Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2015 'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: ELECTRICAL ENGINEERING

Name of the Course: T.Y. B. Tech (Sem I & II)

(Syllabus to be implemented from w.e.f. June 2022)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Engineering & Technology
T.Y. B.Tech. (Electrical Engineering)

Choice Based Credit System Syllabus Structure of T. Y. B.Tech. Electrical Engineering W.E.F. 2022-2023

Semester I

Course Code	***Theory Course Name***	***Hrs./week***			***Credits***	***Examination Scheme***			
		L	***T***	***P***		***ISE***	***ESE***	***ICA***	***Total***
EL 311	Power System III	3	-	-	3	30	70	-	100
EL 312	Linear Control System	3	-	-	3	30	70	-	100
EL 313	Advanced Microcontroller System	3	-	-	3	30	70	-	100
EL 314	Electromagnetic Engineering	3	1	-	4	30	70	25	125
EL 315	Open Elective-I	2	1	-	3	30	70	25	125
EL 316	Self-Learning Module-I			-	2		50		50
Sub Total		**14**	**2**	**-**	**18**	**150**	**400**	**50**	**600**
Laboratory Course Name							***ESE***		
							POE	***OE***	
EL 311	Power System III	-	-	2	1	-	-	25	25	50
EL 312	Linear Control System	-	-	2	1	-	-	25	25	50
EL 313	Advanced Microcontroller System	-	-	2	1	-	50	-	25	75
EL 317	Electrical Workshop	-	-	2	1	-	-	-	25	25
Sub Total		**-**	**-**	**8**	**4**	**-**	**100**		**100**	**200**
Grand Total		**14**	**2**	**8**	**22**	**150**	**500**		**150**	**800**

- *Abbreviations: L - Lectures, P –Practical, T - Tutorial, ISE - In semester Exam, ESE - End Semester Exam, ICA - Internal Continuous Assessment, ESE - University Examination (Theory &/ POE &/Oral examination)*

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Engineering & Technology
T.Y. B.Tech. (Electrical Engineering)

Choice Based Credit System Syllabus Structure of T.Y.B. Tech. Electrical Engineering W.E.F. 2022-2023

Semester II

Course Code	***Theory Course Name***	***Hrs./week***			***Credits***	***Examination Scheme***			
		L	***T***	***P***		***ISE***	***ESE***	***ICA***	***Total***
EL 321	Electrical Machine Design	3	-	-	3	30	70	-	100
EL 322	Electrical Utilization	3	1	-	4	30	70	25	125
EL 323	Power Electronics & Industrial Drives	3	-	-	3	30	70	-	100
EL 324	Advanced Control Systems	3	-	-	3	30	70	-	100
EL 325	Open Elective-II	2	1	-	3	30	70	25	125
EL 326	Self-Learning Module-II	-	-	-	2	--	50	-	50
Sub Total		**14**	**2**	**-**	**18**	**150**	**400**	**50**	**600**
Laboratory Course Name							***ESE***		
							POE	***OE***	
EL 321	Electrical Machine Design	-	-	2	1	-	-	25	25	50
EL 323	Power Electronics & Industrial Drives	-	-	2	1	-	50	-	25	75
EL 324	Advanced Control Systems	-	-	2	1	-	-	-	25	25
EL 327	Mini Hardware Project	-	-	2	1	-	-	25	25	50
Sub Total		**-**	**-**	**8**	**4**	**-**	**100**		**100**	**200**
Grand Total		**14**	**2**	**8**	**22**	**150**	**500**		**150**	**800**

Abbreviations: L - Lectures, P –Practical, T - Tutorial, ISE - In Semester Exam, ESE - End Semester Exam, ICA - Internal Continuous Assessment, ESE - University Examination (Theory &/ POE &/Oral examination)

Self-Learning Module-II:

1. Hybrid Electric Vehicle Design
2. Electrical Safety
3. Solar Photovoltaic System Design & Installation
4. NPTEL Course/MOOC/University Defined Courses

Note –

- Batch size for the TE practical /tutorial shall be of 15 students. On forming the batches, if the strength of remaining student exceeds 7, then a new batch shall be formed.
- Vocational Training (evaluated at B.E. Part-I) of minimum 15 days shall be completed in any vacation after S.E. Part-II but before B.E. Part-I & and evaluated based on presentation as well as training report.
- Student shall select one as Self Learning Module at T.E. Part I and T.E. Part II each from Technical and Humanities and Social
- Sciences Group with at least one as Self Learning Module from the Humanities and Social Sciences Group
- Curriculum for Humanities and Social Sciences Self Learning Modules is common for all undergraduate programmes of faculty of Engineering and Technology
- Minimum four assignments for Self-Learning Modules at T.E. Part I and T.E. Part II shall be submitted by the students which shall be evaluated by a Module Coordinator assigned by institute / department
- Project group for T.E.(Electrical) Part II Mini Project shall not be of more than three students
- Project group for B.E.(Electrical) Part I and Part II shall not be of more than FOUR students.
- ICA shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes, laboratory books and their interaction and attendance for theory and lab sessions as applicable
- Open Elective I & II shall be common and open for the students of the branches – Electronics Engineering, Electronics & Telecommunication Engineering and Electrical Engineering. Students of these branches can take any of these Open Electives. Syllabus and university examination question will be same for all these branches.

List of Open Electives

Sr. No.	Open Elective I	Open Elective II
1	Information Technology & Management	Operating Systems
2	Advanced Electrical Machines	Renewable Energy Sources
3	Business Ethics	Fiber Optic Communication
4	Managerial Economics	Sensors and Applications

DETAILED SYLLABUS

FOR

T.Y. B.Tech. (ELECTRICAL ENGINEERING)

PART – I

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-I
POWER SYSTEM-III

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week,3 Credits	**ESE –** 70 Marks
Practical: - 2 Hrs/Week, 1 Credit	**ICA -** 25Marks
	ISE - 30Marks
	OE - 25Marks

Course Objectives

1. To draw a single line diagram of complex 3-phase power system network and represent various power system equipment in their equivalent circuit models.
2. To provide the solution against the different faults occurred on the power system.
3. To enhance their ability to analyze complete load flow problem of a given sample power network.
4. To get familiar with the complete behavior of the power system network & power system equipment by stability analysis under various conditions.

Course Outcomes: On completion of the course, learner will be able to-

1. Draw a single line diagram of a given power system network.
2. Evaluate the required circuit breaker rating under different fault conditions.
3. Analyze power flow equation for the solution of different load flow problem.
4. Analyze the steady state and transient stability of a power system using analytical methods.

SECTION-I

Unit 1– Representation of Power System Components **No. of Lectures – 08**

- **Prerequisite:** Vectors, AC Circuit Fundamentals, Working principles of AC and DC Machines.
- **Objectives:**
  1. To get familiar with the fundamental concepts of AC Circuits as well as apply the knowledge of AC machines in the study of power system analysis.
  2. To draw a single line diagram of complex 3-phase power system network.
  3. To develop a Per Unit (PU) representation of a given sample power system network.
  4. To analyze impact of admittance in an interconnected network and develop step by step algorithm of bus impedance matrix.
- **Course Outcomes: On completion of the course, learner will be able to-**
  1. Apply fundamentals of AC Circuits to power system and draw Impedance diagram of a given power system by applying the knowledge of AC machines.
  2. Draw a single line diagram of a given power system network.
  3. Develop per unit impedance diagram of a given power system network.
  4. Write an impact of admittance in an interconnected network and develop step by step algorithm of bus impedance matrix
- **Unit Content:**

  Power in single phase & three phase circuit, Complex Power, Complex Power Balance, Equivalent circuits - synchronous machines, Transmission line, Transformers and Loads, Single line diagram of power system, reactance/impedance diagram, per unit system, per unit impedance diagram of power system, Per unit representation of transformer.

  Introduction of Network Matrices, Formation of Y-BUS by method of inspection and method of singular transformation, Formation of Bus Impedance matrix by step-by-step building algorithm, formation of modified bus impedance matrix.
- **Content Delivery Methods:**

  Chalk and talk, power point presentations
- **Assessment Methods:**

  Numerical problems and derivations related to per unit system and its representations.

Unit 2 - Symmetrical Faults Analysis **No. of lectures – 05**

- **Prerequisite:** Equivalent circuit of power system, single line diagram, per unit impedance diagram.
- **Objectives:**
  1. To introduce students' concept of faults and its impacts on power system.
  2. To evaluate required rating of circuit breaker at different locations in power system.
  3. To analyze transients on a transmission line.
  4. To synthesize behavior of synchronous machine during short circuits with and without load.
- **Course Outcomes: On completion of the course, learner will be able to-**
  1. Differentiate system behavior under steady state and transient condition.
  2. Obtain the required circuit breaker rating by calculating the fault level at different locations in power system.
  3. Analyze transients on a transmission line.
  4. Develop a solution against short circuit on a synchronous machine connected with and without load.
- **Unit Content:**

  Introduction of symmetrical faults, percentage reactance, short circuit KVA, Reactor control of short circuit currents, selection of circuit breaker rating, transients on a transmission line, Short-Circuit currents and the reactance of synchronous machines with and without load.
- **Content Delivery Methods:**

Chalk and talk, power point presentation.

- **Assessment Methods:**

Numerical problems and derivation related to above Content.

Unit 3- Symmetrical Components **No. of lectures – 08**

- **Prerequisite:** Equivalent circuit of power system, single line diagram, per unit impedance diagram.
- **Objectives:**
  1. To enable students need of symmetrical components with its significance.
  2. To evaluate symmetrical components of unbalanced vector quantities.
  3. To impart knowledge of sequence impedance and sequence networks of various components used in power system.
  4. To prepare sequence networks of a given sample power system network.
- **Course Outcomes: On completion of the course, learner will be able to-**
  1. Demonstrate need of symmetrical components with its significance.
  2. Calculate symmetrical components of unbalanced vector quantities.
  3. Draw sequence networks of various components used in power system.
  4. Draw and analyze sequence networks of a given sample power system network.
- **Unit Content:**

  Introduction, Resolution of unbalanced phasors into their symmetrical components, Power in terms of symmetrical components**,** Analysis of balanced and unbalanced loads against unbalanced 3 phase supply, Sequence impedances and networks of power system elements like alternator, transformer, and transmission line.
- **Content Delivery Methods:**

  Chalk and talk, power point presentations, animation on wave propagation.
- **Assessment Methods:**

Numerical problems and derivation related to symmetrical components, Sequence impedances and networks.

SECTION-II

Unit 4 - Unsymmetrical Faults **No. of lectures – 07**

- **Prerequisite:** per unit impedance diagram, symmetrical components, Sequence impedances and networks.
- **Objectives:**
  1. To get familiar with different unsymmetrical faults on power system.
  2. To make student understand behavior of power system under unsymmetrical faults
  3. To analyze short circuit calculations of different electrical quantities in power system
  4. To select rating of circuit breaker at different locations in power system.
- **Course Outcomes: On completion of the course, learner will be able to-**
  1. Derive fault current equations under various unsymmetrical faults.
  2. Calculate unsymmetrical fault currents and voltages.
  3. Select required rating of circuit breaker for protection against fault.
  4. Differentiate various unsymmetrical faults with their significance.
- **Unit Content:**

  L-G, L-L, L-L-G faults on an unbalanced alternator with and without fault impedance, Unsymmetrical faults on a power system with and without fault impedance, Open conductor faults in power system.
- **Content Delivery Methods:**

  Chalk and talk, power point presentation.
- **Assessment Methods:**

  Numerical and derivation related to above Content.

Unit 5– Load Flow Studies **No. of lectures – 08**

- **Prerequisite:**

  Concepts of AC Circuit, Numerical methods, concept of algorithm and flow chart
- **Objectives:**
  1. To develop and analyze power flow equation
  2. To enhance ability to analyze complete load flow problem of a given sample power network.
  3. To apply the concepts of numerical methods to power system.
  4. To evaluate power flows through transmission lines in the interconnected power system.
- **Course Outcomes: On completion of the course, learner will be able to-**.
  1. Apply power flow equation for the solution of load flow problem.
  2. Develop a solution for a complete load flow problem of a given sample power network.
  3. Apply a numerical method for the solution of power system network.
  4. Evaluate power flows through transmission lines in the interconnected power system.
- **Unit Content:**

  Introduction, complex power flow, Power flow equations, Classification of buses, Operating constraints, Data for load flow, Gauss-Seidel Method – Algorithm and flow chart for PQ and PV bus, Acceleration of convergence; Newton Raphson's Method –Algorithm and flow chart for NR Method in polar coordinates, Algorithm and flow chart for Fast Decoupled load flow method, Comparison of Load Flow Methods.
- **Content Delivery Methods:**

  Chalk and talk, power point presentation, videos
- **Assessment Methods:**

  Numerical problems up to 1st iteration and derivation related to above Content.

Unit 6 - Stability Studies **No. of lectures – 06**

- **Prerequisite:** concepts of stability, Mechanical dynamics.
- **Objectives:**
  1. To introduce stability issues in power system.
  2. To understand impact of stability on power system performance with its significance.
  3. To analyze stability parameters under various conditions.

- **Course Outcomes: On completion of the course, learner will be able to-**
  1. Write stability issues in power system.
  2. Derive and analyze swing equation, critical clearing angle and time
  3. Analyze the steady state and transient stability of a power system using analytical methods.
- **Unit Content:**
  Introduction**,** rotor dynamics and the swing equation, Steady state and transient stability, Equal area criterion for transient stability evaluation and its applications, critical clearing angle and time
- **Content Delivery Methods:**

Chalk and talk, power point presentations, animation on different types of antennas

- **Assessment Methods:**

Derivation related to swing equation, Steady state and transient stability, Equal area criterion for transient stability, critical clearing angle and time and Numerical related to swing equation.

Textbooks:

1. Elements of Power System Analysis, W. D. Stevenson, TMH,4th Edition
2. Modern Power System Analysis, I. J. Nagrath and D. P. Kothari- TMH, 3rd Edition,2003.
3. Symmetrical Components and Short Circuit Studies, Dr. P. N. Reddy, Khanna Publishers
4. Computer Methods in Power System Analysis, Stag, G. W., and EI-Abiad, A. H.-McGraw Hill International Student Edition. 1968.

Reference Books:

1. Power System Analysis, Hadi Sadat, TMH, 2nd Edition.
2. Power system Analysis, R. Bergen, and Vijay Vittal, Pearson publications, 2nd edition, 2006.
3. Computer Aided Power system analysis, G.L., Kusic, PHI. Indian Edition, 2010.
4. Power System Analysis, W. D. Stevenson & Grainger, TMH, First Edition, 2003.
5. Advanced Power System Analysis and Dynamics, Singh, L. P, New Age International (P) Ltd, New Delhi, 2001.
6. Computer Aided Power System Operations and Analysis"- Dhar, R. N, TMH, 1984.

Internal Continuous Assessment (ICA):

ICA shall consist of at least 8 simulations/programs of the following:

1. Y Bus formation for power systems with mutual coupling by singular transformation
2. Y Bus formation for power systems without mutual coupling by singular transformation
3. Y Bus formation for power systems with mutual coupling by inspection Method.
4. Y Bus formation for power systems without mutual coupling by inspection Method.
5. Determination of bus currents, bus power and line flow for a specified system voltage (Bus) Profile
6. Formation of Z-bus (without mutual coupling) using Z-bus building Algorithm.
7. To obtain swing curve and to determine critical clearing time and regulation for a single machine connected to infinite bus
8. Write a program to perform load flow using Gauss- Seidel method
9. Write a program to perform load flow using NR method
10. Write a program to perform load flow using decoupled method
11. To determine fault currents and voltages in a single transmission line system with star delta transformers at a specified location for LG fault.
12. To determine fault currents and voltages in a single transmission line system with star delta transformers at a specified location for LL fault.
13. To determine fault currents and voltages in a single transmission line system with star delta transformers at a specified location for LLG fault.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T. Y. B. Tech. (Electrical) Semester-I
Linear Control System

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week, 3 Credits	**ESE –** 70 Marks
Practical: - 2 Hrs/Week, 1 Credit	**ICA -** 25Marks
	ISE - 30Marks
	OE - 25Marks

This course covers the fundamentals of Control Systems, types and block diagram representations, Signal flow graph. It includes the modelling of electrical and mechanical systems and their transfer functions. It also introduces analysis of linear time-invariant systems in time domain and frequency domain. It includes concepts of stability in time domain and frequency domain.

- **Course Prerequisite:**

Student should have mathematical background of differential equations, able to apply Kirchhoff's laws. Also, students should have the knowledge of Laplace transform.

- **Course Objectives**
  1. To understand the facing challenges posed by growing trends in control systems
  2. To represent the system by block diagram and signal flow graph.
  3. To enhance the describing ability of the students to represent the control system mathematically.
  4. To enhance the describing ability of the students to analyze the system in time and frequency domain.
  5. To enable student to use transforms techniques for the analysis of LTI systems.
- **Course Outcomes: On completion of the course, student will be able to-**
  1. Explain basic terminologies and applications of control systems.
  2. Derive mathematical model and determine the transfer function of a given control system through various techniques.
  3. Compute the time response and stability the given system.
  4. Analyze the given control system in time and frequency domain.

SECTION I

Unit 1: Introduction to Control System **No. of Lectures -06**

- **Prerequisite:** Laplace transform, Network Systems.
- **Objectives:**
  1. To introduce student different types of control systems.
  2. To develop the transfer function of the electrical systems as well as positive and negative feedback.
- **Course Outcomes: On completion of the course, student will be able to-**
  1. Identify the type / classification of control system.
  2. Compute the transfer function.
  3. Differentiate basic components of control system
- **Unit Content**

Definition, basic components & classification of general control system, Open loop & Closed Loop control systems, advantages & disadvantages, examples, Positive & negative feedback, Transfer Function of open loop and closed loop control system.

- **Content Delivery Methods:**

Chalk and talk

- **Assessment Methods:**

Numerical and derivations related to Transfer functions

Unit 2: Mathematical Models of Physical Systems **No. of Lectures -07**

- **Prerequisite:** Differential equations, Laplace transforms
- **Objectives:**
  1. To represent the system by differential equation
  2. To get familiar with analogous systems.
  3. To evaluate the Transfer functions of AC/DC Servo motors.
- **Course Outcomes: On completion of the course, student will be able to-**
  1. Represent the system by differential equation.
  2. Compare analogous systems.
  3. Obtain the Transfer functions of AC/DC Servo motors**.**
- **Unit Content**

Introduction, Differential equations of physical systems &Laplace transform for these differential equations, Transfer Function of electrical and mechanical (Translational and Rotational) systems, electrical analogy of mechanical systems (F-V & F-I), Transfer Function of AC &DC Servomotor.

- **Content Delivery Methods:**

Chalk and talk, power point presentation

- **Assessment Methods:**

Numerical related to Transfer functions of electrical and mechanical systems.

Unit 3: Reduction of Multiple Systems **No. of Lectures -08**

- **Prerequisite:** Differential equations formation, Laplace transforms
- **Objectives:**
  1. To represent the system by block diagram and SFG.
  2. To evaluate Transfer function of various systems by block diagram reduction techniques
  3. To convert the block diagram to SFG and vice versa.
  4. To analyze the sensitivity of the system.
  5. To synthesize the effect of feedback on system parameters
- **Course Outcomes: On completion of the course, student will be able to-**
  1. Represent the system by block diagram and SFG.
  2. Evaluate Transfer function of various systems by block diagram reduction techniques.
  3. Convert the block diagram to SFG and vice versa and find the transfer function.
  4. Obtain the sensitivity of the system.
- **Unit Content**

Reduction of multiple systems & feedback characteristic, Block diagram representation, Signal flow Graph (SFG), Mason's Gain formula and its application for SFG, Conversion of Block diagram to SFG. Definition of sensitivity, effect of feedback on - system parameter variation, system dynamics & disturbance signal.

- **Content Delivery Methods:**

Chalk and talk, power point presentation

- **Assessment Methods:**

Numerical related to Transfer functions of systems by block diagram and Mason's Gain Formula

SECTION-II

Unit 4: Time-Response Analysis **No. of Lectures -07**

- **Prerequisite:** Transfer function, poles and zeros, Transients in electric circuits.
- **Objectives:**
  1. To educate students about Standard test signals and their representation.
  2. To analyze response of first order and second order systems
  3. To evaluate Steady state errors & error constants Kp, Kv and Ka,
  4. To get familiar with P, PI, PD and PID Controller
- **Course Outcomes: On completion of the course, student will be able to-**
  1. Recognize Standard test signals.
  2. Find the response of first order and second order systems

3. Calculate transient &Steady state errors
4. Apply concepts of P, PI, PD and PID Controller

• Unit Content:

Standard test signals, poles, zeros & system response, response of first order and second order systems to standard input, Transient response specifications, Steady state errors & definitions of error constants Kp, Kv and Ka, P, PI, PD and PID Controller.

• Content Delivery Methods:

Chalk and talk, Power point presentation

- **Assessment Methods:**

Derivations &Numerical on above unit contents

Unit 5: Stability & Root Locus Techniques **No. of Lectures -07**

- **Prerequisite:** Transfer function, S-plane representation of poles and zeros
- **Objectives:**
  1. To Understand the concept of stability
  2. To get familiar with different analytical techniques for stability analysis
  3. To make the students able to understand the procedure for root locus
  4. To analyze stability using root locus
- **Course Outcomes: On completion of the course, student will be able to-**
  1. Develop the stability related to pole location
  2. Apply different analytical techniques for stability analysis.
  3. Sketch & apply root locus
  4. Apply the concept of root locus for stability analysis

• Unit Content

Concept of stability & necessary condition, Routh-Hurwitz criterion with special cases, location of roots in s-plane, concept of root locus diagram, properties, and rules for construction of root locus, Determination of stability from root locus.

• Content Delivery Methods:

Chalk and talk, power point presentation

- **Assessment Methods:**

Theoretical and Numerical on above contents

Unit 6: Frequency Response Analysis **No. of Lectures -07**

- **Prerequisite:** Transfer function, S-plane representation of poles and zeros
- **Objectives:**
  1. To Correlation between Time domain and Frequency domain
  2. To Understand the concept of Bode Plot
  3. To Understand the concept of Polar Plot
  4. To draw and analyze Bode Plot/ Polar Plot.
  5. To analyze stability using Bode Plot.
- **Course Outcomes: On completion of the course, student will be able to-**
  1. Correlate between Time domain and Frequency domain
  2. Apply the concept of Polar Plot
  3. Sketch Bode Plot/ Polar Plot
  4. Obtain the control system for stability

• Unit Content:

Introduction to frequency response of system, Frequency domain specifications, Correlation between Time domain and Frequency domain, polar plot & bode plot for frequency function. Minimum phase function, gain margin & phase margin, determination of stability using Bode Plot.

• Content Delivery Methods:

Chalk and talk, power point presentation

Assessment Methods:

Theoretical and Numerical on above contents

Text Books:

1. Control System Engineering, I. J. Nagrath, M. Gopal,. New Age International Publishers, 5th Edition.
2. Control System Engineering by R. Anandanatrajan, P Ramesh Babu, Scitech publications, 2nd Edition.
3. Automatic Control Engineering, Benjamin C. Kuo, Prentice Hall of India Pvt. Ltd.
4. Modern Control Engineering, K. Ogata, Prentice Hall of India Pvt. Ltd.
5. Control system principles and design, M. Gopal, TMH publication, 3rd edition, 2008.

Reference Books:

1. Feedback Control Systems, C. L. Phillips, R. D. Harbor, PHI publication, 1988
2. Modern Control Systems, Richard C. Dorf, Robert H. Bishop, Pearson Education Eleventh edition.
3. Control systems, Smarajit Ghosh, Pearson Education 2nd Edition

Internal Continuous Assessment (ICA):

ICA consists of minimum 8 experiments of following:

1) To verify potentiometer as transducer and error detector.
2) To verify Synchro as transducer.
3) To verify Synchro as error detector.
4) AC position control system.
5) DC position control system.
6) Time response of first order system.
7) Step response of second order system using R, L and C.
8) To study the effect of P, PI & PID Controller on a 2ndorder system.
9) Transient response specifications of second order system using software program.
10) Root locus plot using software program.
11) Bode plot using software program.

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-I
Advanced Microcontroller System

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week, 3 Credits	**ESE –** 70 Marks
Practical: - 2 Hrs/Week, 1 Credit	**ICA -** 25Marks
	ISE - 30Marks
	POE - 50Marks

Prerequisite:

Students shall have the knowledge of Basic Number System, Binary Arithmetic & Logical Operations and logic gates. He/She should also have the knowledge of electrical machines.

Objectives:

The objectives of this course are

1. To provide understanding of Microcomputer systems.
2. To impart knowledge on the architecture of 8051.
3. To impart knowledge on instruction set and programming of 8051.
4. To impart knowledge on the interfacing of different peripherals with 8051
5. To impart knowledge on the advanced microcontrollers.
6. To use of microcontroller 8051 for various applications.

Course outcomes:

On successful completion of the course the student will be able to

1. Understand the basics of Microcomputer systems.
2. Understand the architecture and addressing modes of 8051.
3. Develop program in assembly language and C language for 8051.
4. Interface a microcontroller 8051 to various devices.
5. Understand the architecture of advanced microcontrollers.
6. Develop various applications of 8051in Electrical Engineering.

SECTION I

Topic 1: Introduction to Microcomputer systems **No of Lectures -07**

Unit Content:

Introduction to digital computer, block diagram of a digital computer, definitions of terms: Hardware, software, firmware, memory, CPU, address bus, data bus, control bus, ports. Memory classification: RAM, ROM, PROM, EPROM, EEPROM, and FLASH. Microprocessor, features of a microprocessor. Microcontroller, features of Microcontroller, Schematic block diagram of a microcontroller. Comparison between a microcontroller and microprocessor. Von-Neumann and Harward architecture. RISC and CISC machines.

Topics 2: 8051 Microcontroller Architecture **No of Lectures -07**

Unit Content:

Features, architecture of 8051 Microcontroller, Pin diagram, pin function, alternate function of pins, reset circuit. De-multiplexing of Address-Data Bus, Memory Organization internal and external program and data memory, Register banks, Special function registers (SFR), Stack and stack pointer, I/O ports structure, serial port registers, SCON, SBUF, and SMOD. Timers/counters, TMOD and TCON SFR map. Interrupts, IE and IP SFR map.

Unit 3: Instructions set and programming of 8051. **No of Lectures -07**

Unit Content:

Addressing modes, Instruction set, introduction to IDE, Development Tools: Simulators, debuggers, cross compilers, in-circuit Emulators for the microcontrollers. C data types. Programming in assembly and C language.

SECTION II

UNIT 4: 8051 Interfacing **No of Lectures -07**

Unit Content:

Memory addresses decoding, interfacing external program (ROM) and data (RAM) memory with 8051. Relay and opto-isolator interface, seven segment LED interface, 16x2 LCD interface, Matrix keyboard interface, ADC 0809, DAC 0808 interface.

UNIT –5 Introductions to advanced microcontroller **No of Lectures -07**

Unit Content:

PIC 16F877A- Features, block diagram, Pin Diagrams, pin description, memory organization, special function registers Status Register,

ARM Processor- fundamentals, features, ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table, ARM instruction set.

UNIT –6 APPLICATIONS OF MICROCONTROLLERS. **No of Lectures -07**

Unit Content:

Temperature measurement using LM35 temperature sensor, DC motor speed control, Stepper motor control, Servo motor control.

- **Content Delivery Methods:**

Chalk and talk, power point presentation

- **Assessment Methods:**

Programs and Interfacing diagram related to above Content.

Guidelines for Instructor's Manual

- Any simulation software like Keil, MPLAB, Multisim, Simulink etc.
- Instruction set of 8051.
- An IDE for simulating the functionalities of 8051microcontroller and its use for software and hardware development.
- Develop and debug program in assembly language or C language for specific applications

Guidelines for Student's Lab Journal

- Title of the program.
- The program has to be written in the following format. Address- Instruction- Comment
- Input data has to be specified.
- Result of the program.

Flow Chart for each program has to be drawn on separate page

Internal Continuous Assessment (ICA):

ICA shall consist of at least 8 simulations/programs of the following:

List of Experiments:

1. Write an ALP to perform arithmetic operations Using 8051.
2. Write an ALP to perform Logical Operations Using 8051.
3. Write an ALP to perform blocks Transfer/block exchange operation Using 8051.
4. Write an ALP to generate square wave on the port and port pin using timer.
5. Write a simple C programs for continuously toggle all bits of a port and particular port pin with some delay.
6. Write a simple C program for bit wise shift operation. Left/right port data continuously.
7. Write a simple C programs for Read input port and send hex data to output port.
8. Interfacing seven segments LED display to 8051 Microcontroller.
9. Interfacing 16x2 LCD display to 8051 Microcontroller.
10. Interfacing Matrix/Keyboard to 8051 Microcontroller.
11. Interfacing DC motor with 8051 Microcontroller.
12. Interfacing Stepper motor with 8051 Microcontroller.
13. Interfacing LM35 with 8051 Microcontroller and display temperature on it.

TEXT BOOKS:

1. Ramesh S. Gaonkar, "Microprocessor – Architecture, Programming and Applications with the 8085", Penram International Publisher , Fifth Edition,2006.
2. Muhammad Ali Mazidi, "The 8051 Microcontroller and embedded systems", Pearson Education.
3. Advanced Microprocessors and Peripherals – A. K. Ray and K. M. Bhurchandani, TMH, 2nd Edition 2006.
4. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012
5. Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC by Ramesh Gaonkar, Thomson and Delmar learning, First Edition.

REFERENCE BOOKS:

1. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed, 2004.
2. Microprocessors and Interfacing, D. V. Hall, TMGH, 2nd Edition 2006.
3. The 8051 Microcontrollers, Architecture and Programming and Applications -K. Uma Rao, Andhe Pallavi, Pearson, 2009.
4. Device datasheet- ATMEL, DALLAS.
5. 8051 Manual (Intel).
6. PIC16F877A Datasheet (Microchip).

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-I
Electromagnetic Engineering

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week, 3 Credits	**ESE –** 70 Marks
Tutorial: - 1 Hr/Week , 1 Credit	**ICA -** 25 Marks
	ISE - 30 Marks

This course introduces electromagnetic field theory which deals with electric and magnetic field vectors.

Course Prerequisite:

Student shall have knowledge of circuit theory and shall also have basic knowledge of vectors and Del operator.

Course Objectives:

1. To make student understand use of different coordinate systems, significance of divergence, gradient, and curl.
2. To introduce to student basic laws of electrostatics and magneto statics.
3. To introduce students to boundary conditions for electric and magnetic fields.
4. To make student derive Maxwell's equations under different conditions.

Course Outcomes:

1. Student can solve numerical problems on different coordinate systems, divergence, curl and gradient.
2. Student can derive basic laws of electrostatics and magneto statics and can apply them for different fields.
3. Students can analyse boundary conditions for conductors and dielectric.
4. Student can derive Maxwell's equations under different conditions

Section I

Unit 1–Vector Analysis & Coulomb's law **No of lectures – 08**

- **Prerequisite:** Scalar and vector quantities**,** trigonometry, differentiation, integration, basics of electricity.
- **Objectives:**
  1. To revise concepts of vector algebra.
  2. To introduce to student different coordinate systems.
  3. To make student understand vector transformation techniques.
  4. To make student understand applications of Del operator.
  5. To make student understand concepts of static electric field and charge distribution.
  6. To make student analyze electric field intensity and density due to various charge distributions.
- **Outcomes: After completing this unit, student -**
  1. Can apply Del operator to solve numerical.
  2. Can calculate length, surface and volume in different coordinate systems.
  3. Can convert vectors in different coordinate system.
  4. Can evaluate force using Coulomb's law
  5. Can calculate electric filed intensity and density over different charge distributions.
- **Unit Content:**
  Scalars & vectors, vector algebra, vector components & vectors, vector field, Dot & cross products, Introduction to Co-ordinate System – Rectangular – Cylindrical and Spherical Co-ordinate System, Introduction to line, Surface and Volume Integrals, Definition of Curl,

Divergence and Gradient, Coulomb's Law in Vector Form, Definition of Electric Field Intensity, Electric field due to continuous charge distribution, Electric Field due to line charge & sheet charge

- **Content Delivery Methods:**

Chalk and talk, power point presentations, animation on coordinate system, 3D models

- **Assessment Methods:**

Numerical problems and derivation related to above Content.

Unit 2–Static Electric Fields **No of lectures – 08**

- **Prerequisite:** Vector calculus, basics of electricity, Coulomb's Law.
- **Objectives:**
  1. To make student derive Gauss's law and understand its applications.
  2. To make student apply Del operator to calculate divergence.
  3. To make student derive & apply Divergence Theorem.
  4. To make student evaluate potential due to various charges in electric field.
- **Outcomes: After completing this unit, student –**
  1. Can derive point form of Gauss's law
  2. Can derive & apply Divergence Theorem.
  3. Can evaluate energy and potential associated with charge distributions.
- **Unit Content:**

Gauss Law – Applications, point form; Divergence theorem, Electric Scalar Potential, Relationship between potential and electric field, Electric Flux Density , Energy & potential energy expended in moving a point charge in an electric field, Line integral, potential difference & potential, potential gradient, potential field of a point charge & system of a charges, dipole, energy density in electrostatic field

Content Delivery Methods:

Chalk and talk, power point presentations

- **Assessment Methods:**

Numerical problems and derivation related to above Content.

Unit 3–Conductors & Dielectrics **No of lectures – 05**

- **Prerequisite:** Concept of Electric fields, Nature of materials.
- **Objectives:**
  1. To make students derive point form of ohm's law.
  2. To make students derive continuity equation for current
  3. To introduce students to Capacitance.
  4. To make student evaluate Capacitance of various types of capacitors.
  5. To make student understand boundary conditions.
- **Outcomes: After completing this unit, student –**
  1. Can derive point form of ohm's law.
  2. Can derive apply Poisson's and Laplace's equation.
  3. Can solve numerical problems to Capacitance of parallel plate and spherical capacitors
  4. Can derive and evaluate boundary conditions for electric fields.
- **Unit Content:**

Electric current, Current density, point form of ohm's law, continuity equation for current, Poisson's and Laplace's equation, Uniqueness, Electric Polarization, Nature of dielectric materials- Definition of Capacitance, calculation of Capacitance of parallel plate and spherical capacitors, Electrostatic energy and energy density, Boundary conditions for electric fields

- **Content Delivery Methods:**

Chalk and talk, power point presentation, videos

- **Assessment Methods:**

Numerical problems and derivation related to above Content.

Section II

Unit 4–Static magnetic field **No of lectures – 09**

- **Prerequisite:**

Concepts of magnetic field, magnetic flux lines, applications of magnetic field

- **Objectives:**
  1. To make student derive Biot Savart law, Ampere's law
  2. To make student apply Curl, Stroke's Theorem for getting magnetic flux and magnetic flux density, scalar, and vector magnetic potentials.
  3. To make student evaluate force on current element using Lorentz force equation.
- **Outcomes:**
  After completing this unit, student –
  1. Can apply Biot Savart law to finite, infinite, and circular current elements.
  2. Can solve numerical problems to find magnetic field intensity and magnetic flux density with various types of current distributions.
  3. Can apply Ampere's circuit law for symmetrical surface and asymmetrical surface.
  4. Can compute forces on current elements using Lorentz force equation.

- **Unit Content:**

The Biot-Savart Law in vector form, Magnetic Field intensity due to a finite and infinite wire carrying a current, Magnetic field intensity on the axis of a circular and rectangular loop carrying a current, Ampere's circuital law and applications, Magnetic flux density, Curl Stokes theorem, Lorentz force equation for a moving charge, Scalar and Vector Magnetic Potential

- **Content Delivery Methods:**

Chalk and talk, power point presentation, videos

- **Assessment Methods:**

Numerical problems and derivation related to above Content.

Unit 5-Fields in Magnetic materials **No of lectures – 08**

- **Prerequisite:** Field theory and circuit theory.
- **Objectives:**
  1. To introduce to student concept of energy stored in magnetic field and inductors.
  2. To understand different magnetic materials and their properties.
  3. To make student understand magnetic boundary conditions.
- **Outcomes: After completing this unit, student** –
  1. Can understand inductance and compute energy density in magnetic fields.
  2. Can understand different magnetic materials with their properties.
  3. Can analyze magnetic boundary conditions.
- **Unit Content:**
  Definition of Inductance, Inductance of loops and solenoids, mutual inductance, Energy density in magnetic fields, Nature of magnetic materials, magnetization and permeability, magnetic boundary conditions, Energy in a inductor & energy density
- **Content Delivery Methods:**
  Chalk and talk, power point presentations
- **Assessment Methods:**

Numerical problems and derivation related to above Content.

Unit 6 -Maxwell's equations **No of lectures –04**

- **Prerequisite:**

Faraday's law, Gauss's law, Ampere's law in point form and integral form.

- **Objectives:**
  1. To introduce to student concept of displacement current and conduction current density
  2. To make student derive mathematical proof of Maxwell's equation.
  3. To introduce to student Maxwell's equations for different field conditions.
- **Outcomes:**

  After completing this unit, student –

  1. Can analyze difference between displacement current and conduction current density
  2. Can derive Maxwell's equation in differential and integral forms.
  3. Can evaluate Maxwell's equations under static and harmonically varying field conditions.
- **Unit Content:**

  Continuity equation for static conditions, displacement current and current density, Maxwell's equations in integral form and point form, Maxwell's equations for static, time varying field and harmonically varying field.
- **Content Delivery Methods:**

Chalk and talk, power point presentation

- **Assessment Methods:**

Derivations related to above Content.

Internal Continuous Assessment (ICA)

ICA shall consist of minimum six tutorials based upon above curriculum. Tutorial shall include numerical problems and derivations.

Text Books:

1. Electromagnetic Engineering, William Hyte, 7th Edition, Tata Mc Graw Hill
2. Electromagnetic field theory & Transmission Lines, GSN Raju, Pearson Education
3. Schaum's series in electromagnetic, Edminister McGraw Hill publications, 3rd edition.

Reference Books:

1. Problems and solutions in electromagnetic, William Hyte, Tata Mc Graw Hill
2. Elements of Engineering Electromagnetics, M. N. O. Sadiku, Oxford University Press, 3rd edition.
3. Electromagnetic Corson and lerrain CBS publications, 2nd edition.

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-I
Open Elective-I
INFORMATION TECHNOLOGY AND MANAGEMENT

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week, 3 Credits	**ESE –** 70 Marks
Practical: - 1 Hrs/Week, 1 Credit	**ICA -** 25Marks
	ISE - 30Marks

This course provides the basic tactical and strategic principles of information technology uses for management information systems and its various applications to the organizations. It also addresses changing face of business with proliferation of electronic commerce and ethical & social issues arising with it. It also introduces about the software projects, software development models and overview of project management.

Course Prerequisite:

Student shall have basic knowledge of computer hardware, software, programming, and communication.

Course Objectives:

1. To introduce concepts of information systems and its impact on business and organization
2. To show how e-commerce helps organization to increase productivity and competitive advantage.
3. To give overview of ethical and social issues concerning information systems
4. To make student aware of software project and its attributes
5. To introduce to student software development life cycle and software models

Course Outcomes: After completion of this course

1. Student can present case studies about changing face of business and importance of management information system for today's business
2. Along with the examples student can explain different e-commerce mechanisms
3. Student can describe necessity and benefits of data management for business and organizations
4. Student can present examples of primary and higher organizational applications of information system
5. Student can illustrate software development life cycle and can describe popular software models
6. Student can describe various social and ethical issues related to IT.

Section-I

Unit 1-Information Systems **No of lectures – 04**

- **Prerequisite:** Basic knowledge of computer hardware, software, programming, and internet.
- **Objectives:**
  1. To introduce concepts of information system and describe various types of information system.
  2. To make student relate and contrast transaction processing and functional information system.
  3. To make student analyse support that IT provides to people in different roles in an organization.
  4. To make student understand how IT provides support to business processes
  5. To give student overview of IT infrastructure, architecture, and emerging computer environments.
  6. To make student realize dimensions of information systems and contemporary approach to information system.
- **Outcomes:** After completing this unit, student -
  1. Can define information system and describe various types of information system.
  2. can relate and contrast transaction processing and functional information system.
  3. Can analyse the support that IT provides to people in different roles in an organization.
  4. can highlight IT infrastructure, architecture, and emerging computer environments through case study.
  5. Able to portray dimensions of information systems and contemporary approach to information system.

- **Unit Content:**

Business in digital economy & information age, information concepts – data, information & knowledge, information systems: concepts and definitions, classification, and types of information systems, how IT support people, information technology, architecture, and emerging computing environments.

- **Content Delivery Methods:**

Chalk and talk, power point presentations, case studies

- **Assessment Methods:**

Questions based upon information system concepts, classification and types of information systems, information system infrastructure, architecture and emerging computing environments, dimensions of information systems, contemporary approach to information system.

Unit 2– E-business and E-commerce **No of lectures – 05**

- **Prerequisite:** Information system concepts, information system infrastructure, architecture, and emerging computing environments
- **Objectives:**
    1. To introduce to student importance and significance of e-business and e-commerce**.**
    2. To make student distinguish business to consumer applications and business to business applications.
    3. To make student understand e-commerce supports services.
    4. To create awareness about ethical and legal issues in e-business.
    5. To make student to gain knowledge about mobile e-commerce.
- **Outcomes:** After completing this unit, student –
    1. Can compare e-business and e-commerce.
    2. Can describe major e-commerce mechanisms.
    3. Able to identify e-commerce support services.
    4. Can explain e-payment systems with Indian context
    5. Can describe mobile e-commerce.
- **Unit Content:**

Overview of e-business and e-commerce, major e-commerce mechanisms, business to consumer applications, business to business applications, major models of e-business, e-commerce supports services, infrastructure support required, e-payment systems, ethical and legal issues in e-business, mobile e-commerce

- **Content Delivery Methods:**

Chalk and talk, power point presentation, case studies

- **Assessment Methods:**

Descriptive questions based upon e-business and e-commerce, major e-commerce mechanisms, business to consumer applications, business to business applications, major models of e-business, e-commerce supports services, ethical and legal issues in e-business, mobile ecommerce

Unit 3–Data Management **No of lectures – 05**

- **Prerequisite:** Operating system, information system, e-commerce.
- **Objectives:**
    1. To introduce to student importance of data management.
    2. To introduce to student database management system.
    3. To make student aware about data management issues
    4. To acquaint student with benefits of data warehouse, data marts and data centers.
- **Outcomes:** After completing this unit, student –
    1. can compare traditional file system with database management system
    2. can describe functions of data base and data base management system.
    3. Can describe the tactical and strategic benefits of data warehouse, data marts and data centers.

- **Unit Content:**

Data hierarchy, problems with traditional file environment, database approach, database management system, creating database, relational DBMS, logical vs physical view, DBMS components, data warehouse, data mart, data mining

- **Content Delivery Methods:**

Chalk and talk, power point presentation, case studies

- **Assessment Methods:**

Descriptive questions based upon managing data, database approach, database and management system, data warehouse, data marts and data centres, enterprise content management, data visualization technology, managerial issues.

Section II

Unit 4– Modern Organizational Applications **No of lectures – 05**

- **Prerequisite:** Information system, information system infrastructure.
- **Objectives:**
    1. To make student aware about organization, features of organization & organizational structure.
    2. To make student understand how information system impact organizations and business firms
    3. To introduce to student primary organizational applications like OLAP, TPS
    4. To introduce to student higher organizational applications like ECM, ERP, supply chain management, decision support system
    5. To make student realize importance of data visualization and its applications
- **Outcomes:** After completing this unit, student –
    1. Can describe features of modern organizational structure
    2. Can explain with case studies how organization and information system are influencing each other in contemporary business practices
    3. Can explain with case studies primary applications of information system in a typical modern business
    4. Can explain with case studies higher applications of information system in a typical modern business
    5. Can list various commercial tools/ software available for data visualization
- **Unit Content:**

What is an organization, features of organizations, organizational structure, doing business in digital economy, organizations, and information systems, how information systems impact organizational practices, OLAP, TPS, enterprise content management, introduction to ERP and supply chain management, introduction to decision support systems, data visualization?

- **Content Delivery Methods:**

Chalk and talk, power point presentation

- **Assessment Methods:**

Questions based upon block diagram and descriptive questions to ensure understanding organization, features of organizations, organizational structure, responses and IT support, impact on organizations and business firms, primary and higher organizational applications of information system

Unit 5–Project & software development life cycle **No of lectures – 05**

- **Prerequisite:** Information system, data management, organizational structure, basics of programming
- **Objectives:**
    1. To introduce to student about project and its attributes.
    2. To make student realize difference between software project and other projects
    3. To make student understand project planning framework.
    4. To introduce to student need and concept of SDLC
    5. To provide to student a short induction to popular SDLC models used by industry
    6. To make student apprehend role and responsibilities of the software project manager
- **Outcomes:** After completing this unit, student –
    1. Can differentiate software projects and other engineering projects

2. Can explain major phases in SDLC
3. Can explain popular SDLC models used by industry
4. Can list project management knowledge areas
5. Can describe IT project methodology

- **Unit Content:**

What is a project? project attributes, project planning framework, software project comparison with other projects, context of project management, role of project manager, project life cycle, software development life cycle, software development process models, project management process and knowledge areas, IT project methodology

- **Content Delivery Methods:**

Chalk and talk, power point presentation, case studies.

- **Assessment Methods:**

Questions based upon block diagram and descriptive questions to ensure understanding project, project attributes, project planning framework, context of project management, the role of project manager, project life cycle, software development life cycle, software development process models, IT project methodology

Unit 6–Ethical and social issues **No of lectures – 04**

- **Prerequisite:** Information system, data management, E-business.
- **Objectives:**
  1. To make student aware about ethical and social issues evolved because of IT and IS
  2. To make student recognize the respect for intelligent property rights
  3. To make student aware about workplace behaviour and health while working in IT industry
  4. To fetch the attention of the student to need and practice of green IT
- **Outcomes:** After completing this unit, student –
  1. Can describe ethical and social issues arose because of IT and IS
  2. Can describe trade secrets, copyrights, patents with examples
  3. Can explain issues related to workplace behavior and health and how to overcome them
  4. Can explain green IT practices
- **Unit Content:**

Ethical and social issues related to systems, moral dimensions of information age, ethical principles, intellectual property rights- trade secrets, copyrights, patents, privacy, workplace behavior and health, de-skilling and alienation, telecommuting, e waste, green IT

- **Content Delivery Methods:**

Chalk and talk, power point presentation, case studies.

- **Assessment Methods:**

Descriptive questions on privacy, workplace monitoring, power over users, candidate ethical principles, workplace behaviour and health, de-skilling and alienation, telecommuting, e-waste, and green IT

- **Internal Continuous Assessment (ICA)**

ICA consists of minimum one assignment based on each unit - may be comprising of case studies, group discussion and information survey.

- **Text Books:**

1. Information Technology for Management – Transforming Organizations into Digital Economy, Efraim Turban, Linda Volonino, Wiley Student Edition, Wiley India Pvt. Ltd.
2. Management Information System, Kel Laudon, Jane Laudan, Rajanish Dass, 11th Edition, Pearson.
3. Software Project Management, Bob Houghes, Mike Cotterall, Tata McGraw-Hill, 4th Edition

- **Reference Books:**

1. Introduction to Information Technology, Turban, Rainer, Potter, Wiley Student Edition, 2nd Edition
2. Information Systems, Ralph Stair, George Reynolds, Cengage Learning, 10th Edition
3. Management Information System (MIS), Rahul De, Wiley India Pvt. Ltd.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-I
Open Elective-I
Advanced Electric Machines

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week, 3 Credits	**ESE –** 70 Marks
Tutorial: - 1 Hrs/Week, 1 Credit	**ICA -** 25Marks
	ISE - 30Marks

This course introduces different Advanced Electrical Machines in electrical engineering with their construction, working principle, operation, analysis and control techniques and applications.

- **Course Prerequisite:**
  Student shall have knowledge of all conventional AC and DC machines.
- **Course Objectives:**

1. To get detailed knowledge of construction, operating principles of different Advanced Electrical Machines.
2. To find equivalent circuit parameters and performance parameters of all Advanced Electrical Machines.
3. To understand different control methods and applications of different Advanced Electrical Machines.

- **Course Outcomes:** Upon successful completion of this course student:

1. Can analyze, examine, and identify applications of Synchronous Reluctance Motors and different stepping motors.
2. Can analyze, examine, and identify applications of Switched Reluctance Motors.
3. Can analyze, examine, and identify applications of Permanent Magnet Brushless dc motors and Permanent magnet Synchronous Motors.

Section-I

Unit 1–Synchronous Reluctance Motors: **No of lectures – 04**

Introduction, Construction of Synchronous Reluctance Motor, Rotor design and construction, working of synchronous reluctance motor, primary design considerations, Torque – speed characteristics, Phasor diagram, Advantages and disadvantages, Applications.

Unit 2–Stepping Motor: **No of lectures – 06**

Introduction, Classification of stepper motors, Single stack variable reluctance stepper motor (Construction, Connection and Principle of Operation),Micro stepping control of stepping motor, Multistack variable reluctance stepper motor, Hybrid stepper motor, Single phase stepping motor (Construction, Connection and Principle of Operation) ,Static and Dynamic characteristics of stepper motor, Torque-speed characteristics, Drive system and control circuitry for stepper motor, Application of Stepper Motor.

Unit 3–Switched reluctance Motor: **No of lectures – 04**

Introduction, Construction and operation, Power semiconductor switching circuits, Voltage and torque equations, Control circuits, Torque-speed characteristics, Advantages and disadvantages, Applications.

Section-II

Unit 4–Permanent Magnet Brushless D.C. Motors **No of lectures – 07**

Introduction, Constructional feature, Principle of operation, Classification, Emf equation, Torque equation, Torque- speed characteristics, Power and control circuit, Advantages and disadvantages, Applications.

Unit 5–Permanent Magnet Synchronous Motors **No of lectures – 07**

Introduction, Construction and principle of operation, Emf equation, Torque equation, Phasor diagram, torque-speed characteristics, Self-control, Vector control, Microprocessor based control

- **Internal Continuous Assessment (ICA):**

ICA consists of minimum eight tutorials based upon above curriculum.

Text Books:

1. Electric Machines, Third Edition, I J Nagrath, D P Kothari Tata McGraw Hill Publication,
2. Electrical Machines, Third Edition, S K Bhattacharya, Tata McGraw Hill Publication,
3. Theory and Performance of Electrical Machines, J B Gupta, S K Kataria& Sons ,
4. A Textbook of Electrical Technology Volume II, B L Theraja, S Chand Publications
5. Brushless Permanent Magnet and Reluctance Motor Drives, T. J. E. Miller Clarendon Press, Oxford.
6. Stepping Motors and Their Microprocessor Controls, T. Kenjo, Clarendon Press London.

Reference Books:

1. Electrical Machinery, A E Fitzgerald, C Kingsley, S D Umans, 6th Edition 2002, Tata McGraw Hill,
2. Electrical Machinery, P S Bhimbhra, Khanna Publishers.
3. Electrical Machines, Ashfaq Hussain, Dhanpat Rai & Sons.
4. Theory and Performance of Electrical Machines, J B Gupta, S K Kataria, and sons
5. Principles of electronic machines & Power electronics, P C Sen, Wiley India,
6. Switched Reluctance Motor Drives–Modeling, Simulation, Analysis, Design and Application, R. Krishnan, CRC Press, New York.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-I
Open Elective-I
Business Ethics

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week, 3 Credits	**ESE –** 70 Marks
Tutorial: - 1 Hrs/Week, 1 Credit	**ICA-**25Marks
	ISE- 30Marks

This course introduces basics of business ethics and its related. The course also introduces theoretical aspects of ethical issues related to stakeholders

- **Course Prerequisite:**

Student shall have knowledge basic management principles.

- **Course Objectives:**
  1. To make students aware of basics of business ethics and related theories
  2. To understand different tools for decision making and management in business ethics
  3. To get acquainted with corporate and ethical issues related with it
  4. To understand different ethical issues related to various stakeholders
- **Course Outcomes:** At the end course student will be able to
  1. Elaborate concepts of ethics and related theories
  2. Describe and apply tools for decision making and management in business ethics
  3. Understand and form the ethical issues in corporation
  4. Understand and identify the ethical issues from various stakeholders' point of context

SECTION-I

Unit 1: Introduction **No of lectures – 04**

Business Ethics: An overview, importance of Business Ethics, Key context- Globalization, sustainability, Normative ethical theories and descriptive ethical theories and contemporary ethical theories

Unit 2: Decisions and management of business ethics **No of lectures – 05**

Models of ethical decision making, Individual and situational influences on decision making business ethics management, Setting standards of ethical behavior, Managing stakeholder relations, Assessing ethical performance, Organizing for Business Ethics management

Unit 3: Framing business Ethics **No of lectures – 05**

Framing Business Ethics- CSR, stakeholders and Citizenship, Corporation- key features, CSR, Stakeholder theory of firm, corporate accountability, corporate citizenship, understanding corporate governance and ethical issues

SECTION-II

Unit 4: Employees, consumers and business ethics **No of lectures – 05**

Models of organization, Employees as stakeholders, Ethical issues in the firm-employee relation, Ethical challenges of globalization, corporate citizen and employee relations towards sustainable employment. Consumers as stakeholders, Ethical issues, marketing and the consumer, Globalization and consumers, Consumers and corporate citizenship, Sustainable consumption

Unit 5: Civil Society and Environment **No of lectures – 05**

Civil society organizations as stakeholders, Ethical issues and CSOs, Globalization and CSOs, Corporate Citizenship and civil society, Civil society, business and sustainability, Business Ethics and Environmental values, The dimensions of pollution and resource depletion, Ethics of pollution control, Ethics of conserving depletable resources

Unit 6: IT and Government **No of lectures – 04**

Information technology and its moral significance to business, IT code of conduct, Data identity and security, Crime and punishment, Government as stakeholder, Ethical issues in the relation between business and government, Globalization and business- government relations, Corporate Citizenship and regulation, Governments, business and sustainability

- **Internal Continuous Assessment (ICA):**

ICA consists of minimum eight tutorials based upon above curriculum. Tutorial shall include case studies related to context like employee, civil citizens, environment, consumer etc. It will be motivated to have seminars and role plays for various case studies related to ethical issues. Visits to various organizations and reports based on that can be considered.

- **Text Books:**

1. Business Ethics by Andrew Crane, Dirk Matten, Oxford University press

- **Reference Books:**

1. Business Ethics: Ethical Decision Making and Cases, O. C. Ferrell, John Fraedrich, Linda Ferrell, Cengage Publication
2. Business Ethics Methods and Application, Christian U. Becker, Taylor and Francis
3. Business & Society: Ethics and Stakeholder Management, Archie B. Carroll, Ann K. Buchholtz , Cengage Publication 7th Edition

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-I
Open Elective-I
Managerial Economics

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week, 3 Credits	**ESE –** 70 Marks
Tutorial: - 1 Hrs/Week, 1 Credit	**ICA-**25Marks
	ISE- 30Marks

This course introduces basics of economics and concepts related to economics. The course also introduces theoretical and practical aspects of decision making for managers.

- **Course Prerequisite:**

Student shall have knowledge basic management principles.

- **Course Objectives:**
  1. To make students aware to concepts of managerial economics
  2. To introduce students to concepts of demand, supply and market
  3. To introduce different tools for demand analysis and forecasting
  4. To make students aware about production and cost functions
  5. To make students aware about correlation of pricing with market, demand and supply
- **Course Outcomes:** At the end course student will be able to
  1. Elaborate the concepts of managerial economics
  2. Analyse the issues related to demand, supply and market
  3. Use different tools for demand analysis and forecasting
  4. Analyse the production and cost functions
  5. Decide price based on market, demand and supply

SECTION-I

Unit 1: Introduction: **No of lectures – 05**

Introduction to Economics, Introduction to Managerial Economics, Economics contribution to managerial decision, Scope of Managerial Economics – Microeconomics and Macroeconomics, Basics of Mathematical Tools – Statistics and Operational Research

Unit 2: Demands, Supply and Market Equilibrium **No of lectures – 05**

Demand, Supply, Market Equilibrium, measuring value of market exchange, changes in market equilibrium, Price ceilings and Price floors, Meaning of demand, Demand utility, Approaches to consumer demand analysis, Analysis of consumer behavior – Cardinal behavior and ordinal approach

Unit 3: Demand and Market Analysis **No of lectures – 04**

Price Elasticity of Demand, Price Elasticity, Total Revenue and Marginal Revenue, Factors Affecting Price Elasticity, Cross Price Elasticity, Income Elasticity of Demand, Other Elasticities, Elasticities for Nonlinear Demand Functions, Elasticity of Supply

SECTION -II

Unit 4: Tools for Demand Forecasting **No of lectures – 06**

Survey Methods – Consumer survey and Opinion Poll, Statistical Method – Trend Projection Barometric Method, Econometric Method, Simultaneous equation, Linear Regression Model, Multiple Regression, Non-linear Regression, Basic concepts used in Linear Programming, Application of Linear Programming Techniques

Unit 5: Production and Cost Analysis **No of lectures – 04**

Introduction to Production, Production Function, Theory of cost concepts, Cost of Production, Breakeven analysis- Linear, Non-linear, Profit Margin of Safety

Unit 6: Market Structure and Pricing Decision **No of lectures – 04**

Concept of Market, Demand side of market, Supply side of Market, Market Structure and Degree of Competition, Pricing Decision and Monopoly Power

- **Internal Continuous Assessment (ICA):**

ICA consists of minimum eight tutorials based upon above curriculum. Tutorial shall include case studies related to above curriculum.

- **Text Books:**

1. Managerial Economics by D. N. Dwivedi – 8th Edition- Vikas Publications
2. Managerial Economics Foundations of Business Analysis and Strategy- C. R. Thomas & Maurice – 8th Edition- McGraw Hill

- **Reference Books:**

1. Managerial Economics Concepts and Applications - C. R. Thomas & Maurice – 8th Edition- MCGraw

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-I
Electrical Workshop

Teaching Scheme	Examination Scheme
Practical: - 2 Hrs/Week, 1 Credit	**ICA-**25Marks

Course Objectives:

1. To develop practical workshop skills in the students.
2. To provide students a widespread knowledge and understanding of the workshop tools and other facilities.

Course Outcomes:

At the end of the course student –

1. can apply workshop equipment, wiring accessories and print circuit boards
2. can prepare the PCB in the practical field.
3. can install the earthing for different equipment
4. can find the faults in the circuits by troubleshooting

Electrical workshop

To perform and record any six of following experiments

1. Understanding of different types of switches such as SPST, SPDT, DPST, DPDT, TPST, TPDT
2. Understanding of different types of switchgears such as MCCB, MCB, ELCB, Isolators, HRC fuses
3. Understanding Different types of meters such as analog multimeter, clamp meter, trivector meter, power quality analyser, RLC meters etc.
4. Measurement of insulation resistance and earth resistance.
5. Understanding Different types of power supply, function generator, DSO, CRO.
6. Study and performing of motor winding.
7. Installation of plate, pipe, and grid earthing.
8. Types of wiring, Industrial, domestic wiring and panel wiring etc.
9. PCB design and fabrication
10. Soldering and desoldering of components on PCB.
11. Troubleshooting in electronic circuits.

Carry out at least one activity of the following to give the students an insight to their practical approach in diverse electrical field.

1. Site visit to nearby apartments/industries to understand the electrical wiring.
2. Workshop on PCB design using any suitable and available software like ORCAD, eagle, Proteus etc.
3. Workshop on Solar panel installation.
4. Workshop on motor rewinding.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-II
Electrical Machines Design

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week,3 Credits	**ESE –** 70 Marks
Practical: - 2 Hrs/Week, 1 Credit	**ICA-**25Marks
	ISE- 30Marks
	OE - 25 Marks

Course Prerequisite:

Knowledge on types, construction and working of transformers, DC Machines, three phase induction motor and Synchronous machines.

Course Objectives:

1. To clear the basic concept of design of transformer.
2. To get detailed information for designing a DC Machine.
3. To get detailed information for designing a Three phase Induction machine.
4. To get detailed information for designing a Synchronous machine.

Course Outcomes:

Upon successful completion of this course:

1. Student will get a basic knowledge to design a transformer.
2. Student will get a basic knowledge to design a DC Machine.
3. Student will get a basic knowledge to design a three phase Induction motor.
4. Student will get a basic knowledge to design a Synchronous machine.

SECTION-I

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Unit 1: Introduction: **No of Lectures- 04**

- **Prerequisite:** Working principle of DC and AC Machines
- **Objectives:**

  1. To make students to Understand design principles of design and design factors.
  2. To make students to Understand modern trends in design of electrical machines.

- **Outcomes: After completion of this unit the learner will be able to-**
  1. Understand principles of design and design factors.
  2. Modern trends in design of electrical machines.

- **Unit Content:**
  Principles of design, design factors, specifications, limitations, modern trends in design of electrical machines.
- **Delivery Methods:**
  Chalk and Talk
- **Assessment Methods:**
  Theoretical questions related to above contents

Unit 2: Design of transformers: **No of Lectures -10**

- **Prerequisite**: Transformer basics like Types, construction and working principle
- **Objectives:**
  1. To make students to Understand basic concepts of design of Transformer.
  2. To make students to understand how to design various parts of Transformer.

- **Outcomes: After completion of this unit the learner will be able to**
    1. Design core and yoke.
    2. Design winding and Tank.
- **Unit Content:**
  Types, classification & specifications, output equation, design of core, selection of design constants, design of yoke, design of window, and design of windings, tank design with and without cooling tubes
- **Delivery Methods:**
  Chalk and Talk, Video lectures
- **Assessment Methods:**
  Theoretical questions related to above contents, Numericals on output equation, design of core, design of yoke, design of window, and design of windings, tank design with and without cooling tubes

Unit 3: Design of DC Machines **No of Lectures -07**

- **Prerequisite:**
  Basic knowledge of Rotating machines and Constriction, working of DC Machines
- **Objectives:**
    1. To make students to Understand design of DC Machine.
    2. To make students to Understand how to design various parts of transformer.

Outcomes: After completion of this unit the learner will be able to

1. Design and Analyze parameters of rotating machines
2. Design of Poles, core length and design of field system

- **Unit Content:**
  Output equations of DC machine, factors affecting size of rotating machines, Choice of specific loadings, separation of main dimensions, Selection of no of poles, core length, air gap, design of armature of field system
- **Delivery Methods:**
  Chalk and Talk, Video lectures
- **Assessment Methods:**
  Theoretical questions related to above contents, Numerical on output equation, specific loadings, Selection of no of poles, core length, air gap, design of armature of field system

SECTION-II

Unit 4: Design of three phase induction motors: **No of Lectures 10**

- **Prerequisite:**
  Basic knowledge of Constriction, Types and working of Three Phase Induction Motors
- **Objectives :**
    1. To make students to Understand design of three phase induction motors
    2. To make students to Understand design of various parts of three phase induction motors
- **Outcomes: After completion of this unit the learner will be able to**
    1. Design of Stator.
    2. Design of rotor.
- **Unit Content:**
  Output equation, Choice of specific loadings, main dimensions, stator design, stator winding, stator core, stator slot design, selection of stator slots, air gap length, rotor design, selection of rotor slots, rotor bars/windings calculation, design of end ring, design of wound rotor, no of rotor turns, area of rotor conductors, rotor tooth density, design of rotor core.
- **Delivery Methods:**
  Chalk and Talk, Video lecture
- **Assessment Methods:**
  Theoretical questions related to above contents, Numerical on above contents

Unit 5: Design of synchronous machines: **No of Lectures 11**

- **Prerequisite:**
  Basic knowledge of Construction, Types and working of Synchronous machines
- **Objectives:**
  1. To make students to understand the basic concepts of design of Synchronous machines
  2. To make students to understand how to design various parts of Synchronous machines
- **Outcomes: After completion of this unit the learner will be able to**
  1. Design of Main dimensions.
  2. Design length of air gap.
- **Unit Content:**
  Output equation, specific loadings, design of salient pole machines-main dimensions, length of air gap, armature design, design of turbo alternator main dimensions, length of air gap,stator design, rotor design.
- **Delivery Methods:**
  Chalk and Talk, Video lecture
- **Assessment Methods:**
  Theoretical questions related to above contents, Numericals on above contents

- **Internal Continuous Assessment (ICA):**

Term work shall consist of at least 6 drawing sheets based on the above syllabus.

Text Books:

1. A.K Sawhney, "A course in Electrical machine design", Dhanpat Rai & Sons
2. R.K Agarwal, "Principles of Electrical machine design" , S K Kataria & Sons

Reference Books:

1. Mittle V.N and Mittle A, "Design of Electrical machines", Standard publications and Distributors
2. M.G.Say, "Performance & design of A.C machines", CBS Publishers & Distributors
3. A.E.Clayton, "Performance & design of D.C machines", CBS Publishers & Distributors

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-II
Electrical Utilization

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week, 3 Credits	**ESE –** 70 Marks
Tutorial: - 1 Hr/Week , 1 Credit	**ICA -** 25 Marks
	ISE - 30 Marks

Course Prerequisite:
Basics of Electrical Engineering, Effects of electric current, Control circuit design basics, awareness about artificial lighting, Characteristics and application of different electric motors, awareness about traction, awareness about energy conservation.

Course Objectives

1. To provide the students the fundamental concepts of traction system, train movement, tractive effort used in electric traction and controlling of traction motors.
2. To analyze the accessing techniques for braking system implementation in traction.
3. To comprehend the different issues related to heating, welding and illumination.
4. To make the students aware about the importance of maximizing the energy efficiency by optimum utilization of electrical energy.
5. To develop self and lifelong learning skills, introduce professionalism for successful career.

Course Outcomes

1. Students will be able to design a suitable scheme of speed control for the traction systems.
2. Students will be able to understand different controlling methods, transition methods in traction.
3. Students will be able to identify a heating/ welding scheme for a given application.
4. Students will be able to identify/ Trouble shoot various lamps and fittings in use.
5. Students will be able to understand the importance of maximizing the energy efficiency by its optimum utilization and mould their practical work in professional world accordingly

SECTION-I

Unit-1 Traction Systems **No of Lectures- 08**

- **Prerequisite:**
  Awareness about traction
- **Objectives:**
  1. To introduce to student basic terms used in traction system.
  2. To introduce different types of traction systems.
  3. To introduce student to types of speed time curve.
- **Outcomes: After completing this unit student-**
  1. Can define different terms in traction system.
  2. Can understand different types of traction systems.
  3. Can analyze selection of speed time curves for different services.
- **Unit Content:**
  Introduction, different system of traction, systems of electric traction, speed time curve for different services, calculation by trapezoidal and quadrilateral speed time curve, mechanics of train movement, tractive effort for propulsion of train, determination and factors effecting specific energy consumption using speed time curve, dead weight, accelerating weight and adhesive weight, introduction to metro system, monorail system.
- **Content Delivery Methods:**
  Chalk and talk, Power point presentation, Video lectures
- **Assessment Methods:**
  Derivation, Numerical, Theoretical questions on above unit content.

Unit-2 Control of Traction Motors and Train Lighting **No of Lectures- 08**

- **Objectives:**
  1. To introduce to student about different types of motors used for traction, different braking systems and lighting systems.
  2. To introduce student to speed control, control and auxiliary equipment.
- **Outcomes: After completing this unit student-**
  1. Can define different types of motors, braking systems and lighting systems.
  2. Can analyze selection of control and auxiliary equipment.
- **Unit Contents:**
  Desirable characteristic of traction motors, suitability of dc series motor, 3 phase induction motor for traction, control of traction motors -series-parallel control, shunt and bridge transition, electrical breaking, regenerative breaking in traction, control equipment and auxiliary equipment, drum controller, master controller, train lighting system.
- **Content Delivery Methods:**
  Chalk and talk, Power point presentation, Video lectures
- **Assessment Methods:**
  Derivation, Numerical, Theoretical questions on above unit content.

Unit-3 Selection of Motors for Industrial Applications **No of Lectures- 05**

- **Objectives:**
  1. To make students to understand concepts and operation of different types of motors.
  2. To make students to understand application of different motors.
- **Outcomes:**
  After completing this unit student-
  1. Can understand operation of different motors.
  2. Can analyze for application of motors.
- **Unit Contents:**
  Motor selection in textile industries, machine tools, rolling mills, sugar mills, cranes and Lifts
- **Content Delivery Methods:**
  Chalk and talk, Power point presentation, Video lectures
- **Assessment Methods:**
  Theoretical questions

SECTION-II

Unit-4 Electric Heating and Welding **No of Lectures- 08**

- **Objectives:**
  1. To ensure that the knowledge acquired can be applied in various fields of electric Heating.
  2. To ensure that the knowledge acquired can be applied in various fields of electric Welding.
- **Outcomes: After completing this unit student-**
  1. Students will get technical knowledge of modern heating techniques in practical world.
  2. Students will get technical knowledge of modern welding techniques in practical world.
- **Unit Contents:**
  Electric heating- types, advantages, disadvantages & applications, electric welding- types, advantages, disadvantages & applications
- **Content Delivery Methods:**
  Chalk and talk, Power point presentation, Video lectures
- **Assessment Methods:**
  Theoretical questions, Numerical on resistance heating

Unit-5 Illumination **No of Lectures- 08**

- **Objectives:**
  1. To develop ability amongst the students to analyze the performance of different sources of light.

2. To develop ability amongst the students to analyze the performance of different illumination schemes.

- **Outcomes: After completing this unit student-**
  1. will be able to design simple illumination schemes
  2. Can analyze selection of sources of light
- **Unit Contents:**
  Introduction, terms used in illumination, laws of illumination, factors to be considered for design of illumination scheme, source of light, discharge lamps, MV and SV lamps, comparison between tungsten filament lamps and fluorescent tubes, basic principles of light control, street lighting and flood lighting, CFL & LED Lamps.
- **Content Delivery Methods:**
  Chalk and talk, Power point presentation
- **Assessment Methods:**
  Numerical, Theoretical questions

Unit-6 Energy Conservation **No of Lectures- 05**

- **Objectives:**
  1. To make the students aware about the importance of Energy Conservation.
  2. To make the students aware about the importance of maximizing the energy efficiency by optimum utilization of electrical energy.
- **Outcomes: After completing this unit-**
  1. Students will be able to define the importance of Energy Conservation.
  2. Students will be able to define the importance of maximizing the energy efficiency by its optimum utilization
- **Unit Contents:**
  Introduction, Motivation for Energy Conservation, Principles of Energy Conservation, Energy Conservation Planning, Energy Conservation in Industries, Energy Conservation in Household and Commercial Sectors, Energy Conservation in Transport and Agriculture
- **Content Delivery Methods:**
  Chalk and talk, Power point presentation
- **Assessment Methods:**
  Theoretical questions

Text Books: -

1. J.B. Gupta, “A course in Electrical Power” by, S K Kataria And Sons
2. Dr. S.L. Uppal, “Electrical power”, Khanna Publishers

References Books: -

1. B.R. Gupta, “Generation of Electrical Energy”, S Chand
2. E. O. Taylor, “Utilizations of electrical energy”, Orient Longman Pvt Ltd.
3. H Partab, “Art & Science of Utilization of Electrical Energy” Dhanpat Rai & Co

Internal Continuous Assessment (ICA):-

There should be minimum 6 assignments on the above syllabus and one industrial visit. Visit to any one location from the following-

1. Railway station (Control room)
2. Loco shed
3. Traction substation
4. Forging Industry

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech. (Electrical) Semester-II
Power Electronics & Industrials Drives

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week, 3 Credits	**ESE –** 70 Marks
Practical: - 2 Hrs/Week, 1 Credit	**ICA-** 25 Marks
	ISE- 30 Marks
	POE - 50 Marks

Course prerequisite: Basics of low power Semiconductor devices, uncontrolled rectifiers, AC, DC waveforms and its equations, Electrical Machines.

Course Objectives To enable students to gain knowledge and understanding in the following aspects:

1. Fundamentals of power electronic devices and characteristics.
2. The concepts and operating principles of power electronics circuits.
3. Provide the basics of DC and AC variable speed drives.

Course Outcome: Upon successful completion of this course, a student should be able to:

1. Understand the fundamental principles and applications of power electronics circuits
2. Solve problems and design switching regulators according to specifications.
3. Use Computer-aided techniques for the design of power converter circuits.
4. Appreciate the latest developments in power electronics.
5. Assimilate new technological and development in related field
6. Analyze and solve numerical problems on electrical drives.
7. Apply the knowledge to practical industrial systems.

SECTION-I

Unit 1 Silicon Controlled Rectifier and Semiconductor Devices **No of Lectures - 07**

- **Prerequisite:**

Low power Semiconductor diode, transistor and MOSFET

- **Objective:**

1. To introduce to student Silicon controlled Rectifier (SCR).
2. To make student understand SCR & Power Semiconductor Devices characteristics.
3. To make student understand Turn ON & Turn OFF methods of SCR.

- **Outcome:**

After completion of topic students will be able to

1. Understand operation and Characteristics of various power electronic devices.
2. Draw Static & Dynamic Characteristics of SCR
3. Draw circuits & waveforms of commutation methods
4. Draw circuits of turn on methods

- **Unit Content:**

Introduction to PN junction, Principle of operation of Silicon Controlled Rectifier (SCR), Static & Dynamic characteristics, Turn on Methods, Firing circuits (using R, R-C only), Commutation Circuits (class C & D only), Protection circuits of SCR (over voltage, over current, dv/dt & di/dt). Principle of operation, V-I characteristics, rating and applications of Triac, Diac, Gate turn Off Thyristor (GTO),

- **Content Delivery Method:**

Chalk and Talk, Power Point Presentation, Animation Video

- **Assessment Methods:**

Theoretical questions on above contents.

Unit 2 Phase Controlled Rectifiers **No of Lectures - 07**

- **Prerequisite:**

Low Power diode based rectifiers.

- **Objective:**

1. To enable students to gain knowledge and understanding of the concepts and operating principles of phase-controlled rectifiers.
2. To enable students to analyze phase-controlled rectifiers
3. To enable students to gain knowledge and understanding of the concepts and operating principles of DC-to-DC converters.
4. To enable students to analyze DC to DC converters

- **Outcome:**

After completion of topic students will be able to

1. Understand the concepts & operating principles of phase-controlled rectifiers
2. Analyze phase-controlled rectifiers
3. Understand the concepts & operating principles of DC to DC converters
4. Analyze DC to DC converters

- **Unit Content**

Rectifiers: Introduction, Half wave controlled rectifiers with R, R-L load with and without freewheeling diode. Full Wave controlled rectifiers (Half controlled & Fully controlled) with R, R-L load with and without freewheeling diode, Three phase half controlled & Fully controlled rectifiers with R load only.

Chopper's: Principle of operation, Classification of choppers, Control Techniques, Step down and Step up choppers, DC-DC switched mode regulators– Buck, Boost, Buck-Boost and Cuk.

- **Content Delivery Method:**

Chalk and Talk, Power Point Presentation, Animation Video

- **Assessment Methods:**

Theoretical and numerical on the above contents.

Unit 3 Inverters & AC Voltage Controllers. **No of Lectures - 07**

- **Prerequisite:**

Operation of Switching devices, pure and quasi-AC waveforms.

- **Objective:**

1. To enable students to gain knowledge and understanding of the concepts and operating principles of Inverters
2. To enable students to analyze Inverter circuits
3. To enable students to analyze AC voltage controllers

- **Outcome:**

After completion of topic students will be able to

1. Understand the concepts & operating principles of inverters
2. Analyze inverter circuits
3. Understand the concepts & operating principles of AC to AC converters

- **Unit Content**

Inverters: Introduction and Classification of Inverters, Principle of operation, Single phase half and full bridge Inverters with R & R-L load, 3 phase bridge Inverters (120^0 and 180^0 conduction mode) with R load. Voltage control methods of 1- phase inverters.

AC Voltage Controllers - Introduction of AC Voltage Controllers, Principle of On-Off Control, Principle of Phase Control, Single Phase bidirectional control with R load only.

- **Content Delivery Method:**
  Chalk and Talk, Power Point Presentation, Animation Video
- **Assessment Methods:**
  Theorical and derivations questions on above contents.

SECTION: II

Unit-4 Introduction and Dynamics of Electrical Drives **No of Lectures - 07**

- **Prerequisite:**

Basic concepts from Electrical Machines, Speed control of Electric Machines.

- **Objectives:**

1. To make students to understand Electrical Drive concept.
2. To make students to understand selection of motor rating for drive.
3. To make students to understand selection of converter rating for drive.
4. To make students to understand dynamics of Electrical Drives.

- **Outcomes:**

After completing this unit, student –

1. Able to apply the concepts of Electrical Drive.
2. Able to select proper motor rating for drive.
3. Able to select converter rating for drive.
4. Understand the dynamics of Electrical Drives.

- **Unit Content:**

Block diagram, Types of the electrical drives, parts of electrical drives, criteria for Selections & choice of electrical drives. Dynamics of electrical drives: Fundamental torque equation, speed, torque, connection and Multi-quadrant operation of Drives, Close loop control of drives.

- **Content Delivery Method:**

Chalk and Talk, Power Point Presentation, Animation Video

- **Assessment Methods:**

Theoretical questions on above contents.

Unit-5 DC Drives **No of Lectures - 07**

- **Prerequisite:**

Basic relations & characteristics of DC motor, conventional speed control methods of DC motors, basic knowledge of rectifier and chopper operation etc.

- **Objectives:**

1. To make students to understand the speed control of DC motors using power electronic converters such rectifiers, Choppers etc.
2. To make students to perform the various speed control methods of DC motors using different converters.
3. To make student to understand the real time application of these methods.

- **Outcomes:**

After completing this unit, student –

1. Would understand the converter fed DC motor speed control techniques.
2. Would perform the practical using different speed control methods.
3. Would be able to get the real time application of converter fed DC motor.

- **Unit Content:**

Single phase, three phase half and fully controlled converter fed DC motor drives. Chopper controlled dc shunt motor drives in single quadrant and multi-quadrant operation chopper controlled drives, Braking and types of Electrical Braking. Brush less DC Motor drives operation & converter circuit, numerical on rectifier fed dc motors only.

- **Content Delivery Method:**

  Chalk and Talk, Power Point Presentation, Animation Video

- **Assessment Methods:**

Theorical and derivations questions on above contents.

Unit-6 AC Drives **No of Lectures – 07**

- **Prerequisite:**

Basic relations & characteristics of Induction motor, conventional speed control methods of induction motors, basic knowledge of inverter operation etc.

- **Objectives:**

1. To make students to understand the speed control of induction motor using power electronic converters such as inverters.
2. To make students to perform the various speed control methods of induction motors using different converters.
3. To make student to understand the real time application of these methods.

- **Outcomes:**

After completing this unit, student –

1. Would understand the inverter fed induction motor speed control techniques.
2. Would perform the practical using different speed control methods.
3. Would be able to get the real time application of inverter fed induction motor.

- **Unit Content:**

Basic relations, of 3 phase induction motor, Stator voltage control of 3 phase induction motor by AC regulators fed 3 phase induction motor speed control, variable frequency control by CSI & VSI, comparison between VSI and CSI. VSI fed synchronous motor drives, Variable frequency control of multiple Synchronous motor drives, Stepper motor drives operation & converter circuit, switched reluctance motor drives operation & converter circuit.

- **Content Delivery Method:**

Chalk and Talk, Power Point Presentation, Animation Video

- **Assessment Methods:**

Theoretical questions on above contents.

Text Books:

1. M H Rashid, “Power Electronics” Prentice-Hall of India
2. P S Bimbhra, “Power Electronics” Khanna Publishers
3. K Hari Babu, “Power Electronics” Scitech Publication
4. Alok Jain, “Power Electronics & its Applications” Penram International Publishing (India) Pvt. Ltd.
5. Vedam Subramanyam, “Power Electronics” New Age International.
6. Gopal. K. Dubey, “Fundamentals of Electrical Drives”, Narosa Publication

Reference Book:

1. Landers “Power Electronics”, McGraw Hill
2. M.D. Singh, K.B. Khanchandani, “Power Electronics” Tata McGraw Hill
3. P.C.Sen, “Modern Power Electronics” Wheeler Publication
4. M H Rashid, “Power Electronics Handbook” Academic Press Series in Engineering.
5. N. Mohan T.M. Udeland and W.P. Robbins John, “Power Electronics convertor application” Willey & Sons
6. Vedam SuryaVanshi, “Electrical Drives-concept and application” IEEE, 1997
7. B.K. Bose “Modern power electronics & AC drives” Prentice Hall PTR, 2002

Internal Continuous Assessment (ICA):

Minimum Six experiments on hardware and Three simulations should be performed:

List of experiment is as follows:

1. V-I Characteristic of SCR
2. Characteristic of any one high switching frequency devices
3. Commutation circuit of SCR
4. Experiment based on controlled rectifiers
5. Experiment based on inverters
6. Experiment based on DC to DC converter
7. Experiment based on AC voltage controller
8. Speed control of DC motor based on controlled rectifiers.
9. Speed control of AC motor using VSI.
10. Speed control of AC motor based on Regulators.

List of simulations is as follows:

1. Simulations based on AC to DC converter
2. Simulations based on DC to DC converter
3. Simulations based on DC to AC converter
4. Simulations based on AC to AC converter

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B. Tech. (Electrical) Semester-II
Advanced Control System

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week,3 Credits	**ESE –** 70 Marks
Practical: - 2 Hrs/Week, 1 Credit	**ICA -** 25Marks
	ISE - 30Marks

- **Course Prerequisite:**

Student shall have knowledge of Ordinary differential equation, mathematical modelling of different systems, transient and steady state response of systems, stability of systems in time domain and frequency domain. Student shall also have basic knowledge of linear algebra and Laplace and Z-Transform.

- **Course Objectives**
  1) To enhance the analytical ability of the students in facing the challenges posed by growing trends in designing the control systems in time and frequency domain.
  2) To enhance the ability of the students to analyze and design the control system in modern control approach.
  3) To enhance the ability of the students to understand nonlinear control systems.
  4) To enhance the ability of the students to analyze the Discrete Time Control Systems.
- **Course Outcome**
  1) Students will be able to design the controller in time and frequency domain.
  2) Students will be able to examine and design the control system in modern approach.
  3) Students will be able to analyze the nonlinear control systems.
  4) Students will be able to analyze the Discrete Time Control Systems.

SECTION I

Unit 1: Design of compensator using Root Locus **No of Lectures- 08**

- **Prerequisite:** Time domain specifications, stability, root locus plot
- **Objectives:**
  1) To revise root locus plot and stability analysis
  2) To make student understand different compensation techniques
  3) To make student design the compensators in time domain
  4) To make student realize the compensators
- **Outcomes: After completing this chapter, the student will be able to:**
  1) Use the root locus to design cascade compensators to improve the steady-state error
  2) Use the root locus to design cascade compensators to improve the transient response
  3) Use the root locus to design cascade compensators to improve both the steady-state error and the transient response
  4) Realize the designed compensators physically
- **Unit contents:**
  Introduction of design problem, Approach & preliminary considerations, Realization of basic compensators with passive and active networks, Design of lead, lag & lag-lead compensators
- **Content Delivery Methods:**
  Chalk and talk, Video lectures and power point presentations
- **Assessment Methods:**
  Design problems and theoretical aspects

Unit 2: Design of compensator using Frequency response **No of Lectures- 06**

- **Prerequisite:** Frequency domain specifications, correlation between time and frequency domain, stability, Bode plot
- **Objectives:**
  1) To revise Bode plot and stability analysis
  2) To make student design the compensators in frequency domain
  3) To make student realize the compensators
- **Outcomes:**
  After completing this chapter, the student will be able to:
  1) Use the Bode plot to design cascade compensators to improve the steady-state error
  2) Use the Bode plot to design cascade compensators to improve the transient response
  3) Use the Bode plot to design cascade compensators to improve both the steady-state error and the transient response
- **Unit Content:**
  Transient response through gain adjustment, lag compensation, lead compensation, lag-lead compensation using Bode Plot
- **Content Delivery Methods:**
  Chalk and talk, Video lectures and power point presentations
- **Assessment Methods:**
  Design problems and theoretical aspects

Unit 3: State-Space Analysis **No of Lectures- 07**

- **Prerequisite:** Introductory linear algebra, introductory differential equations and Laplace transform, introductory vector-matrix analysis
- **Objectives:**
  1) To introduce the basic methods of state variables and state equations
  2) To make student obtain the state space representation for electrical and mechanical systems
  3) Students can use state-space techniques to model linear systems
  4) Students understand the concepts of controllability and observability
- **Outcomes:**
  After completing this chapter, the student will be able to:
  1) Find a mathematical model, of state-space representation, for a linear, time invariant system.
  2) Model electrical and mechanical systems in state space.
  3) convert a transfer function to state space and vice versa.
  4) Controllability and observability
- **Unit Content:**
  Concept of state, state variable & state model, state-space representation of transfer function of electrical and mechanical systems, state transition matrix, its properties, Solution of homogeneous and non-homogeneous state equation, Controllability & Observability
- **Content Delivery Methods:**
  Chalk and talk, Video lectures and power point presentations
- **Assessment Methods:**
  Design problems and theoretical aspects

SECTION-II

UNIT 4: State Space Design **No of Lectures- 07**

- **Prerequisite:** Qualitative theory of ordinary differential equations, Linear algebra, State space representation and analysis
- **Objectives:**
  1) Understanding the basis results in state-space analysis of LTI systems
  2) Learn fundamental control design architectures
- **Outcomes: After completing this chapter, the student will be able to:**

1) Apply state space and state feedback in modern control systems, and pole placement.
2) Design pole placement controller and/or observer for the given system to achieve desired response
3) Design of state observers and output feedback controllers

- **Unit Content:**
  Introduction, Design of Pole placement, Necessary and sufficient condition for arbitrary pole placement, Determination of K using transformation Matrix, Direct Substitution and Ackermann's Formula, State Observer, Full state observers, Effects of addition of the observer on a closed loop system. TF of the observer-based controller Design of Control System with observers
- **Content Delivery Methods:**
  Chalk and talk, Video lectures and power point presentations
- **Assessment Methods:**
  Design problems and theoretical and numerical aspects

Unit 5: Non-linear Control Systems **No of Lectures- 07**

- **Prerequisite:** The students are expected to be familiar with ordinary differential equations, linear control systems and linear algebra
- **Objectives:**
  1) Learn properties of nonlinear behavior and nonlinear controlled systems
  2) Understand phase-plane analysis, equilibrium Points, describing function method
  3) Students will learn a variety of methods for analyzing the structure and behavior of nonlinear feedback systems.
- **Outcomes: After the successful completion of the course the students will be able to:**
  1) Construct the phase plane trajectory of a given nonlinear system
  2) Demonstrate non-linear system behavior by phase plane and describing function methods
  3) Identify the existence of limit cycle(s) for the given nonlinear system
  4) Perform the stability analysis nonlinear systems
- **Unit Content:**
  Introduction, common non-linearity in control system, Phase plane method. Singular points, Stability of Nonlinear Systems, construction of phase trajectories by analytical and graphical methods, Definition & derivation of Describing Functions for different nonlinearity.
- **Content Delivery Methods:**
  Chalk and talk, Video lectures and power point presentations
- **Assessment Methods:**
  Design problems and theoretical aspects

UNIT 6: Discrete-time Control System **No of Lectures- 07**

- **Prerequisite:** Difference Equations, Z Transforms, Laplace Transforms, Linear Control System Analysis
- **Objectives:**
  1) To equip the students with the basic knowledge of discretization.
  2) To explain basic and digital control system for the real time analysis of control systems
  3) To explain the process of sampling and the effect of sampling period in the performance of digital control system
  4) To calculate the performance of a given pulse transfer function in time domain
- **Outcomes: After completing this chapter, the student will be able to:**
  1) Derive discrete-time mathematical models in both time domain (difference equations, state equations) and z-domain (transfer function using z-transform)
  2) Predict and analyze transient and steady-state responses of discrete-time control systems
  3) Analyze stability of open-loop & closed-loop linear, time-invariant, discrete-time control systems
- **Unit Content:**
  Basic elements of discrete data control system and its advantages over the continuous time system, Pulse Transfer Function of cascade elements, closed loop systems and digital controller, Z-

transform analysis of Discrete-Time Control Systems, Mapping between s-plane & z-plane, stability analysis of closed loop systems in z-plane using Juri's Test, Bilinear Transformation and Root Locus

- **Content Delivery Methods:**
  Chalk and talk, Video lectures and power point presentations
- **Assessment Methods:**
  Design problems and theoretical aspects

Internal Continuous Assessment (ICA):

Minimum **eight** programs should be performed in the laboratory based on the entire syllabus.

Text Books:

1. I. J. Nagrath, M. Gopal "Control System Engineering", 5th Edition. New Age International Publishers.
2. Control System Engineering by R. Anandanatrajan, P Ramesh Babu, 2nd Edition, SciTech
3. Discrete-time Control Systems by K Ogata, Prentice Hall India, 2nd Ed
4. Digital Control Systems by B.C. Kuo, Saunders college Publishing, 2nd Ed

Reference Books:

1. Benjamin C. Kuo, "Automatic Control Engineering", Prentice Hall of India Pvt. Ltd.
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988
4. Control system principles and design, M. Gopal, TMH publication, 3rd edition, 2008
5. Feedback Control Systems, C. L. Phillips, R. D. Harbor PHI publication, 1988

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B. Tech. (Electrical) Semester-II
Open Elective-II
Operating Systems

Teaching Scheme	Examination Scheme
Theory: - 2 Hrs/Week, 2 Credits	**ESE –** 70 Marks
Tutorial: - 1 Hrs/Week, 1 Credit	**ICA -** 25Marks
	ISE - 30Marks

This course covers the classical internal algorithms and structures of operating systems, including CPU scheduling and memory management. It also includes the unifying concept of the operating system as a collection of cooperating sequential processes. It also covers topic such as file systems, memory management, virtual memory, and deadlocks.

- **Course Prerequisite:**

Student shall possess knowledge of data structure, microprocessors, and microcontrollers. Elementary knowledge of computer architecture, algorithms, and serial communication concepts is desirable. A strong programming skill is necessary.

- **Course Objectives:**

1. To introduce to student structure of operating system and its types.
2. To make student realize importance of processes and inter process communication.
3. To make student analyze and design algorithm for process scheduling, synchronization and removing deadlock.
4. To make student analyze memory management during process execution
5. To make student create directory structure and file system in an operating system

- **Course Outcomes:** After completion of this course,

1. Student can identify and describe structure, operations, and different types of operating system.
2. Student can describe the concept of process and inter process communication.
3. Student can analyze effect of different scheduling criteria on scheduling techniques.
4. Student can describe deadlock condition and implement methods to overcome deadlock.
5. Student can analyze memory management concepts like logical and physical addressing.
6. Student can make use of file systems, directories and different commands associated to it.

Section I

Unit 1–Introduction and overview of operating system No of lectures –05

- **Prerequisite:** Evolution of computer system and operating system. Concepts of basic computer system-hardware & software architecture, programming languages.
- **Objectives:**

1. To make student aware about operating system, its goals and various operations supported by it.
2. To make student acquaint with different types of operating systems and their significance.
3. To introduce to student structure of operating system.
4. To introduce to student operation of system call.

- **Outcomes:** After completing this unit, student -

1. Can explain goals and services provided by operating system.
2. Can draw and explain simple batch system and multi programming system.
3. Can explain significance of time-sharing system, real time operating system and distributed operating system.
4. Can draw and explain structure of general operating system.
5. Can explain the concept of system call.

- **Unit Content:**

Operating system, goals of an operating system, services of an operation system, classes of an operating system -simple batch system, multiprogramming system, time sharing system, real time system, distributed operating systems, structure of OS, system call and its uses.

- **Content Delivery Methods:**

Chalk and talk, power point presentations, video tutorials

- **Assessment Methods:**

Questions based upon goals and services of an operating system, descriptive questions to ensure understanding batch processing, real time system, and time sharing system distributed system, system call, block diagram of operating system structure.

Unit 2–Process management **No of lectures – 05**

- **Prerequisite:** Program execution environment in computer system, concepts of queue and buffer.
- **Objectives:**

1. To make student understand how to create a process.
2. To make student analyze operations on process.
3. To introduce to student concept of cooperation between processes.
4. To introduce student the notion of threads.
5. To make student understand inter process communication and its types.

- **Outcomes:** After completing this unit, student –

1. Can describe concepts of process.
2. Can draw and explain different states of process and process control block.
3. Can demonstrate operations on processes and implement the concepts like process creation using C programming.
4. Can describe the notion of threads
5. Can explain different types of inter process communication.

- **Unit Content:**

Process concept, process state diagram and process control block, operations on processes- creation & termination, cooperating processes, inter process communication, threads: multi- threading models and threading issues

- **Content Delivery Methods:**

Chalk and talk, power point presentation, C programs on threads

- **Assessment Methods:**

Questions based upon block diagram and descriptive questions to ensure understanding of the process state diagram and PCB, process creation and termination, threads and inter process communication.

Unit 3–Process scheduling & synchronization **No of lectures – 04**

- **Prerequisite:** Concept of system call and Process concepts.
- **Objectives:**

1. To introduce to student concept of process scheduling and different scheduling criteria
2. To make student implement FCFS, SJF, SRTF, priority and round-robin scheduling algorithms using C programming
3. To make student identify classical problems of synchronization
4. To make student analyze and resolve critical section problem.
5. To make student use synchronization tool: semaphore to avoid critical section problems

- **Outcomes:** After completing this unit, student –

1. Can design an algorithm for process scheduling and scheduling criterions.
2. Can describe analytical concepts related to FCFS, SJF, priority scheduling and round robin scheduling algorithms along with their implementation using C programming.
3. Can examine classical problem of synchronization and to analyze semaphore implementation.
4. Can explain critical section problem

- **Unit Content:**

Process scheduling concept, scheduling criteria, scheduling algorithms- non pre-emptive, pre-emptive, different scheduling algorithm- FCFS, SJF, SRTF, priority based, round robin, classical problems of synchronization- the critical section problem, semaphore as synchronization tool

- **Content Delivery Methods:**

Chalk and talk, power point presentation, animation, C programs

- **Assessment Methods:**

Numerical questions based upon process scheduling and descriptive questions to ensure understanding of the process scheduling and their algorithms, classical problems of synchronization and critical section problems.

Section II

Unit 4-Deadlock **No of lectures – 04**

- **Prerequisite:** Process & synchronization.
- **Objectives:**

1. To introduce to student concept of deadlock characterization.
2. To make student understand different methods for handling deadlocks
3. To make student investigate deadlock states.

- **Outcomes:** After completing this unit, student –

1. Can investigate deadlock and its characterizations
2. Can design & describe resource allocation graph to handle deadlock.
3. Can analyze and describe deadlock prevention methods to avoid deadlock.

- **Unit Content:**

Introduction to deadlock, deadlock characterization, methods for handling deadlocks, dead lock prevention, deadlock avoidance, deadlock detection , recovery from deadlock.

- **Content Delivery Methods:**

Chalk and talk, power point presentation, animation.

- **Assessment Methods:**

Questions based upon deadlock and deadlock characterization, descriptive question based on deadlock prevention and deadlock avoidance and detection methods.

Unit 5-Memory management **No of lectures – 03**

- **Prerequisite:** Memory storage schemes, primary memory, secondary memory, RAM partitioning
- **Objectives:**

1. To make student realize logical versus physical address space mapping.
2. To introduce to student concept of process swapping for effective utilization of memory.
3. To make student understand contiguous allocation of memory.
4. To make student explore paging & segmentation

- **Outcomes:** After completing this unit, student –

1. Can illustrate logical versus physical address mapping.
2. Can draw & describe need and procedure of process swapping.
3. Can portray types of memory allocation scheme along with memory fragmentation.
4. Can draw & describe paging and segmentation.

- **Unit Content:**

Background of memory, logical versus physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging

- **Content Delivery Methods:**

Chalk and talk, power point presentation, animation.

- **Assessment Methods:**

Descriptive questions based on logical versus physical address mapping, swapping, contiguous memory allocation, paging & segmentation.

Unit 6- Virtual memory **No of lectures – 03**

- **Prerequisite:** Memory management

- **Objectives:**

1. To introduce to student basics of virtual memory management and demand paging
2. To make student analyze page replacement policy and solve problems related to it.
3. To make student realize frame allocation & thrashing
4. To make student understand demand segmentation.

- **Outcomes:** After completing this unit, student –

1. Can describe concept of virtual memory.
2. Can draw & describe demand paging.
3. Can describe and analyze page replacement algorithm.
4. Can draw and explain frame allocation & thrashing.

- **Unit Content:**

Background, demand paging, need of page replacement, page replacement algorithms, allocation of frames, thrashing concept, demand segmentation

- **Content Delivery Methods:**

Chalk and talk, power point presentation, animation

- **Assessment Methods:**

Descriptive question based upon demand paging, page replacement techniques & algorithm, allocation of frames, thrashing, and demand segmentation, page replacement -analytical problems based on page replacement algorithm

Unit 7- File system **No of lectures – 04**

- **Prerequisite:** Disk input output system & direct memory access
- **Objectives:**

1. To introduce to student concept of file system and directory.
2. To make student comprehend file system mounting and protection.
3. To make student apply file allocation methods.
4. To introduce to student concept of file system in Linux.

- **Outcomes:** After completing this unit, student –

1. Can demonstrate file system.
2. Can demonstrate & describe file access methods, file system mounting and protection.
3. Can demonstrate & describe file allocation methods.

- **Unit Content:**

File system concept, file access methods, directory structure, file-system mounting, protection, directory implementation, allocation methods, free-space management

- **Content Delivery Methods:**

Chalk and talk, power point presentation, animation, Linux file system utilities

- **Assessment Methods:**

Questions based upon file access method, file directories, file allocation methods, procedure description of file system mounting and protection, directory implementation

- ## Internal Continuous Assessment (ICA):

It consists of **minimum eight experiments** based on operations on process, system calls, scheduling algorithm, threads, memory management using C programming language over Linux platform.

Text Books:

1. Operating System Concepts -Silberschatz Galvin- John Wiley Publications
2. Operating System Concept Based Approach- Dahanjay M. Dhamdhare, 3rdEdition- Tata McGraw Hill

Reference Books:

1. Operating Systems Internals and Design Principles- William Stallings-5thEdition, Prentice Hall India
2. Operating System with Case Studies in UNIX, Netware and Windows NT-Achyut S. Godbole, Tata McGraw Hill
3. Operating System in Depth- Thomas W. Doeppner- Wiley Student Edition, Wiley India Pvt. Ltd

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B. Tech. (Electrical) Semester-II
Open Elective-II
Renewable Energy Sources

Teaching Scheme	Examination Scheme
Theory: - 2 Hrs/Week, 2 Credits	**ESE** – 70 Marks
Tutorial: - 1 Hrs/Week, 1 Credit	**ICA**-25Marks
	ISE- 30Marks

- **Course Objectives**

1. To study role and potential or renewable energy sources in modern power system
2. To understand different instruments or devices used and applications of renewable energy sources.

- **Course Outcomes**

1. To become familiar with the renewable energy sources and their applications to power generation.

SECTION-I

Unit- 1 Solar Radiation and its Measurement **No of lectures – 04**

- **Prerequisite:** Knowledge of solar Energy.
- **Objectives:**
  1. To introduce student to Solar Energy.
  2. To make student understand the measurement of solar radiation.
- **Outcomes:** After completing this unit, students
  1. Can understand the role and potential of Renewable sources.
  2. Can analyze different instruments for measurement of solar radiation.
- **Unit Content:**

Role and potential of new and renewable source, the solar energy option, physics of the sun, the solar constant, terrestrial and extra-terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data.

- **Content Delivery Methods:**

Chalk and talk, power point presentations.

- **Assessment Methods:**

Theory questions related to above content.

Unit- 2 Solar Energy Collection **No of lectures – 05**

- **Prerequisite:** Knowledge of Solar Energy Collection.
- **Objectives:**
  1. To introduce student to Solar Energy Collection methods.
- **Outcomes: After completing this unit, students –**
  1. Can understand the different methods for collection of solar energy
  2. Can analyze flat plate and concentrating solar collectors.
- **Unit Content:**

  Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.
- **Content Delivery Methods:**

  Chalk and talk, power point presentations.
- **Assessment Methods**

  Theory questions related to above content.

Unit- 3 Solar Energy Storage and Applications **No of lectures – 02**

- **Prerequisite:** Knowledge of solar energy storage and its applications.
- **Objectives:**

To introduce student to Solar Energy Storage methods.

- **Outcomes: After completing this unit, students –**

1. Can understand the different methods for storage of solar energy.
2. Can study the different applications of solar energy.

- **Unit Content:**

Different methods, Sensible, latent heat and stratified storage, solar ponds, Solar Applications-solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

- **Content Delivery Methods:**

Chalk and talk, power point presentations.

- **Assessment Methods:**

Theory questions related to above content.

Unit- 4 Wind Energy **No of lectures – 03**

- **Prerequisite:** Knowledge of Wind Energy and its applications.
- **Objectives:**

To introduce student to Wind Energy.

- **Outcomes: After completing this unit, students –**

1. Can understand the operation of wind energy.
2. Can define site selection considerations of wind energy.
3. Can define merits, demerits and applications of WECS.

- **Unit Content:**

Sources and potentials, site selection considerations, Basic components of a WECS, classification of WEC systems, advantages and disadvantages of WECS, horizontal and vertical axis windmills, performance characteristics of Wind-machines, Bet'z criteria.

Content Delivery Methods:

Chalk and talk, power point presentations.

- **Assessment Methods:**

Theory questions related to above content.

SECTION-II

Unit -5 Bio-Mass **No of lectures – 04**

- **Prerequisites:** Terms related to Bio-conversion
- **Objective:**

1. To revise basic concepts of Bio-Conversion
2. To make students understand IC Engine operation

- **Outcomes:**

After completion of this unit students can understand Bio-gas Power plant Process.

- **Unit Content:**

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I. C. Engine operation and economic aspects

- **Content Delivery Methods:**

Chalk and talk, Videos

- **Assessment Methods:**

Concept understanding of Combustion process of Bio-gas

Unit-6 Geothermal Energy **No of lectures – 04**

- **Prerequisites:** Terms related to Geothermal
- **Objective:**

To revise basic concepts of Geothermal energy

- **Outcomes:**

After completion of this unit students can understand geothermal energy conversion

- **Unit Content:**

Resources, types of wells, methods of harnessing the energy, potential in India

- **Content Delivery Methods:**

Chalk and talk, Videos

- **Assessment Methods:**

Concept understanding of various geothermal energy plant in India

Unit-7 Ocean Energy **No of lectures – 04**

- **Prerequisites:** Terms related to thermodynamics
- **Objectives:**

1. To revise basic concepts of Ocean Energy
2. To make students understand energy conversion

- **Outcomes:**

After completion of this unit students can understand about OTECH

Unit Content:

OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles, Tidal and wave Energy: Potential and conversion techniques, mini-hydel power plants, and their economics

- **Content Delivery Methods:**

Chalk and talk, Videos

- **Assessment Methods:**

Concept understanding operation of Ocean thermal energy

Unit-8 Direct Energy Conversion **No of lectures – 02**

- **Prerequisites:** Terms related to DEC
- **Objectives:**

To revise basic concepts of Energy Conversion

- **Outcomes:**

After completion of this unit students can understand Carnot cycle

- **Unit Content:**

Need for DEC, Carnot cycle, limitations, principles of DEC

- **Content Delivery Methods:**

Chalk and talk, PPT

- **Assessment Methods:**

Concept understanding Direct Energy Conversion

Text books:

1. Non-Conventional Energy Sources, G D Rai, Khanna Publications
2. Renewable energy resources, Tiwari and Ghosal, Narosa.

References:

1. Renewable Energy Resources, Twidell & Wier, CRC Press (Taylor & Francis)
2. Renewable Energy Technologies, Ramesh & Kumar, Narosa
3. Renewable energy sources and emerging technologies, D. P. Kothari, K. C. Singhal, P.H.I.

ICA: Minimum six assignments on the above syllabus

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B. Tech. (Electrical) Semester-II
Open Elective-II
Fiber Optic Communications

Teaching Scheme	Examination Scheme
Theory: - 2 Hrs/Week, 2 Credits	**ESE –** 70 Marks
Tutorial: - 1 Hrs/Week, 1 Credit	**ICA-**25Marks
	ISE- 30Marks

This course introduces the basic concept of optical communication. It explains the basic working principle of optical fiber. It covers the study of basic optical devices as optical source, optical detector, and optical joints. It also introduces aspects of practical design of optical communication system.

- **Prerequisite:**

FOCT is a graduate level course, intended to expose the students to the physical layer elements and seamlessly provide a transition from the physical layer issues to data link layer issues in optical communication systems and networks.

- **Objectives:**

The objectives of this course are

1. To make students to understand basic working principle of optical fiber.
2. To introduce to student basic losses in optical fiber & reasons behind the losses.
3. To make students to understand the basics of optical sources (LASER & LED).
4. To make students to understand the basics of optical detectors.
5. To study the concepts of optical networks

- **Course outcomes:**

On successful completion of the course the student will be able to

1. Demonstrate working of optical fiber.
2. Explain transmission characteristics of optical fibers & concept of optical joints.
3. Illustrate different optical sources & optical detectors.
4. Solve the numerical to calculate the various parameters of optical sources & detectors.
5. Explain the different types of optical amplifier & optical networks.
6. Analyze the functional blocks in optical communication system.

SECTION -I

UNIT - 1 Overview of Optical Fiber Wave Guides **No of lectures – 04**

Overview of optical communication, other forms of communication system, introduction to vector nature of light, Propagation of light, Ray model & Wave model. Optical Fiber: Types, structure and wave guiding fundamentals, Optical fiber modes and analysis, Step and Graded index Fibers. Single mode fiber, Fiber material, fiber Fabrication.

Unit –II Transmission Characteristics of Optical Fibers and Optical Joints **No of lectures – 05**

Introduction, Attenuation, absorption- intrinsic & extrinsic, linear &nonlinear scattering losses, bending loss, dispersion- intermodal & intra modal, Fibers alignment and joint loss, fiber splices, connectors, fiber couplers& its types.

Unit III–Optical Source **No of lectures – 05**

Laser: Requirements of optical source, basic concept of LASER, optical emission from semiconductors, hetero junction structure, Semiconductor injection laser and structures, Injection laser characteristics. LED: LED structures, LED characteristics, Light Modulation.

SECTION -II

Unit IV-Optical Detectors **No of lectures – 04**

Introduction, requirements of optical detector, optical detection principles, performance parameters of detector- absorption, quantum efficiency, responsivity, cut off wavelength. Semiconductor photo diodes with and without internal gain, PN, PIN, Avalanche Photo diodes, Phototransistors.

Unit V-Optical Networks **No of lectures – 05**

Optical Networks: Introduction, networking terminology, optical network modes, SONET / SDH, SONET/SDH rings, Optical Ethernet, data buses, Fiber Distributed Data Interface (FDDI).

Unit VI-Fiber Optical Communication Systems **No of lectures – 05**

Introduction, Transmitter Design, Receiver Design, Noise equivalent model of receiver, Link Design, Wavelength Division Multiplexing (WDM), DWDM, Optical Time Division Multiplexing.

- **Internal Continuous Assessment (ICA):**

ICA consists of minimum 8Practicals based upon above curriculum.

Suggested List of Practical:

1. Setting up fiber optic analog & digital link.
2. Frequency modulation using fiber optic cable.
3. Pulse width Modulation using fiber optic cable.
4. Study of propagation loss in optical fiber.
5. Study of bending loss in optical fiber.
6. Measurement of optical power using optical power meter.
7. Measurement of Numerical Aperture.
8. Transmission of voice signal using FOC.
9. Study of WDM.
10. Study of LED output characteristics.

Text Books:

1. Optical Fiber Communications, John M. Senior, Pearson Education. 3rd Impression, 2007
2. Optical Fiber Communications, Gerd Keiser, 4th Ed., MGH, 2008
3. Optical Fiber Communications, D. C. Agarwal - S.Chand and company

Reference Books:

1. Optical Communications, David Gover – PHI
2. Fiber Optics communication, Hozold Kolimbiris - Pearson Education.
3. Fiber Optics Communication – 5th Edition, Palais-Pearson Education

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B. Tech. (Electrical) Semester-II
Open Elective-II
Sensors and Applications

Teaching Scheme	Examination Scheme
Theory: - 2 Hrs/Week, 2 Credits	**ESE –** 70 Marks
Tutorial: - 1 Hrs/Week, 1 Credit	**ICA-**25Marks
	ISE- 30Marks

This course provides good knowledge of working of different types of sensors used in various application areas. This course also provides knowledge of interfacing of electronic circuits with different sensors for its applications in different fields.

- **Course Prerequisite:**

Concept of internal characteristics of passive elements like resistor, capacitor, inductor etc., Diode and transistor working, knowledge of basic fundamentals of mechanical terms like position, strain, stress etc.

- **Course Objectives:**
  1. To introduce students with the basics of various sensors and its characteristics.
  2. To make students familiar with the working principle of different types of sensors and transducers.
  3. To introduce various signal conditioning and smoothing circuits for sensors
  4. To familiarize students with different sensor technologies and interfacing techniques.
  5. To introduce students with the concept of actuators.
- **Course Outcomes:** At the end of this course, Students will be able to
  1. Elaborate the concept of sensors and its characteristics.
  2. Describe the working principle of analog and digital sensors.
  3. Design sensor interface circuits for a given engineering problem.
  4. Select an appropriate sensor for a given engineering application based on interface technique, material and technology of a sensor.
  5. Describe the working principle of different types of actuators.

Section I

Unit 1: Sensors Fundamentals and Characteristics **No of lectures – 04**

Sensors, Signals and Systems, Sensor Classification, Units of Measurements, Sensor Characteristics

Unit 2: Physical Principles of Sensing **No of lectures – 05**

Electric Charges, Fields, and Potentials, Capacitance, Magnetism, Induction, Resistance, Piezoelectric Effect, Hall Effect, Temperature and Thermal Properties of Material, Heat Transfer, Light, Dynamic Models of Sensor Elements

Unit 3: Interface Electronic Circuits **No of lectures – 05**

Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors

Section II

Unit 4: Sensors in Different Application Area **No of lectures – 05**

Occupancy and Motion Detectors, Position, Displacement, and Level, Velocity and Acceleration, Force, Strain, and Tactile Sensors, Pressure Sensors, Humidity and Moisture Sensors, Light Detectors, Temperature Sensors

Unit 5: Sensor Materials and Technologies **No of lectures – 04**

Materials, Surface Processing, Nanotechnology

Unit 6: Actuators **No of lectures – 05**

Introduction, Classification, Principle of Operation (Electrical Actuators, Electromagnetic Actuators, Electromechanical Actuators, Hydraulic and Pneumatic Actuators, Micro- and Nano-actuators), Selection Criteria.

- **Internal Continuous Assessment (ICA):**

ICA consists of minimum Ten Practical and/or assignments based upon above curriculum.

Text Books:

1. Handbook of Modern Sensors: Physical, Designs, and Applications, J. Fraden, AIP Press, Springer
2. Sensors and Actuators: Engineering System Instrumentation, Clarence W de Silva, CRC Press, 2nd Edition
3. Electrical and Electronic Measurements and instrumentation R.K Rajput S. Chand

Reference Books:

1. Sensors and Transducers, D. Patranabis, Prentice Hall India Learning Private Limited, New Delhi
2. A Course in Electronics and Electrical Measurements and Instruments, J.B. Gupta, S K Kataria & Sons
3. A Course in Electrical and Electronic Measurements and Instrumentation A. K. Sawhney, Dhanpat Rai & Co.(P) Ltd.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B. Tech. (Electrical) Semester-II
Self-Learning Module-II
HYBRID ELECTRIC VEHICLE DESIGN

Teaching Scheme	Examination Scheme
Theory: - 2 Credits	**ESE** – 50 Marks

- **Course Objectives: The students will be able to**
  1) Explain the basics of hybrid electric vehicles, their architecture, technologies and fundamentals.
  2) Design and component sizing of the power electronics devices used in hybrid electric vehicles.
  3) Analyze various electric drives suitable for hybrid electric vehicles
  4) Discuss different energy storage technologies used for hybrid electric vehicles and their control.
  5) Demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

- **Course Outcomes: After completing the course, the students will be able to**
  1) Explain the basics of hybrid electric vehicles, their architecture, technologies, and fundamentals.
  2) Analyse different power electronics devices and electrical machines in hybrid electric vehicles.
  3) Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
  4) Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration, performance analysis and Energy Management strategies in HEVs

UNIT 1: Introduction to Hybrid Electric and Conventional Vehicles **No of Lectures-07**

Hybrid electric vehicles: History of Hybrid Electric Vehicles (HEVs), social and environmental importance of HEVs, Architectures of HEVs, Interdisciplinary Nature of HEVs, State of the Art of HEVs, Challenges and Key Technology of HEVs. Impact of modern electric drive on energy supplies.

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

UNIT 2: Electric Propulsion unit **No of Lectures-07**

Introduction to electric components used in HEVs, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT 3: Energy Storage System **No of Lectures-07**

Introduction to Energy Storage Requirements in HEVs, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT 4: Fundamentals of Regenerative Braking **No of Lectures-07**

Energy Consumption in Braking, Braking Power and Energy on Front and Rear Wheels, Brake System of HEVs, Antilock Brake System.

UNIT 5: Sizing the drive system **No of Lectures-07**

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

UNIT 6: Energy Management Strategies **No of Lectures-07**

Introduction to energy management strategies used in hybrid electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Reference Books:

1) Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press, 2003.

2) Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, CRC Press, 2004.

3) Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley, 2003.

4) Power Sources for Electric Vehicles, B D McNicol, D A J Rand, Elsevier publications, 1st Edition, 1998.

5) Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Chris Mi, M. Abul Masrur, 2nd Edition Wiley, 2017.

6) Build Your Own Electric Vehicle, Seth Leitman, MC Graw Hill, 1st Edition, 2013.

- **Internal Continuous Assessment (ICA):**

ICA shall consist of minimum two case studies and four assignments based on above syllabus.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B. Tech. (Electrical) Semester-II
Self-Learning Module-II
ELECTRICAL SAFETY

Teaching Scheme	Examination Scheme
Theory: - 2 Credits	**ESE –** 50 Marks

Prerequisite: Knowledge of electrical standard and measurement

Course Objectives –
Student should understand safety precautions during working on electrical installations**.**

Course Outcome-
Students will get acquitted with Electrical safety procedures

Unit I: - Significance of safety management in electrical plants.
Objective of safety management, procedure of "work permit" at site to do work on electrical plant, equipment, auxiliaries.

Unit II: - Safety clearances and creepages.
Adquet clearances to be provides between phases, phase to earth, work section and live parts, isolating distance, etc.

Unit III: -Electrical shocks
Primary shocks & secondary shocks their occurrence, effect of electrical shocks on human body, safety precautions against electric shocks, recommendations for preventing electric shocks.

Unit IV: - First aid for a person who gets electric shock
Removal of contact with live conductor, methods of artificial respirations, safety procedures during erection phase, during commissioning phase, and during operation and maintenance phase.

Unit V: -Electrical fires
Cause of different type of electric fires, how do deal with fire on electrical installations, actions to be taken in case of fire, prevention of electric fires, types of extinguishers used.

Text books:-

1. Testing commissioning operation & maintenance of electrical equipments by S. Rao. Khanna Publication.
2. Installation commissioning & maintenance of electrical equipments by Trilok Singh S. K. Kataria & Sons.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B. Tech. (Electrical) Semester-II
Self-Learning Module-II
Solar Photovoltaic System Design & Installation

Teaching Scheme	Examination Scheme
Theory: - 2 Credits	**ESE –** 50 Marks

Course prerequisite:
Basics of Electricity, Wires & Cables, Work, Power & Energy, Ohm's Law, Magnetism, Alternating Current, Power Generation, Distribution & Transmission.

- **Course Objectives**
  1) To make student to know solar photovoltaic.
  2) To make student to understand components of solar PV system, types of solar photovoltaic systems.
  3) To make student to understand components of installation tool kit and safety equipment
  4) To make student to understand installation of components.

- **Course Outcome: After successful completion of this course**
  1) Students will be able to know solar photovoltaic.
  2) Students will be able to understand components of solar PV system, types of solar photovoltaic systems.
  3) Students will be able to understand components of installation tool kit and safety equipment.
  4) Students will be able to understand installation of components.

Unit 1: Introduction to Renewable and Solar Energy
Renewable Energy and its prospects various RE sources, Introduction to Solar Energy and Solar Radiation, its importance, Differentiate solar PV and solar thermal energy, Solar Resource, Measurement, Instrumentation, and its applications.

Unit 2: Introduction of Photovoltaic Technology and its applications
Basics of Light to Energy Conversion, Brief History of Solar/PV cells, Physics of Energy Conversion in Solar Cell (Current and Voltage), Understanding basic terminologies of a PV cell (I-V Curve, efficiency, FF), Solar Cells to Module, Module name plate specifications, Module to Array and Basic Structure of PV module, Classification of PV Modules based upon technology, Brief on PV Cell/Module manufacturing process, Factors affecting output of a PV module (Temperature, Irradiance, Tilt angle, cell area, shadowing, dust, mismatch, PV module configurations, MPPT operation etc.), PV module defects and degradation in the field (Techniques for identification of defects), PV module Testing and Certification Standards, Applications of PV, different configurations of PV power system: Stand alone, Grid, hybrid system etc.

Unit 3: Components of a PV System: Battery, inverter and Charge controllers
Basics of standalone PV system, Balance of System (BOS)**,** Introduction: Batteries, type of batteries, operation and structure**,** Basic Terminologies of a Battery, Charging & Discharging Characteristics**,** Factors affecting Battery operation and Selection Criteria, Testing standards for batteries, Introduction: Inverter, type of Inverters, operation, make and specifications, Basic Terminologies of a Inverter and Characteristics, Factors affecting inverter operation and Selection Criteria, Testing standards for inverters, Basics of Charge controllers, operation and specifications, DC-DC converters, Types of charge controllers and selection criteria, Components of a grid connected SPV system (ACB, DB and cabling), Types of wires and selection criteria, wire sizing. Other components like: Junction Box, Lighting arresters, grounding etc.

Unit 4: Fundamentals of PV system sizing

Sizing, significance and steps involved in sizing, Load Estimation, analysis and basics on energy efficiency, Site survey and assessment, Shading analysis, Customer profiling and Role play, Inverter, Battery sizing and its aspects, Module sizing and its aspects. Lay out diagrams, Spacing of PV strings and placing of each component, Selection of modules, batteries and inverters from the market specifications, Various steps involved in sizing of grid connected PV systems, Introduction to single line diagram and its significance, Listing of various components required for a grid connected and standalone Solar power plant. (A check list of Each and every component), Understanding of various costs (Project heads) involved in the solar projects.

Unit 5 Installation of Solar Power plant

Preparation and general considerations for installation (DC and AC components), Installation of Array support structure and mounting of PV modules, Interconnection of modules, strings and Combiner boxes, Installation of other System components, i.e. Inverter, battery etc, Installation of AC and DC power distribution boxes, General safety consideration in the installation phase of solar power plant.

Text Books:

1. Solar Electricity Handbook - 2014 Edition: Michael Boxwell
2. Photovoltaics: System Design and Practice 1st Edition by Heinrich Häberlin
3. Solar PV Installer: Handbook

Reference Book:

1. Photovoltaics: Design and Installation Manual 1st Edition
2. The Ultimate Solar Power Design Guide by Lacho Pop,Dimi Avram

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B. Tech. (Electrical) Semester-II
Mini Hardware Project

Teaching Scheme	Examination Scheme
Practical: - 2Hrs/week 1 Credits	**ICA -** 25Marks
	OE – 25Marks

This course encourages student for project-based learning through development of hardware mini project in applied areas. The course aims to apply acquired skills of electronic circuit designing, digital design, instrumentation, microcontroller, electrical & electronic components specifications and their testing. The hardware project also provides experience of working in a team with set target. The project report writing allows student to gain knowledge of technical documentation of certain product. The entire experience in the project may be useful for entrepreneurship development.

Course prerequisite: Electrical & Electronic component identification and their testing, fundamentals of electronic circuit designing, concepts in digital designing, knowledge of various sensors, knowledge of control systems fundamentals, microcontrollers.

Course Objectives:

1. To encourage student to undertake and execute mini hardware project in a group which includes selection of appropriate hardware components, understanding their specifications and testing procedures.
2. To make student acquaintance with computer aided PCB designing tool
3. To develop electronic hardware assembly, soldering and testing skills amongst student
4. To nurture technical report witting skills amongst student
5. To understand the product development cycle through mini project.

Course Outcomes:

After successfully completing this course, the student shall be able to:

1. Understand, plan and execute a mini project with team.
2. Device electronic hardware by implementing knowledge of PCB design techniques, soldering techniques and hardware debugging techniques
3. Prepare technical report based on the mini project
4. Estimate cost of the mini project, deliver technical seminar over mini project.

Guidelines:

Project group shall consist of not more than 3 students. The mini project plan shall include phases group formation, mini project topic selection, circuit component selection, pre-testing of project over breadboard, PCB artwork designing using EDA tool, simulation, hardware assembly, testing, enclosure design, testing and analysis, presentation and report writing.

Domains for mini projects (but not limited to following):

Instrumentation and control systems
Automation and protective system
Application of electronics to power system
Electric drives
Electronics communication systems
Embedded systems
Renewable Energy systems
Disaster management systems

- ***Assessment Methods:***

Below scheme is recommended for ICA marks –

Selection of the project and pre circuit testing	20 %
Circuit design, simulation, PCB and assembly	30%
Results / Output from final assembly	10%
Mini project presentation seminar	20%
Project report	20%