagonalization of State Matrix.
2	Eigenvalues and Stability Analysis. Concept of controllability and observability.
3	Eigenvalues and Stability Analysis. Concept of controllability and observability.
4	Discrete-time systems. Difference Equations.
5	State-space models of linear discrete-time systems. Stability of linear discrete-time systems

CO-PO Mapping:

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



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



Syllabus for B.Tech Admission Batch 2024

Subject Name: Power Electronics

Credit: 3

Lecture Hours: 35

Subject Code: PCEEE504

Study material	Coursera	NPTEL	LinkedIn Learning	Infosys Springboard
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Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Dr. Rajat Shubhra pal

Pre-requisite: Analog Electronics, Basic Electronics Engineering

Course objectives:

The purpose of learning this course is to

1. Understand the operation and characteristics of power semiconductor devices and their protection techniques.
2. Analyze the performance of rectifiers, choppers, inverters, and AC–AC converters.
3. Apply mathematical tools to evaluate converter performance and harmonics.
4. Apply power electronics concepts to practical industrial applications.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Assignment Lab	TEXT BOOK	Mapped Chapter
1	Power semiconductor switches	Power diodes, SCR, and transistors (BJT, MOSFET and IGBT) Ratings, static and dynamic characteristics, drive and switching aid circuits and cooling; isolation; protection.	International Academia: (https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007/) Industry Mapping: <i>industrial motor drives, electric vehicles, and renewable energy converters for efficient power control.</i>	6	Performance parameter analysis of power semiconductor switches for designing inverters used in renewable energy systems Design of firing circuits suitable for triggering SCR in a 1- phase full controlled bridge converter used in battery charging systems, enabling controlled DC output suitable for large industrial batteries Design different triggering circuit for controlling the voltage applied to motors enabling speed control in conveyor belts, elevators, and cranes.	P.S. Bhimra, Power Electronics, Khanna Publishers	2,4
2	Controlled Rectifiers	Single phase and three phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Fourier series analysis of input current.	International Academia: (https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007/) Industry Mapping: <i>DC power supplies, battery chargers, and electrochemical industries like electroplating</i>	9	Investigating the effect of load variation (purely R to R-L) using single phase controlled converter for heating control of appliances. Obtaining precise voltage control for BLDC motor using single phase half controlled symmetrical bridge converters. Achieving precise and smooth lighting control using single phase controlled converter and verify the effect of source inductance on the output.	P.S. Bhimra, Power Electronics, Khanna Publishers	6

3	Choppers	Buck, Boost and Buck-Boost converters; circuit configuration and analysis with; continuous and discontinuous loads; Quadrant operations of Type A, Type B, Type C, Type D and type E choppers; multiquadrant operation; example of a typical drive circuit.	International Academia: (https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007/) Industry Mapping: electric vehicles, DC motor speed control, and SMPS applications	6	Analysis of the buck-boost chopper performance in terms of voltage regulation and efficiency for charging batteries to match the battery's charging requirements used in industrial UPS systems. Integrating step up and step down chopper using IGBT with DC-DC charging station for solar panels and observing voltage variation.	P.S. Bhimra, Power Electronics, Khanna Publishers	7
4	Inverters	current source and voltage source inverters, active and reactive power handling; single phase and three phase voltage source and PWM inverters; PWM techniques; mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage); a typical trigger / drive circuit.	International Academia: (https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007/) Industry Mapping: solar PV systems, UPS, and variable frequency drives (VFDs)	7	Implement a three phase bridge inverter for star connected lamp load intensity control. Analyze the effect of modulation index on the output voltage of a pulse width modulated bridge inverter used in EV drive systems.	P.S. Bhimra, Power Electronics, Khanna Publishers	8
5	AC to AC conversion	Single phase AC static switches; transient-free switching of inductive loads; voltage regulators; Cycloconverter: Single-phase Bridge-type, Three-phase Half-wave	International Academia: (https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007/) Industry Mapping: light dimmers, AC voltage regulators, and industrial heating control systems	4	Study of Performance of Three-Phase AC Controller with R and R-L Loads for Industrial Heating and Motor Speed Control Applications	P.S. Bhimra, Power Electronics, Khanna Publishers	9,10

6	Applications	Switched Mode Power Supply (SMPS); Uninterruptible Power Supplies (UPS); High Voltage dc Transmission; Static VAR controller; Separately excited DC motor drive.	International Academia: (https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007/) Industry Mapping: SMPS, UPS, HVDC transmission, FACTS devices, and DC motor drive systems	3		P.S. Bhimra, Power Electronics, Khanna Publishers	11,12
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Course outcome:

- CO1. Explain and compare power semiconductor devices and their drive circuits.
- CO2. Analyze and design various power electronic converters for different loads.
- CO3. Evaluate converter performance using harmonic and Fourier analysis.
- CO4. Apply power electronic systems in real-world applications like drives and power supplies.

Suggested Learning Resources:

Text books:

1. P.S. Bhimra, Power Electronics, Khanna Publishers

Reference books:

1. M. H. Rashid, Power Electronics Circuits, Devices, and Applications, 3rd Edition, Pearson Education Inc.
2. D. W. Hart, Power Electronics, Tata McGraw-Hill Education Private Limited.
3. N. Mohan, First Course on Power Electronics and Drives, MNPERE
4. P.C. Sen., Modern Power Electronics, edition II, S.Chand & Co.
5. V.R.Moorthi, Power Electronics, Oxford University Press.

Lesson Plan:**Module 1: Power semiconductor switches, Year: 3rd, (Faculty: Rajat Shubhra Pal)**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Introduction to Power Electronics and applications
2	Power diodes – types, characteristics, and ratings
3	SCR – construction, working, V-I characteristics
4	SCR triggering methods and commutation basics
5	Power transistors (BJT, MOSFET, IGBT) – characteristics
6	Gate drive circuits, protection, isolation, and cooling

Module 2: Controlled Rectifiers, Year: 3rd, (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
7	Single-phase half-wave and full-wave controlled rectifiers (R load)
8	Single-phase converter with RL load
9	Single-phase converter and RLE load
10	Three-phase half-wave controlled rectifier
11	Three-phase full converter operation
12	Effect of source impedance on performance
13	Derivation of ripple factor and form factor
14	Fourier analysis of input current
15	Performance comparison and numerical problems

Module 3: Choppers, Year: 3rd, (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
16	Introduction to DC–DC converters and classification
17	Buck converter – operation (CCM & DCM)
18	Boost and Buck-Boost converters – analysis
19	Quadrant operation (Type A & B choppers)
20	Type C, D, E choppers and multi-quadrant operation
21	Practical drive circuits and applications

Module 4: Inverters, Year: 3rd, (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
22	Introduction to inverters (VSI & CSI)
23	Single-phase VSI operation
24	Three-phase VSI operation
25	PWM techniques (SPWM, etc.)
26	Fourier analysis of output voltage
27	Harmonic reduction techniques
28	Inverter applications and drive circuits

Module 5: AC to AC conversion, Year: 3rd, (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
29	Single-phase AC voltage controllers with R load
30	AC voltage controllers with RL load and switching issues
31	Cycloconverter – single-phase bridge type
32	Three-phase cycloconverter basics and applications

Module 6: Applications, Year: 3rd, (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
33	SMPS and UPS – working and applications
34	HVDC transmission and Static VAR compensators
35	DC motor drives and overall course review

CO-PO Mapping:

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

Syllabus and Lesson Plan for B.Tech Admission Batch 2024-2028

Subject Name: AI & ML

Credit: 3

Lecture Hours: 40

Subject Code: O-EEE 501A

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Prof. Dr. Tanmay Sinha Roy

Pre-requisite: (1) Design and Analysis of Algorithms, Data Structures and Algorithms (2) Basic concepts from Mathematics & Statistics (Linear Algebra, and Statistics and Probability, Calculus) (3) Programming in Python/R

Course Objectives:

1. To introduce the concept of Classical Artificial Intelligence techniques and agents to achieve desired objectives.
2. To introduce and familiarize the students with the various searching algorithms relevant for Artificial Intelligence.
3. Introduce and apply the concepts of Knowledge Representation and Reasoning methodologies.
4. Introduce the details of the various planning techniques important for building artificial intelligence systems
5. Introduce Expert Systems using the concepts of representing and usage of domain knowledge in the respective areas of applications.
6. To understand how Machine learning techniques are used to make computers learn from data and experience, a vast variety of application areas, from spam filters, medical imaging, analyze customer purchase data, or to detect fraud in credit card transactions.
7. To discover patterns in your data and then make predictions based on often complex patterns to answer business questions, detect and analyse trends and help solve problems.
8. To understand and appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning and be able to design and implement various machine learning algorithms in a range of real-world application.

Relevant Links:

Study Material	Coursera Hyperlinked	Nptel	LinkedIn Learning:	Infosys Springboard:
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Detailed Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	Introduction Artificial Intelligence and its applications, Components of Artificial Intelligence (AI), Artificial Intelligence Techniques, Level of models, criteria of success, Intelligent Agents, Nature of Agents, Learning Agents, advantages and limitations of AI, Impact and Examples of AI, Application domains of AI.	AICTE prescribed syllabus: https://www.aicteindia.org/sites/default/files/UG_Emerging.pdf International Academia: (1) MIT: https://ocw.mit.edu/courses/6034-artificial-intelligence-fall-2010/resources/lecture-1-introduction-and-scope/industry (2) Stanford Univ.: https://stanford-cs221.github.io/spring2024/ IITs: (1) IIT Kanpur: https://cse.iitk.ac.in/users/cs365/2008/syllabus.html (2) IIT Bombay: https://www.cse.iitb.ac.in/~siva/talks/cs621intro.pdf https://www.ieor.iitb.ac.in/acad/courses/ie703 Coursera https://www.coursera.org/learn/introduction-to-ai Nptel https://nptel.ac.in/courses/106102220	4	‘Artificial Intelligence’ by Saroj Kaushik	Artificial Intelligence - by Rich and Knight (McGraw Hill) Artificial Intelligence – by Saroj Kaushik (Cengage)	Chapter-1

2	AI Search & Optimization Algorithms <i>Uninformed Search Algorithms</i> Depth First Search, Breadth-First Search, Depth-Limited Search, Uniform Cost Search. <i>Informed Search Algorithms</i> Greedy Search Algorithm, A* Search Algorithms, Graph Search. <i>Local Search Algorithms</i> Tabu Search, Hill Climbing Algorithms, Simulated Annealing, Genetic Algorithms, Local Beam Search. <i>Swarm Intelligence Algorithms</i> Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC) Algorithm. <i>Adversarial Search Algorithms</i> Minimax Algorithm, Alpha-Beta Pruning.	AICTE prescribed syllabus: https://www.aicteindia.org/sites/default/files/UG_Emerging.pdf International Academia: (1) MIT: https://ocw.mit.edu/courses/6034-artificial-intelligence-fall-2010/resources/lecture-1-introduction-and-scope-of-industry/ (2) Stanford Univ.: https://stanford-cs221.github.io/spring2024/ IITs: (3) IIT Kanpur: https://cse.iitk.ac.in/users/cs365/2008/syllabus.html (4) IIT Bombay: https://www.cse.iitb.ac.in/~siva/talks/cs621intro.pdf https://www.ieor.iitb.ac.in/acad/courses/ie703 Coursera https://www.coursera.org/learn/introduction-to-ai Nptel https://nptel.ac.in/courses/106102220	12	Implementation of Depth First Search for Water Jug problem. Implementation of Breadth First Search for Tic-Tac-Toe problem. Solve 8-puzzle problem using Best First Search.	Artificial Intelligence and Soft Computing – by Amit Konar (CRC Press)	Chapter-4
3	Introduction to Machine Learning Defining machine learning, its types (supervised, unsupervised, reinforcement), and its applications. Neural Networks Perceptron, Single Layer Perceptron, Multilayer Perceptron, Classifier Evaluation, Ensemble Learning, Boosting.	Coursera https://www.coursera.org/specializations/machine-learning-introduction Nptel https://nptel.ac.in/courses/106106139	8	Implementation of Navie Bayes Classifier algorithm. Implementation of Support Vector Machine Classification.	Machine Learning - Tom Mitchell (TM) (publ. by TM, DHS McGraw Hill) Pattern Classification – Duda, Hart and Stork (DHS) (Wiley, 2nd edn.)	Chapter-1 DHS Chapter-2, 3, 6, 7, 8, 9.

4	Supervised and Unsupervised Machine Learning Algorithms Decision Tree, Bayesian Networks, Bayes Classifier, Linear Regression, Logistic Regression, k-Nearest Neighbour Learning, Support Vector Machines, Random Forest Classifier. Clustering, K-Means Clustering Dimensionality Reduction, Reinforcement Learning.	Coursera https://www.coursera.org/specializations/machine-learning-introduction Nptel https://nptel.ac.in/courses/106106139	12	Performance Analysis on a specific dataset (Mini Project)	Machine Learning - Tom Mitchell (TM) (publ. by McGraw Hill) Pattern Classification - Duda, Hart and Stork (DHS) (Wiley, 2nd edn.)	DHS Chapter-3, 5, 6, 9, 10 TM Chapter-4, 5, 13.
5	Introduction to Deep Learning Kernels in CNN Model, Hyper-Parameters, CNN Model Architecture, AlexNet, LeNet, VGG Networks, Google Network, Residual Networks.	Coursera https://www.coursera.org/specializations/deep-learning Nptel https://nptel.ac.in/courses/106105215	4	Implementation of CNN model on a specific dataset.	Artificial Intelligence and Soft Computing – by Amit Konar (CRC Press)	

Course Outcomes:

CO1: Understand the basic concepts and techniques of Artificial Intelligence and Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.

CO2: Apply AI algorithms for solving practical problems, using tools of logic and knowledge representation

CO3: Planning - planning with state space search, partial order, graphs, with propositional logic, Analysis of planning approaches, Hierarchical planning, conditional planning, Continuous and Multi Agent planning

CO4: Explain Expert System and implementation and be able to design and implement various machine learning algorithms in a range of real-world application

Lesson Plan:**Module 1: Introduction to Artificial Intelligence and its applications: 3rd Year, (Faculty : Prof. Dr. Tanmay Sinha Roy)**

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Artificial Intelligence and its applications, Components of Artificial Intelligence.
Day 2	Artificial Intelligence Techniques, Level of models, criteria of success, Intelligent Agents.
Day 3	Nature of Agents, Learning Agents, advantages and limitations of AI.
Day 4	Impact and Examples of AI, Application domains of AI.

Module 2: AI Search & Optimization Algorithms: 3rd Year, (Faculty : Prof. Dr. Tanmay Sinha Roy)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Uninformed Search Algorithms-Depth First Search
Day 2	Breadth-First Search, Depth-Limited Search
Day 3	Uniform Cost Search
Day 4	Informed Search Algorithms- Greedy Search Algorithm
Day 5	A* Search Algorithms, Graph Search
Day 6	Local Search Algorithms-Tabu Search
Day 7	Hill Climbing Algorithms
Day 8	Simulated Annealing, Genetic Algorithms (GAs)
Day 9	Swarm Intelligence Algorithms-Ant Colony Optimization (ACO)
Day 10	Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC) Algorithm, Local Beam Search
Day 11	Adversarial Search Algorithms-Minimax Algorithm
Day 12	Alpha-Beta Pruning.

Module 3: Introduction to Machine Learning: 3rd Year, (Faculty : Prof. Dr. Tanmay Sinha Roy)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Machine Learning Fundamentals
Day 2	Machine Learning Types (supervised, unsupervised, reinforcement)
Day 3	Machine Learning Applications
Day 4	Neural Networks Perceptron, Single Layer Perceptron
Day 5	Multilayer Perceptron
Day 6	Classifier Evaluation
Day 7	Ensemble Learning
Day 8	Boosting

Module 4: Supervised and Unsupervised Machine Learning Algorithms: 3rd Year, (Faculty : Prof. Dr. Tanmay Sinha Roy)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Supervised and Unsupervised Machine Learning Algorithms
Day 2	Decision Tree
Day 3	Bayesian Networks
Day 4	Bayes Classifier
Day 5	Linear Regression
Day 6	Logistic Regression
Day 7	k-Nearest Neighbour Learning
Day 8	Support Vector Machines
Day 9	Random Forest Classifier
Day 10	Clustering, K-Means Clustering
Day 11	Dimensionality Reduction
Day 12	Reinforcement Learning

Module 5: Introduction to Deep Learning: 3rd Year, (Faculty : Prof. Dr. Tanmay Sinha Roy)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Deep Learning- Fundamentals
Day 2	Kernels in CNN Model, Hyper-Parameters
Day 3	CNN Model Architecture, AlexNet, LeNet, VGG Networks
Day 4	Google Network, Residual Networks.

CO-PO Mapping:

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

TEXT BOOK:

1. Artificial Intelligence - by Rich and Knight (McGraw Hill)
2. Artificial Intelligence – by Saroj Kaushik (Cengage)
3. Artificial Intelligence and Soft Computing – by Amit Konar (CRC Press)
4. Machine Learning - Tom Mitchell (TM) (publ. by McGraw Hill)
5. Pattern Classification - Duda, Hart and Stork (DHS) (Wiley, 2nd edn.)

REFERENCE BOOKS:

6. Artificial Intelligence and Machine Learning - by Vinod Chandra S.S. (PHI Learning, 1st edn., 2014)
7. Artificial Intelligence by Padhy, (Oxford University Press, 2005)
8. A First Course in Artificial Intelligence – by Deepak Khemani (McGraw Hill, 2013)
9. Artificial Intelligence by Nils J. Nilsson (Elsevier India; First Ed, 2003)
10. Introduction to Machine Learning - **E. Alpaydin (EA)** (publ. MIT Press, 3rd edn.)
11. The Elements of Statistical Learning - **Hastie, Tibshirani, Friedman (HTF)** - (publ. Springer, 2nd edn.)
12. Understanding Machine Learning: From Theory to Algorithms - **Shai Shalev-Shwartz and Shai Ben-David**, (publ. Cambridge University Press)
13. Pattern Recognition and Machine Learning - **Christopher Bishop** (publ. Springer)



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



Syllabus and Lesson Plan for B.Tech Admission Batch 2024

Subject Name: Computer Organisation

Credit: 3

Lecture Hours: 3

Subject Code: O-EEE 501B

List of Faculty Members handling the Subject –

1.

Pre-requisite: (1) Design and Analysis of Algorithms, Data Structures and Algorithms (2) Basic concepts from Mathematics & Statistics (Linear Algebra, and Statistics and Probability, Calculus) (3) Programming in Python/R

Course Objective:

To expose the students to the following:

- CO1: How Computer Systems work & the basic principles
- CO2: The current state of art in memory system design
- CO3: How I/O devices are accessed and its principles.
- CO4: To provide the knowledge on Instruction Level Parallelism

Relevant Links:

	Coursera Hyperlinked	Nptel	LinkedIn Learning:	Infosys Springboard:
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Detailed Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	Introduction: Basic organization of the stored program in computer and operation sequence for execution of a program. Role of operating systems and compiler/ assembler. Fetch, decode and execute cycle. Concept of operator, operand, registers and storage. Instruction format. Instruction sets and addressing modes. Commonly used number systems. Fixed and floating point representation of numbers.	Academic Mapping: CTE Model Curriculum for (aict-india.org) Industry Mapping:	10		Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill.	Ch 1, 2
2	Overflow and underflow. Design of address- ripple carry and carry look ahead principles. Design of ALU Fixed point multiplication-Booth's algorithm Fixed point division-Restoring and non restoring algorithms. Floating point-IEEE 754 standard.	Academic Mapping: CTE Model Curriculum for (aict-india.org) Industry Mapping:	10		Computer Systems Architecture – M.Moris Mano, 3rd Edition, Pearson/PHI	Ch3, Ch 10
3	Memory unit design And Memory Organization: Memory unit design with special emphasis on implementation of CPU-memory interfacing. Memory organization. Static and dynamic memory, memory hierarchy, associative memory. Cache memory. Virtual memory. Data path design for read/write access.	Academic Mapping: CTE Model Curriculum for (aict-india.org) Industry Mapping:	10		Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill. Computer Systems Architecture – M.Moris Mano, 3rd Edition, Pearson/PHI	Ch 5, 6 Ch 12

4	Pipelining and Input- output organization: Design of control unit-hardwired and micro programmed control. Introduction to instruction pipelining. Introduction to RISC architecture, RISC vs. CISC architecture. I/O operations-Concepts of handshaking. Polled I/O, Interrupt and DMA.	Academic Mapping: CTE Model Curriculum for (aictelibrary.org) Industry Mapping:	10		Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill. Computer Systems Architecture – M.Moris Mano, 3rd Edition, Pearson/PHI	Ch 1, 8 Ch 8
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Course Outcome:

Upon completion of this course, students should be able to:

1. Student will learn the concepts of computer organization for several engineering applications.
2. Student will develop the ability and confidence to use the fundamentals of computer organization and tool in the engineering of digital systems.
3. An ability to identify, formulate, and solve hardware and software computer engineering problems using sound computer engineering principle.
4. To impart the knowledge on micro programming and comprehend the concepts of advanced pipelining techniques.

CO-PO Mapping:

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

TEXT BOOK:

1. Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, 5th Edition, McGraw Hill.
2. Computer Systems Architecture – M.Moris Mano, 3rd Edition, Pearson/PHI

REFERENCE BOOKS:

1. “Computer Architecture and Organization”, 3rd Edition by John P. Hayes, WCB/McGraw-Hill
2. “Computer Organization and Architecture: Designing for Performance”, 10th Edition by i. William Stallings, Pearson Education.
3. “Computer System Design and Architecture”, 2nd Edition by Vincent P. Heuring and Harry ii. F. Jordan, Pearson Education.



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



Syllabus and Lesson Plan for B.Tech Admission Batch 2024

Subject Name: Electric Vehicles **Credit:** 3 **Lecture Hours:** 32

Subject Code: P-EEE-571A

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Dr. Sourav Das

Pre-requisite:

Course Objective:

1. To understand the basic difference between conventional and Hybrid vehicles.
2. To understand different configuration and control of Electric drives.
3. To understand energy storage system in Hybrid vehicles.
4. To understand different energy management strategies of Hybrid vehicles.
5. To solve numerical problems on the topics studied

Relevant Links:

Study Material	Coursera Hyperlinked	Nptel	LinkedIn Learning:	Infosys Springboard:
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Detailed Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1.	Introduction: Introduction to Electric & Hybrid Electric Vehicles: History of hybrid and electric vehicles, efficiencies of electric & ICEs, classifications of hybrid vehicle powertrains, advantages & disadvantages of EVs and HEVs, social and environmental importance of hybrid and electric vehicles, dynamics of EV. Recent cutting edge EV technology: AI Based Cyber-Security for EV Technology, Threat management and risk assesment, Core Concepts of Embedded Technology for EV	International Academia: https://ocw.mit.edu/courses/16-682-technology-in-transportation-spring-2011/pages/syllabus/ AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/FINAL%20-%20NEP%202020%20Model%20Syllabus%20for%20Open%20Electives%20in%20Electric%20Vehicles.pdf Industry Mapping: JSW-MG MOTORS INDIA, mgmotors.skill-lync.com AI mapping: Introduction to Automotive Cybersecurity & Vehicle Networks Coursera	8	Hardware experiment: Development of Prototype for EV (2W) using EV drivetrain and power train components.	J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.	Chapter 2, 3 & 4

2.	EV & HEV Drive-trains: Electric Drive-trains: Fundamentals of electric vehicle architecture, components, and energy flow. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, DC Motor, Induction Motor control, Permanent Magnet Motor drives (BLDC, PMSM), Understand traction motors, power electronics, and fault diagnostics in EVs.	International Academia: https://ocw.mit.edu/courses/16-682-technology-in-transportation-spring-2011/pages/syllabus/ AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/FINAL%20-%20NEP%202020%20Model%20Syllabus%20for%20Open%20Electives%20in%20Electric%20Vehicles.pdf Industry Mapping: JSW-MG MOTORS INDIA, mgmotors.skill-lync.com	8	Hardware Experiements 1. Development of Solution Tools for Noise Reduction and Efficiency Enhancement in BLDC Motors under Forward, Reverse, and Braking Conditions in Electric Vehicles. 2. Performance Evaluation of Electric Vehicle under Power Lock Condition and without Power Lock Condition 3. Design and Analysis of Electric Vehicle Performance under Various Fault Conditions. Software Experiement 4. Development of Solution Tools for Noise Reduction and Efficiency Enhancement dashboard using AI for BLDC Motors under Forward, Reverse, and Braking Conditions in Electric Vehicles.		
3.	Energy Storage & Charging Technology: EV battery chemistry, design, performance, and safety basics, Fuel Cell based energy storage and its analysis, low & high voltage batteries, different types of batteries (Li-ion/Na-ion Ni-metal hydride), battery management system (BMS), regenerative braking. EV & PHEV Charging: different levels of charging, V2G, V2H, V2V, EV charging equipment, wireless charging, selecting the energy storage technology.	International Academia: https://ocw.mit.edu/courses/16-682-technology-in-transportation-spring-2011/pages/syllabus/ AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/FINAL%20-%20NEP%202020%20Model%20Syllabus%20for%20Open%20Electives%20in%20Electric%20Vehicles.pdf Industry Mapping: JSW-MG MOTORS INDIA, mgmotors.skill-lync.com	10	Hardware Experiments 1. Fabrication of Anode/Cathode for Li-ion & Na-ion Battery. 2. Fabrication of coin cell for Li-ion & Na-ion Battery. Software Experiments 3. Design Intelligent Charging Scheduling Techniques Using MATLAB SIMULATION incorporating G2V and V2G Mode of Operation 4. Design of digital twin of battery pack in MATLAB	J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.	Chapter 9, 10, 12 & 13, 14, 19

4.	Energy Management Strategies and vehicle connectivity Introduction to energy management strategies used in hybrid and electric vehicles, different intelligent energy management strategies using AI, implementation issues of energy management strategies, CAN Network, AI based fault detection using CAN Network, Case Studies and best practices, ADAS SYSTEM: Understanding vehicle connectivity, essential principals of ADAS	International Academia:https://ocw.mit.edu/courses/16-682-technology-in-transportation-spring-2011/pages/syllabus/ AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/FINAL%20-%20NEP%202020%20Model%20Syllabus%20for%20Open%20Electives%20in%20Electric%20Vehicles.pdf Industry Mapping: JSW-MG MOTORS INDIA, mgmotors.skill-lync.com	6	Software Experiments 1. Development of Intelligent Energy Management Strategies for EV Charging in Distributed Energy Resources (DER), Integrated with Conventional Grids 2. Designing Driving scenario generation for ADAS through the appropriate placement of various sensors like ultrasonic, LIDAR to generate synthetic object detection.	J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.	Chapter 3: Energy Management Problem in HEVs
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- CO1** To understand the basic difference between conventional and Hybrid vehicles along with its cyber physical aspects
- CO2** To understand different configuration and control of Electric drives.
- CO3** To understand energy storage system and charging technology in EV & Hybrid vehicles
- CO4** To understand different energy management strategies and vehicle connectivity for ADAS.

Lesson Plan:

Working Day	Lesson Plan – Description
1	Module 1: Introduction – Overview of Electric and Hybrid Electric Vehicles
2	History of Electric & Hybrid Vehicles – Global Evolution
3	Efficiency comparison of ICE vs Electric Vehicles
4	Classification of Hybrid Vehicle Powertrains (Series, Parallel, Series-Parallel)
5	Advantages & Disadvantages of EVs and HEVs
6	Social, Environmental, and Economic Importance of EVs
7	Recent Trends – AI-based Cybersecurity in EVs
8	Threat Management and Risk Assessment in EV Architecture
9	Core Concepts of Embedded Technology in Electric Vehicles
10	Module 1 Review and Discussion (Case Studies on Tesla, MG, Tata EVs)
11	Module 2: Introduction to EV & HEV Drive-trains – Architecture and Components
12	Energy Flow in Electric Drive-trains
13	Electric Propulsion Units – Overview and Functional Blocks
14	DC Motor Drives in EVs – Torque-Speed Characteristics
15	Induction Motor Drives – Control and Efficiency Aspects
16	Permanent Magnet Motor Drives – BLDC and PMSM Operation
17	Power Electronics Interface – Converters, Inverters, and Controllers
18	Fault Diagnostics and Protection Systems in EV Drive-trains

Working Day	Lesson Plan – Description
19	Case Study – Motor Selection for EV Applications
20	Module 2 Review & Numerical Problems on Motor Control and Power Flow
21	Module 3: Introduction to Energy Storage Systems
22	EV Battery Chemistry and Design Basics
23	Battery Performance, Safety, and Life Cycle Analysis
24	Types of Batteries – Li-ion, NiMH, Solid-State Batteries
25	Battery Management System (BMS) – Architecture and Functions
26	Regenerative Braking – Energy Recovery and Control Algorithms
27	Fuel Cell-based Energy Storage – Working Principle and Advantages
28	EV & PHEV Charging: Levels of Charging (L1, L2, L3, DC Fast)
29	EVSE Components and Standards – Connectors, Communication Protocols
30	Wireless Charging Techniques and Emerging Trends
31	Module 3 Review & Discussion on Real-World Charging Infrastructure (MG Motors, Tata Power)
32	Module 4: Energy Management Strategies – Overview
33	Conventional Energy Management Strategies in HEVs
34	AI-based Intelligent Energy Management Strategies
35	Implementation Challenges of EMS in Real-time Systems
36	Vehicle Connectivity: CAN Network Architecture and Communication
37	AI-based Fault Detection using CAN and Data-driven Diagnostics
38	Introduction to ADAS (Advanced Driver Assistance Systems)

Working Day	Lesson Plan – Description
39	ADAS Sensors, Architecture, and AI Integration for Vehicle Safety
40	Module 4 Review, Case Studies, and Course Summary Discussion

CO-PO MAPPING

C0s \ P0s	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
C01	3	2	1	0	0	3	1	0	1	0	2
C02	3	3	3	2	3	0	0	1	0	0	2
C03	3	2	2	3	3	2	0	0	1	0	2
C04	2	3	3	3	2	3	1	0	2	1	3

TEXT BOOK:

1. J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.

REFERENCE BOOKS:

1. M. Ehsani, Y. Gao, S. E. Gayand A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.



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



Syllabus for B.Tech Admission Batch 2024

Subject Name: Renewable & Non Conventional Energy
Subject Code: PEEE571B

Credit: 3

Lecture Hours: 36

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Pratik De Sarkar

Pre-requisite: Basic Electronics

Course objectives:

The purpose of learning this course is

1. To understand the difference between Renewable and non-renewable energy sources
2. To understand methods of conversion of solar energy and wind energy to other form of energy
3. To understand methods harnessing energy from Biomass, Geothermal and ocean
4. To understand the principle of operation of Magneto Hydrodynamic power generation
5. To understand the principle and operation of fuel cell
6. To solve numerical problems of Renewable and non-renewable energy sources

Relevant Links:

<u>Study Material</u>	<u>Coursera</u>	<u>LinkedIn learning</u>	<u>Nptel</u>	<u>Infosys Springboard</u>
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Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	Introduction to Energy sources	Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources. Impact of renewable energy generation on environment, Kyoto Protocol	International Academia: https://ocw.mit.edu/courses/22-081j-introduction-to-sustainable-energy-fall-2010/ Industry Mapping: MATLAB	3	Monitoring the health and performance of electric vehicle (EV) battery systems to ensure optimal operation, extend battery life, and support efficient energy management in automotive and fleet management applications (Hardware and MATLAB simulation).	Non-conventional Energy sources, G.D. Rai, 6th Edition, Khanna Publishers, 2017	1
2	Solar Energy	Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings,	International Academia: https://ocw.mit.edu/courses/ec-s07-photovoltaic-solar-energy-systems-fall-2004/ Industry Mapping: Atlas Homer PVsyst SolarEdge	10	1. Performance Evaluation of Solar PV Panel using I-V and P-V Characteristics for PV Module Testing under Standard Test Conditions (STC) to ensure quality and compliance with international standards (Hardware and MATLAB simulation) 2. Optimizing the Maximum Power Point (MPP) to achieve	Renewable energy resources and emerging technologies, D.P. Kothari, 2 nd Edition, PHI	3, 4, 5, 6

		photo voltaics - solar cells, different types of PV Cells, Mono-poly Crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems & its applications. PV hybrid systems.			maximum efficiency for supplying industrial loads by utilizing series and parallel combinations of solar PV panels, ensuring reliable and cost-effective renewable energy solutions in industrial applications (Hardware and MATLAB simulation). 3. Design a solar plant yielding maximum energy considering the variation of solar irradiance throughout the day for supplying the variable load (Hardware and MATLAB simulation). 4. Design a solar plant yielding maximum energy considering proper placement and orientation of solar PV module for supplying the variable load (Hardware and MATLAB simulation). 5. Analyze the effect of the bypass diode on the PV module so that stable voltage and current levels is maintained in grid-tied systems by minimizing power disruptions caused by partial shading 6. Analyze the behavior of PV module by varying radiation and intensity for catering the load		
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					demand (Hardware and MATLAB simulation). 7. Analyzing the impact of varying loads on the performance of a solar and grid-tied inverter system to ensure efficient power delivery, optimal load management, and seamless grid integration in real-world applications (Hardware and MATLAB simulation). 8. Design a single-phase grid tied inverter for solar PV application in MATLAB Simulink.		
3	Wind Energy	Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; various types of Generators used for wind energy conversion, design considerations of horizontal and vertical axis wind machines; analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations	International Academia: https://ocw.mit.edu/courses/ec-711-d-lab-energy-spring-2011/video_galleries/wind-micro-hydro/ Industry Mapping: OpenFAST Bladed	10	1. Performance evaluation of a wind plant to analyze the impact of wind speed and ensure efficient power generation (Hardware and MATLAB simulation).	Non-conventional Energy sources, G.D. Rai, 6th Edition, Khanna Publishers, 2017	6
4	Energy from Biomass	Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas	International Academia: https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/resources/mit2_60s20_lec24/ Industry Mapping: TRNSYS	4		Renewable Energy Sources and Emerging Technologies, D.P. KOTHARI, PHI, Second Edition, 2011	12

5	Geothermal Energy	Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India	International Academia: https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/resources/mit2_60s20_lec18/ Industry Mapping: GEOPHIRES	3		Non-conventional Energy sources, G.D. Rai, 6th Edition, Khanna Publishers, 2017	8
6	Energy from Ocean	Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy	International Academia: https://ocw.mit.edu/courses/22-081j-introduction-to-sustainable-energy-fall-2010/resources/mit22_081jf10_lec03a/ Industry Mapping: MATLAB	3		Non-Conventional Energy Resources, B. H. Khan, 3rd Edition, Mc Graw Hill	10
7	Hydrogen Energy	Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles	International Academia: https://ocw.mit.edu/courses/2-61j-internal-combustion-engines-spring-2017/resources/mit2_61s17_lec21/ Industry Mapping: FCS3000 Fuel Cell Simulation Software	3		Non-Conventional Energy Resources, B. H. Khan, 3rd Edition, Mc Graw Hill	12

Course outcomes:

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

- CO1: Explain the principle of conversion of solar energy, wind energy, biomass, Geothermal energy, Ocean energy, Hydrogen energy to other form of energy and magneto hydrodynamic power generation.
- CO2: Use Solar energy, Wind energy, Biomass, Geothermal energy, Ocean energy, Hydrogen energy and fuel cell for different applications to set up wind mill and biogas generation plant
- CO3: Estimate conversion efficiency of fuel cell, solar energy, wind energy, ocean energy and hydrogen energy to heat and electric energy.
- CO4: Solve numerical problems relating to conversion of solar energy, Wind energy, Biomass, Ocean energy and Hydrogen energy to heat and electric energy

Lesson Plan:**Module 1: Introduction to Energy sources Year 2026, (Faculty : Mr. Pratik De Sarkar)**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development;
2	strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources.
3	Impact of renewable energy generation on environment, Kyoto Protocol

Module 2: Solar Energy Year 2026, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation
2	local solar time, derived solar angles, sunrise, sunset and day length.
3	flat plate collectors, concentrating collectors Solar air heaters-types, solar driers,
4	storage of solar energy-thermal storage,
5	solar pond , solar water heaters, solar distillation,
6	solar still, solar cooker, solar heating & cooling of buildings,
7	photo voltaics - solar cells, different types of PV Cells,
8	Mono-poly Crystalline and amorphous Silicon solar cells
9	Design of PV array. Efficiency and cost of PV systems & its applications. PV hybrid systems.

Module 3: Wind Energy Year 2026, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Principle of wind energy conversion;
2	Basic components of wind energy conversion systems;
3	wind mill components,
4	various types and their constructional features;
5	various types of Generators used for wind energy conversion,
6	design considerations of horizontal and vertical axis wind machines:
7	analysis of aerodynamic forces acting on wind mill blades and
8	estimation of power output;
9	wind data and site selection considerations

Module 4: Energy from Biomass Year 2026, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	omass conversion technologies, Biogas generation plants,
2	classification, advantages and disadvantages, constructional details,
3	site selection, digester design consideration, filling a digester for starting,
4	maintaining biogas production, Fuel properties of bio gas, utilization of biogas

Module 5: Geothermal Energy Year 2026, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal,
2	geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy,
3	prospects of geothermal energy in India

Module 6: Energy from Ocean Year 2026, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India.
2	Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy.
3	Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy

Module 7: Hydrogen Energy Year 2026, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Introduction, Hydrogen Production methods,
2	Hydrogen storage, hydrogen transportation, utilization of hydrogen gas,
3	hydrogen as alternative fuel for vehicles

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	1	2	0	0	3	0	0	0	0	0
CO 2	3	3	2	2	2	3	3	0	0	0	0
CO 3	3	3	3	3	2	2	2	0	1	0	0
CO 4	3	2	0	3	0	0	2	0	0	0	0

Suggested Learning Resources:Text Books:

1. Renewable energy resources and emerging technologies, D.P. Kothari, 2nd Edition, PHI
2. Non-conventional Energy sources, G.D. Rai, 6th Edition, Khanna Publishers
3. Non-Conventional Energy Resources, B. H. Khan, 3rd Edition, Mc Graw Hill

Reference Books:

1. Renewable energy sources and conversion technology, Bansal Keemann, Meliss, Tata Mc Graw Hill.
2. Energy Technology, O.P. Gupta, Khanna Publishing House.
3. Non-conventional Energy, Ashok V. Desai, New Age International Publishers Ltd
4. Non-conventional Energy sources, Chandra, Khanna Publishing House.



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

Syllabus for B.Tech Admission Batch 2024

Name of the Course/ Subject	ELECTRIC MACHINE II LABORATORY	Subject Code:	PC-EEE-591
Semester	V	Course Nature	Practical
Pre-Requisite(s):	Basic Electrical Engineering Lab (ES-EE-191), Electric Machine-I Lab (PC-EEE-491)		
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
0	0	3	1

Course objectives:

The purpose of learning this course is

1. To enable, train and evaluate the ability of the students to perform the analysis of any electromechanical system.
2. To empower students to determine the parameters of AC, DC machines and transformers by performing experiments on these machines.
3. To enable students to identify and solve AC, DC machine and Transformer related problems.
4. The ability to select a suitable measuring instrument for a given application.

Detailed Syllabus

Module No.	Description	No of period
1	Application of different starter for maintaining the stable operation of a 3 phase Cage Induction Motor [DOL, Auto transformer & Star-Delta].	3
2	Design of an 18 slot 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	Design 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	Design a equivalent circuit for synchronous machine for analyzing the machine performance using industrial testing procedure [Direct axis resistance (X_d) & Quadrature reactance (X_q)].	3
8	Performance verification of Induction generator for wind mill application.	3
9	Determination of voltage regulation of Synchronous machine by a. 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	Different methods of starting of a 3 phase Cage Induction Motor & their comparison [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 regulation of Synchronous machine by a. Potier reactance method. b. Synchronous Impedance method.	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	V-curve of Synchronous motor.	https://em-coep.vlabs.ac.in/exp/synchronous-motor/simulation.html

Laboratory outcome:

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

LO1. Identify appropriate equipment and instruments for the experiment.

LO2. Test the instrument for application to the experiment.

LO3. Construct circuits with appropriate instruments and safety precautions.

LO4. Validate different characteristics of single phase Induction motor, three phase Induction motor, Induction generator and synchronous motor , methods of speed control of Induction motors and parallel operation of the 3 phase Synchronous generator.

Simulation based Experiments :

1. Design a simulation model for determining the characteristics of Self Excited Induction Generator in MATLAB Simulink

2. Design a simulation model for evaluating the optimal characteristics of Three Phase Induction Motor Controlled by AC Voltage Controller in MATLAB Simulink

3. Design a MATLAB Simulation model for 3 phase Induction Motor Torque Speed Characteristics.

Suggested Learning Resources:

1. Laboratory experiments on Electrical Machines, C.K. Chanda, A. Chakrabarti, Dhanpat Rai & Co.

2. Laboratory manual for Electrical Machines, D.P. Kothari, B.S.Umre, I K International Publishing House Pvt. Ltd.

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University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus

Syllabus for B.Tech Admission Batch 2024

Name of the Course/ Subject	CONTROL SYSTEM LABORATORY	Subject Code:	PCEEE592
Semester	V	Course Nature	Practical
Pre-Requisite(s):	1. Basic Electrical Engineering 2. Electric Circuit Theory 3. Electric Machine-I		
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
0	0	3	1

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	No of period
1	Familiarization with MAT-Lab control system tool box, MAT-Lab-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	Determination of approximate transfer functions experimentally from Bode plot.	3
7	Evaluation of steady state error, setting time, percentage peak overshoot, gain margin, phase margin with addition of Lead, Lag, Lead-lag compensator.	3
8	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 ratio from experimental data.	3
9	Design of Lead, Lag and Lead-Lag compensation circuit for the given plant transfer function. Analyze step response of the system by simulation.	3
10	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
11	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
12	PID controller tuning for dc motor speed control.	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

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Syllabus for B.Tech Admission Batch 2024

Name of the Course/ Subject	Power Electronics Laboratory	Subject Code:	PCEEE593
Semester	5th	Course Nature	B.Tech in EEE
Pre-Requisite(s):	Analog Electronics, Basic Electronics		
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	0	3	1

Course Objective(s):

The purpose of learning this course is-

1. To identify the basic elements of the power electronics engineering
2. To understand the basic operation of different power converter
3. To design different power converter for specific application.

Detailed Syllabus

Module No.	Description	No of period
1.	Performance parameter analysis of power semiconductor switches for designing inverters used in renewable energy systems	3
2.	Design different triggering circuit for controlling the voltage applied to motors enabling speed control in conveyor belts, elevators, and cranes.	3
3.	Design of firing circuits suitable for triggering SCR in a 1- phase full controlled bridge converter used in battery charging systems, enabling controlled DC output suitable for large industrial batteries	3
4.	Investigating the effect of load variation (purely R to R-L) using single phase controlled converter for heating control of appliances.	3

5.	Obtaining precise voltage control for BLDC motor using single phase half controlled symmetrical bridge converters.	3
6.	Analysis of the buck-boost chopper performance in terms of voltage regulation and efficiency for charging batteries to match the battery's charging requirements used in industrial UPS systems.	3
7.	Implement a three-phase bridge inverter for star connected lamp load intensity control.	3
8.	Achieving precise and smooth lighting control using single phase-controlled converter and verify the effect of source inductance on the output.	3
9.	Integrating step up and step-down chopper using IGBT with DC-DC charging station for solar panels and observing voltage variation.	3
10.	Analyze the effect of modulation index on the output voltage of a pulse width modulated bridge inverter used in EV drive systems.	3
11.	Study of Performance of Three-Phase AC Controller with R and R–L Loads for Industrial Heating and Motor Speed Control Applications	3

Course Outcomes:

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

CO1. Identify the basic elements of the power electronics engineering.

CO2. Understand the basic operation of electronic switches.

CO3. Understand the operation of different types of power converter.

CO4. Design basic converter for various applications

Suggested Learning Resources:

1. P.S. Bhimra, "Power Electronics", Khanna Publishers
2. M.H. Rashid "Power Electronics Handbook", Academic Press
3. Timothy L. Skveranina, "The Power Electronics Handbook", CRC Press
4. R.S. Ramshaw, "Power Electronics Semiconductor Switches", Springer-Science
5. [Farzin Asadi](#), [Kei Eguchi](#), "Power Electronics Circuit Analysis with PSIM", De Gruyter

Syllabus for B.Tech Admission Batch 2024

Name of the Course/ Subject	Electric Vehicles Laboratory	Subject Code:	PEEE591A
Semester	V	Course Nature	Practical
Pre-Requisite(s):	Basic Electrical Engineering Lab, Electric Circuit Theory Lab		
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
0	0	3	1

List of the experiments:

Sl. No	Hardware Experiment	No. of periods
1.	Development of Solution Tools for Noise Reduction and Efficiency Enhancement in BLDC Motors under Forward, Reverse, and Braking Conditions in Electric Vehicles	3
2.	Analysis of Charging and Discharging Characteristics of Lithium-Ion Battery Used in Electric Vehicles	3
3.	Design and Implementation of Cell Balancing Techniques for Lithium-Ion Battery Packs in EV Applications	3
4.	Performance Evaluation of Electric Vehicle under Power Lock Condition	3
5.	Performance Evaluation of Electric Vehicle without Power Lock Condition	3
6.	Design and Analysis of Electric Vehicle Performance under Various Fault Conditions	3
7.	Designing Intelligent Charging Scheduling Techniques Using MATLAB Simulation Incorporating G2V and V2V Mode Of Operation.	3
8.	Designing Intelligent Charging Scheduling Techniques Using MATLAB SIMULINK & Soft Computing incorporating G2V and V2G mode of operation.	3
9.	Development of Intelligent Energy Management Strategies for EV Charging in Distributed Energy Resources (DER), Integrated with Conventional Grids	3
10.	Design of Intelligent Control Techniques of BLDC Motor Using Artificial Intelligence (AI).	3



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Syllabus for B.Tech Admission Batch 2024-2028

Name of the Course/ Subject	Renewable & Non-Conventional Energy Lab	Subject Code:	PEEE591B
Semester	V	Course Nature	Practical
Pre-Requisite(s):	Basic Electrical Engineering Lab, Electric Circuit Theory Lab		
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
0	0	3	1

Course objectives:

The purpose of learning this course is

1. To understand the different concepts of Renewable & Non-Conventional Energy like Wind & Solar
2. To understand the different operational behavior changes with different controlling parameters of renewable sources.
3. To understand the different controlling parameters for battery storage systems.
4. To understand the concept of developing a simulation model for renewable sources.

Detailed Syllabus

Experiment No	Experiment Name	No of period
1	Performance Evaluation of Solar PV Panel using I-V and P-V Characteristics for PV Module Testing under Standard Test Conditions (STC) to ensure quality and compliance with international standards (Hardware and MATLAB simulation)	3
2	Optimizing the Maximum Power Point (MPP) to achieve maximum efficiency for supplying industrial loads by utilizing series and parallel combinations of solar PV panels, ensuring reliable and cost-effective renewable energy solutions in industrial applications (Hardware and MATLAB simulation).	3

3	Design a solar plant yielding maximum energy considering the variation of solar irradiance throughout the day for supplying the variable load (Hardware and MATLAB simulation).	3
4	Design a solar plant yielding maximum energy considering proper placement and orientation of solar PV module for supplying the variable load (Hardware and MATLAB simulation).	3
5	Analyze the effect of the bypass diode on the PV module so that stable voltage and current levels is maintained in grid-tied systems by minimizing power disruptions caused by partial shading	3
6	Analyze the behavior of PV module by varying radiation and intensity for catering the load demand (Hardware and MATLAB simulation).	3
7	Performance evaluation of a wind plant to analyze the impact of wind speed and ensure efficient power generation (Hardware and MATLAB simulation).	3
8	Analyzing the impact of varying loads on the performance of a solar and grid-tied inverter system to ensure efficient power delivery, optimal load management, and seamless grid integration in real-world applications (Hardware and MATLAB simulation).	3
9	Monitoring the health and performance of electric vehicle (EV) battery systems to ensure optimal operation, extend battery life, and support efficient energy management in automotive and fleet management applications (Hardware and MATLAB simulation).	3.
10	Design a single-phase grid tied inverter for solar PV application in MATLAB Simulink.	3

Course outcomes:

After completion of this course the learners will be able to

1. Remember the working principle of solar cell and wind turbine.
2. Apply the concept of charging and discharging to monitor the health of EV battery system.
3. Evaluate the effect of different loads in a solar and grid-tie inverter system.
4. Create a MATLAB simulation to draw the I-V and P-V characteristics of the PV module.

Suggested Learning Resources:

1. [Workbook](#)
2. [NPTEL](#)
3. [Linkedin Learning](#)
4. [Coursera](#)
5. [Infosys Springboard](#)