### SEMESTER-I

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TOTAL 18 10 -- 150 350 100 100 50 750 18 05

### SEMESTER-II

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Total 18 10 -- 150 350 100 50 100 750 18 05

Th: Theory lectures hours/week
Pr: Practical hours/week
Tu: Tutorial hours/week
Th: Theory lectures hours/week
Pr: Practical hours/week
Tu: Tutorial hours/week

T.E. Electrical Engineering (2015 Course) – Savitribai Phule Pune University
Audit Course

- Audit Course: Optional for 1st and 2nd term of TE Electrical Engineering

- ‘Audit Courses’ means a Course in which the student shall be awarded Pass or Fail only. It is left to the discretion of the respective affiliated institute to offer such courses to the students. Evaluation of audit course will be done at institute level itself.

- Teaching-learning process for these subjects is decided by concern faculty/industry experts appointed by the affiliated Engineering College.

- Marks obtained by student for audit course will not be taken into consideration of SGPA or CGPA.

Audit Course III
(A) Wind Energy Systems
(B) Microcontroller MSP 430 and Applications

Audit Course IV
(A) Bioenergy Systems
(B) Applications of Power Electronics
311121: Industrial And Technology Management

Teaching Scheme | Credits | Examination Scheme [Marks]
--- | --- | ---
Theory: 03 Hrs./Week | 03 | In Sem.: 30 Marks
 |  | End Sem.: 70 Marks

Course Objective:
The course aims to
- Possess knowledge of types of business organizations; explore the fundamentals of economics and Management.
- Understand the basic concepts of Technology management and Quality management.
- Analyse and differentiate between marketing management and financial management.
- Recognize the importance of Motivation, Group dynamics, Team work, leadership skill and entrepreneurship.
- Explain the fundamentals of Human Resource management.
- Identify the importance of Intellectual property rights and understand the concept of patents, copy rights and trademarks.

Course Outcome:
Upon successful completion of this course, the students will be able to
- Differentiate between different types of business organization and discuss the fundamentals of economics and management.
- Explain the importance of technology management and quality management.
- Describe the characteristics of marketing and its types.
- Discuss the qualities of a good leader.

Unit 01: Introduction to managerial and economical demand (06Hrs)
Managerial Economics: Definition of economics, Demand and Supply concept, Law of demand and supply, Elasticity of demand and supply, Demand forecasting: Meaning and methods.

Unit 2: Technology and Industrial Management (06Hrs)
Introduction to industrial management: Concept, development, application and its scope.
Introduction of Technology Management: Definition of technology, Management and its relation with society, classification of technology, Management of technology at various levels- its importance on National Economy, Ethics in technology management, Critical Factors in technology management.
Unit 3: Quality Management  (06Hrs)

Unit 4: Marketing and Financial Management  (06Hrs)
Marketing Management: Market, meaning, characteristics and its types: Perfect Competition, Monopoly, Monopolistic completion and Oligopoly. Marketing and selling, marketing planning. Market survey and market research, online Marketing.
Financial Management: Definition of financial management, cost. Types of costs, and methods of costing, price, capital. Debit, credit, books of accounts and final accounts.

Unit 5: Human Resource Management  (06Hrs)

Unit 6: Entrepreneurship  (06Hrs)
Entrepreneurship- Definition, concept, traits, qualities of entrepreneur. Importance and limitations of rational decision making, Decision making under certainty, uncertainty and risk. Incentives for small business development, Government policies and incentives, Case study on Small scale industries in India. Introduction to Intellectual Property Rights (IPR), Meaning of IPR, Different forms of IPR, Patents, Criteria for securing Patents. Patent format and structure, Copy and trademark (Descriptive treatment only).

Text Books:
Reference Books:


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<th>Unit</th>
<th>Text Books</th>
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### 303141: Advance Microcontroller and its Applications

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<td>01 End Sem.: 70 Marks</td>
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### Prerequisite:
- Knowledge of Number system
- Knowledge of basic logic components.
- Programming skills in C Language,
- Microprocessor and Microcontroller Architecture.

### Objectives:
The objectives of this course are
- To provide understanding of architecture of PIC 18F458 microcontroller
- To develop ability to Write and Interpret Assembly and C language programs for PIC 18F458
- To interface various devices with PIC18F458

### Course outcomes:
On successful completion of the course the student will be able to
- Explain architecture of PIC18F458 microcontroller, its instructions and the addressing modes.
- Develop and debug program in assembly language or C language for specific applications
- Use of an IDE for simulating the functionalities of PIC microcontroller and its use for software and hardware development.
- Interface a microcontroller to various devices.
- Effectively utilize advance features of microcontroller peripherals.

### Unit 01: PIC Architecture (08 Hrs.)
Comparison of CISC and RISC, RAM and Program memory organization, Program counters, Stack pointer, Bank Select Register, Status register, Data transfer instructions, Arithmetic and logical instructions. Assembly language programs.

### Unit 02: Assembly language programming (08 Hrs.)
Addressing Modes for PIC 18 microcontroller, Branch instruction, CALL, RETURN, Bit addressable instruction. Assembly language programs I/O ports, SFR related to PORTs, I/O port programming.
Unit 03: Programming of PIC microcontroller in C (08 Hrs.)
Embedded C concepts, Header and source files and pre-processor directives, Data types, data structures, Control loops, functions, bit operations. I/O port programming in C, Delay programming. PIC 18 Timer 0 Programing in C

Unit 04: Special Hardware features and Programming (08 Hrs.)

Unit 05: Interrupt programming (08 Hrs.)
Interrupt Programming, Programming of Timer interrupts, Programming of External interrupts, Serial port programming. Interfacing of PIC18F458 8 bit model LCD(16x2)

Unit 06: Interfacing of PIC Microcontroller (08 Hrs.)

Guidelines for Instructor's Manual
- Commands to be followed in order to operate the PIC18 micro controller kit.
- Detailed connection diagram / Circuit Diagram of the KIT.
- Pin Diagram and PIN layout of PIC 18F458, all supporting ICs.
- Manuals for interfacing kits such as DC motor, DAC.
- User manuals of all the interfacing kits such as stepper motor, DC motor, DAC etc.

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.

Guidelines for Laboratory Conduction
- Each student within the group has to enter and execute the program turn wise.
  Staff member has to check the result of all the groups after the execution of the program.
- Each subgroup of students in the laboratory should consist of maximum three numbers.
List of Experiments:
Any six experiments from section (A) and any three experiments from section (B)

Section A.
1. i) Introduction to MPLAB. ii) Programs on Addition, Subtraction and Multiplication
2. Data transfer to ports
3. Timer, Counter, Delay programming
4. Interfacing 18F458 to Switch and LED
5. Interfacing of LCD [16 X 2] with PIC 18F458
6. Generation of square, positive ramp, negative ramp, triangular waveforms using DAC interface
7. Generating PWM waveform using PWM mode of 18F458 timer
8. Driving relay from 18F458 using software and hardware interrupts

Section B.
1. Interfacing DC motor with PIC 18F458
2. Interfacing Stepper motor with PIC 18F458
3. Interfacing LM35 with PIC 18F458 and display temperature on it.

Text Books:
[T3] Programming And Customizing the PIC Microcontroller by MykePredko, TATA McGraw-Hill.

Reference Books:
[R1] PIC18F458 datasheet
[R2] MPLAB IDE user guides

<table>
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<tr>
<th>Unit</th>
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303142: Electrical Machines II

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<td>Practical</td>
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Prerequisites:
- Working principle and concepts of electrical machines
- Construction of DC series motor
- Phasor diagram and equivalent circuit of single phase transformer
- Construction and working of three phase induction motor.

Course Objectives:
- Learn construction & working principle of three phase synchronous machines.
- Define regulation of alternator & calculate it by direct and indirect methods.
- Study the methods of starting 3-phase synchronous motor, & its operation under different conditions.
- Learn Speed control methods of three phase induction motor.
- Develop phasor diagram & circle diagram of a c series motor.
- Develop equivalent circuit of single phase induction motor.

Course Outcomes:
Students will be able to
- Explain construction & working principle of three phase synchronous machines
- Estimate regulation of alternator by direct and indirect methods.
- Demonstrate operation of synchronous motor at constant load and variable excitation (v curves & A curves) & constant excitation and variable load.
- Explain Speed control methods of three phase induction motor.
- Plot circle diagram of ac series motor
- Obtain equivalent circuit of single phase induction motor by performing no load & blocked rotor test.

Unit 01: Three phase Synchronous machines. (08Hrs.)
Three phase Synchronous machines: Construction, rotating-field type and rotating-armature type, salient-pole type and non-salient-pole type and their comparison. Excitation Methods.
Three phase Synchronous generator (salient pole type): Armature reaction as per Blondel’s two reaction theory for salient-pole machines, Direct-axis and quadrature-axis synchronous reactance’s and their determination by slip test. Phasor diagram of Salient-pole generator and calculation of voltage regulation.

Unit 02: Voltage regulation of Three phase Synchronous generator: (08 Hrs.)

Unit 03: Three phase synchronous motor: (08 Hrs.)

Unit 04: 3-ph induction motor, Induction generator and special purpose motors: (08 Hrs.)

Special Purpose Motors (Descriptive Treatment Only): Construction, principle of working, characteristics ratings and applications of Brushless D.C. motors, Stepper motors (permanent magnet and variable reluctance type only), Permanent Magnet motor (A.C. & D.C.) and linear induction motors.

Unit 05: A.C. series motor (08 Hrs.)
Operation of D.C. series motor on a.c. supply, nature of torque developed, problems associated with AC. operation and remedies.


Universal motors: ratings, performance and applications, comparison of their performance on A.C. and D.C. supply.
Unit 06: Single phase induction motor (08 Hrs.)


Guidelines for Instructor's Manual

Prepare 3/4 sets of standard experiments. It must contain title of the experiment. Also, Aim, Apparatus including name of machines with their specifications, rheostats, ammeter, voltmeter, wattmeter if used along with their ratings / ranges etc.

- **Theory:** Brief theory explaining the experiment
- **Circuit / connection diagram** or construction diagram must be drawn either manually using geometrical instruments or using software on A-4 size quality graph paper / plain white paper.
- **Procedure:** Write down step by step procedure to perform the experiment.
- **Observation table:**
- **Sample calculation:** For obs. number ---
- **Result table:**
- **Nature of graph:**
- **Conclusion:**
- **Questions / Answers:** Write minimum 4 /5, questions / answers based on each experiment.

Theory part must be typed on A-4 good quality paper on single side. Put these pages of experiments / circuit diagram in plastic folder and provide it to a group of 4/5 students.

Guidelines for Student's Lab Journal

1. Students should write the journal in his own hand writing.
2. Circuit / Connection diagram or construction diagram must be drawn either manually using or using software. [Do not use Xerox copy of standard journal]
3. Hand writing must be neat and clean.
4. Journal must contain certificate indicating name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
5. Index must contain sr. number, title of the experiment, page number, and the signature of staff along with date.
6. Put one blank page in between two experiments. Prepare the parallelogram at the center of page and write experiment number, date and title of the experiment in separate line.
   (Use black or blue ink pen for writing.)
Guidelines for Laboratory Conduction

1. Check whether the MCB / main switch is off.
2. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For rest of the connections, use thick wire. Do not keep loose connection. Get it checked from teacher / Lab Assistant.
3. Perform the experiment only in presence of teacher or Lab Assistant.
4. Do the calculations and get it checked from the teacher.
5. After completion of experiment, switch off the MCB / main switch.

Write the experiment in the journal and get it checked within week.

List of Experiments: To perform any eight experiments from the following list

A) Compulsory experiments:
   1. Determination of regulation of cylindrical rotor alternator by following methods
      a) EMF method b) MMF method.
   2. Determination of regulation of cylindrical rotor alternator by Potier method.
   3. Determination of regulation of salient pole alternator by slip test.
   4. V and inverted V curve of synchronous motor at constant load.
   5. Speed control of three phase induction motor by V/F method

B) Optional experiments ( any Three)
   1. Determination of Regulation of alternator by direct loading.
   2. Load test on three phase synchronous motor.
   4. Load test on Single-phase series motor.
   5. No load and blocked-rotor test on a single phase Capacitor-start induction motor
      and Determination of its equivalent circuit parameters.
   6. Performance characteristics of single phase series motor using circle diagram.
   7. Synchronization of three phase alternator by Lamp and Synchroscope methods.
   8. Simulation of three phase induction motor on MATLAB to obtain its performance.

Text Books:
[T10] M V Deshpande, Electrical Machines, Prentice Hall of India
Reference Books:

[R1] M.G. Say, Performance and Design of A.C. Machines (3rd Ed.), ELBS
[R6] Suvarnsingh Kalsi Application of high Temperature super conductors to electric power equipments (Rotating Machines) Wiley publication.

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303143: Power Electronics

Teaching Scheme | Credits | Examination Scheme [Marks]
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Lectures: 4hrs/week | 04 | In sem 30
Practical 2hrs/week | 01 | End sem 70
Practical | | Practical 50

Prerequisite:
- Knowledge of semiconductor material, basic electronics, diode, BJT, UJT, FET and its characteristics
- Working of Diode based rectifier, concept of rms and average value
- Use square notebooks for notes and plotting of waveforms

Course Objectives:
To enable students to gain knowledge and understanding in the following aspects:
- Fundamentals of power electronic devices and characteristics.
- The concepts and operating principles of power electronics circuits.
- Design procedures and techniques of power electronics systems.

Course Outcomes:
The students will be able to:
- Develop characteristics of different power electronic switching devices
- Reproduce working principle of power electronic converters for different types of loads
- Analyse the performance of power electronic converters

Unit 01: Silicon Controlled Rectifier (08 hrs)
Construction, Static and dynamic Characteristics, specifications/rating of SCR, Triggering Circuits (R, R-C, UJT), Commutation Circuits (class C&D), Protection (over voltage, over current, and Thermal), Gate Turn Off (GTO) Thyristor (Construction, Working and Application).

Unit 02: Transistor based Devices and DC-DC converter (08 hrs)
Transistor based Devices: MOSFET, IGBT, Construction, working, Static and Dynamic Characteristics, specifications, safe operating area, Latching of IGBT.

Unit 03: Single Phase AC-DC Converter (08 hrs)
Single phase Converter: Fully controlled converter (rectification and inversion mode), Half controlled converter (Semi-converter), Operation of all converters with R, RL load, derivation of Average and RMS output voltage, power factor, THD, TUF. Numerical based on output voltage and current calculations, Effect of source inductance on operation of converter, Concept of overlap angle and voltage drop calculation. Single phase dual converter (Descriptive treatment only).
Unit 04: Three Phase Converter and AC Voltage Regulator  

**Three phase converter:** Fully controlled converter, rectification and inversion mode, Half controlled converter (Semi-converter). Operation of all converters with R, RL load, derivation of Average and RMS output voltage, power factor, THD, TUF. Numerical based on output voltage and current calculations  

**AC voltage regulator:** DIAC, TRIAC- four mode operation, triggering of TRIAC using DIAC; Single phase AC Voltage regulator principle with R and RL Load, derivation of Average and RMS output voltage, Concept of two stage AC voltage regulator (With R and R-L load).

Unit 05: Single phase DC-AC Converter (Transistor based)  

Full bridge VSC, derivation of output voltage and current, Numericals, current source converter with ideal switches. **PWM techniques:** Single pulse, multiple pulse and sinusoidal pulse modulation with Fourier analysis.

Unit 06: Three phase DC-AC Converter (Transistor based)  

Three phase VSC using 120° and 180° mode and their comparison, PWM based VSC, voltage control and harmonic elimination techniques (Single Pulse Modulation, Transformer Connection, Multilevel Control, Stepped Wave), Multilevel Converter concept its classification (Neutral Point Clamped Converter, Flying Capacitor Converter, cascaded multilevel converter) comparison between multilevel converters, balancing of dc voltage across capacitor

**Guidelines for Instructor's Manual**  
- Title and circuit diagram of power electronic switching device and converter circuit.  
- Working operation and output characteristics / output waveforms of power electronic switching device /converter circuit.  
- Procedure to carry out the experiment.

**Guidelines for Student’s Lab Journal**  
- Title, aim, circuit diagram, procedure and theory of power electronic switching device or converter circuit.  
- Equipments along with the specifications needed to carry out the experiment.  
- Circuit diagram, observation table, calculations must be written on left side of the journal and aim, theory related to experiment and procedure must be written on right side.  
- Analyse and interpret the experimental results and write the conclusions appropriately.

**Guidelines for Laboratory Conduction**  
- Each group in the lab should have not more than three students.  
- All the students in the group must do the connections and perform the practical under the the guidance of the staff member.  
- Staff member has to check the result of all the groups.
List of Experiments:

**Group A : Hardware Experiments (Any Six)**
1. Static VI characteristic of SCR /GTO
2. Static VI characteristic of TRIAC
3. Single phase Half controlled converter with R and RL load
5. Single Phase fully controlled converter with and without Free Wheeling diode with RL load
6. Single phase A.C. voltage regulator with R load
7. Study of DC step down chopper
8. Output and Transfer Characteristic of MOSFET and IGBT (Both)
9. Three phase voltage source converter using 120° and 180° mode

**Group B: Perform any THREE experiments based on Software**
1. Three phase AC-DC fully controlled bridge converter R and RL load
2. Three phase voltage source inverter using 120° and 180° mode
3. Study of DC step down chopper
4. Single phase A.C. voltage regulator R and RL load
5. Study and Design of single phase VSC
6. Design of snubber circuit and verification using simulation

**Text Books:**

**Reference Books:**
1. Vedam Subramanyam - Power Electronics , New Age International , New Delhi
8. M.S. Jamil Asghar, Power Electronics, PHI.
10. NPTEL Web course and video course on Power Electronics by Dr.B.G.Fernandis,IIT,Mumbai.

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<tr>
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303144: Electrical Installation, Maintenance and Testing

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<th>Credits</th>
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<tbody>
<tr>
<td>Theory</td>
<td>03 Hrs./Week</td>
<td>03</td>
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<tr>
<td>Practical</td>
<td>02 Hrs./Week</td>
<td>01</td>
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<td>Term work : 50 Marks</td>
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</table>

Prerequisites:
- Introduction of Electrical supply system, Typical AC power supply scheme, Classification of Supply systems.
- Single line Diagram of electrical supply system.

Course Objective:
The course aims:-
- To understand the basic concepts, design and estimation of distribution systems & substation
- To enable candidate to design earthing system for residential and industrial premises
- To understand practical aspects of condition monitoring and maintenance of various electrical equipment.
- To learn testing methods of various electrical equipment.

Course Outcome:
Upon successful completion of this course, the students will be able to :-
- Classify distribution systems, its types and substations
- Design of different earthing systems for residential and industrial premises
- Select methods of condition monitoring and testing of various Electrical Equipments
- Estimate and Costing of residential and industrial premises

Unit 01: Distribution Systems: (06 Hrs.)
Classification of supply systems (State Only)
(i)DC, 2-wire system, (ii) Single phase two wire ac system, (iii) Three phase three wire ac supply system, iv) Three phase four wire ac supply system. Comparison between overhead and underground systems (For above mentioned systems) on the basis of volume requirement for conductor. AC Distribution System: Types of primary and secondary distribution systems, calculation of voltage drops in ac distributors (Uniform and Non Uniform Loading) (Numerical) Economics of power transmission: Economic choice of conductor (Kelvin’s law) (Derivation and Numerical) Distribution Feeders: Design considerations of distribution feeders; radial and ring types of primary feeder’s voltage levels, energy losses in feeders.
Unit 02: Substation and Earthing: (06 Hrs.)
Substation: Classification of substations, Various equipments used in substation with their specifications, Bus bar arrangements in the substation: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.
Earthing: Necessity of Earthing, Types of earthing system (Equipment and Neutral), and Maintenance Free Earthing system. Methods of testing earth resistance, Different electrode configurations (Plate and Pipe electrode), Tolerable step and touch voltages, Steps involved in design of substation earthing grid as per IEEE standard 80 – 2000.

Unit 03: Maintenance and Condition Monitoring: (06 Hrs.)

Unit 04: Condition Monitoring and Testing of Electrical Equipment: (06 Hrs.)
Failure modes of transformer, Condition monitoring of oil as per the IS/IEC standards, Filtration/reconditioning of insulating oil, Condition monitoring of transformer bushings, On load tap changer, dissolved gas analysis, degree of polymerization. Induction motor fault diagnostic methods – Vibration Signature Analysis, Motor Current Signature Analysis.
Testing of Power cables – Causes of cable failure, fault location methods and Remedial actions. Testing of Transformer - Type tests and Routine tests.

Unit 05: Estimation and Costing: (06 Hrs.)
Introduction, HT, LT overhead lines and underground cables, cable sizing, price catalogue, labour rates, schedule of rates and estimating data (only theory), Estimation and conductor size calculations of internal wiring for Residential and Commercial (Numericals) installations and estimate for underground LT service lines.

Unit 06: Electrical Safety: (06 Hrs.)
Causes of Accidents, Prevention of Accidents & precautions to be taken. Dangers arising as a result of faulty equipments and tools, chemicals, water, poor joints and insulation strains and moving machines. Contents of first aid box, treatment for cuts, burns and electrical shock. Procedures for first aid (e.g. removing casualty from contact with live wire and administering artificial respiration). Various statutory regulations (Electricity supply regulations, factory acts and Indian electricity rules of Central Electricity Authority (CEA), Classification of hazardous area.
Industrial Visit:
Visit to repair workshop (Any One).
i) Three phase induction motor  ii) Transformer  iii) Power Cable.

List of Experiments:
Compulsory experiments:
(Drawing sheets for 1 and 2 using AutoCAD or other CAD software)
1. Single Line diagram of 132 or 220 or 400 kV substation (based on actual field visit) Symbols, Plate or Pipe earthing.
2. Estimation for 11 kV feeders and substation.
3. Assignment on design of earthing grid for 132/220 kV substation.

Any five experiments are to be performed out of following:
2. Study of troubleshooting of electrical equipment based on actual visit to repair workshop (Any One).i) Three phase induction motor ii) Transformer iii) Power Cable
3. Study of thermograph images and analysis based on these images.
4. Assignment – Construction, working and troubleshooting of any two household Electrical equipments (Fan, Mixer, Electric Iron, Washing Machines, Electric Oven, Microwave - Limited to electrical faults)
5. Study the various types of earthing for electrical appliances/systems, Practice of earthing and Measurement of Earth resistance of Campus premises.
6. Design, Estimation and costing of earthing pit and earthing connection for computer lab, Electrical Machines Lab, HT Substation.
7. Project design and estimation of power circuit of labs/industry.
8. Measurement of insulation resistance of motors and cables

Guidelines for Instructor’s Manual Practical Sessions –
The Instructor’s Manual should contain following related to every experiment –
• Brief theory related to the experiment.
• Apparatus with their detail specification as per IS code.
• Basic AUTOCAD instructions for drawing the sheet.
• Design / Solving of given problem using data book as a reference.
• Students should be encouraged to visit workshops or small industries of transformer/induction motor / cables also for repairing of household equipment.
• Students should write the troubleshooting charts and visit report based on visit as mentioned above.
• Few short questions related to design.
Guidelines for Student’s Manual Practical Sessions –

The student’s Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Apparatus with their detail specification as per IS code.
- Design/Solve a given problem.
- Students should visit workshops or small industries of transformer/ induction motor / cables also for repairing of household equipment.
- Students should write the troubleshooting charts and visit report based on visit as mentioned above.
- Few short questions related to experiment.

Guidelines for Lab /TW Assessment

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

Text Books:


Reference Books:

IS/IEEE Standards:
1. IS : 1180 – Distribution Transformer.
2. IS : 2026 – Power Transformer.
4. IS : 694:1986 – PVC insulated cables for working voltages up to and including 1100 V.
8. Indian Electricity Rules.

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<tr>
<th>Unit</th>
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<td>5</td>
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<td>R3, R4, R5</td>
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<td>6</td>
<td>T7</td>
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Course Objectives:
• Gaining of actual knowledge (terminology, classification, methods and advanced trends)
• Learning fundamental principles, generalization or theories
• Discussion and critical thinking about topics of current intellectual importance
• Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to the course.

Course Outcomes:
At the end of this student will able to
• Relate with the current technologies and innovations in Electrical engineering.
• Improve presentation and documentation skill.
• Apply theoretical knowledge to actual industrial applications and research activity.
• Communicate effectively.

Seminar should be based on a detailed study of any topic related to the advance areas/applications of Electrical Engineering. Topic should be related to Electrical Engineering. However it must not include contents of syllabus of Electrical Engineering.

It is expected that the student should collect the information from journals, internet and reference books in consultation with his/her teacher/mentor, have rounds of discussion with him/her. The report submitted should reveal the students assimilation of the collected information. Mere compilation of information from the internet and any other resources is discouraged.

Format of the Seminar report should be as follows:
1. The report should be neatly typed on white paper. The typing shall be with normal spacing, Times New Roman (12 pt) font and on one side of the paper. (A-4 size).
2. Illustrations downloaded from internet are not acceptable.
3. The report should be submitted with front and back cover of card paper neatly cut and bound together with the text.
4. Front cover: This shall have the following details with Block Capitals
   a. Title of the topic.
   b. The name of the candidate with roll no. and Exam. Seat No. at the middle.
   c. Name of the guide with designation below the candidate’s details.
   d. The name of the institute and year of submission on separate lines at the bottom.
5. Certificate from institute as per specimen, Acknowledgement and Contents.
6. The format of the text of the seminar report should be as follows
   i. The introduction should be followed by literature survey.
II. The report of analytical or experimental work done, if any.
III. The discussion and conclusions shall form the last part of the text.
IV. They should be followed by nomenclature and symbols used.
V. The Reference Books are to be given at the end.
7. The total number of typed pages, excluding cover shall from 20 to 25 only.
8. All the pages should be numbered.
9. Two spiral bound copies of the seminar report shall be submitted to the college.
10. Candidate shall present the seminar before the examiners.
11. The total duration of presentation and after-discussion should be about 30 minutes.

The assessment for the subject shall be based on:

Audit Course III

303152 (A): Wind Energy Systems

Course Name: Wind Energy Systems
Prerequisite: Completion of FE or equivalent

Teaching Scheme: Lectures 2 h per week
Field Visit: 1 day

Examination Schemes: Audit (P/F)
Written / MCQ / Term paper

Description:
The following topics may be broadly covered in the classroom. The course will introduce the basics of: wind energy, availability, introduction to wind machines, generators, basics of design of wind electric generators, small and large wind machines, various designs and types of wind machines, grid interaction, advantages and limitations of the technology, environmental impact, introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The site visit will be organized to understand the basic operation and system elements.

Details:
- Energy in wind, Basic wind energy conversion
- Introduction to wind turbines, Types of wind energy systems
- Typical construction of various wind energy systems
- Wind electricity generation systems
- Environmental impact of wind electricity generators
- Economics and sustainability of wind electricity
- Introduction to Wind Electricity Generation (WEG) systems
- Wind turbine basics and design
- Generator designs for WEG
- Small and large WEG systems, Site requirements for WEG
- Controllers for WEG systems
- Grid integration of WEG
- Economics of WEG
- Financial modeling of WEG
- Software tools for simulation, validation and economics of WEG
- Operation and maintenance of WEG
- Environmental impact assessment
- Standards and certification for WEG
- Basics of WEG systems, Elements of WEG systems for small and large scale
- Procurement versus production
- Bought-outs, assemblies, sub-assemblies
- Manufacturing and assembly, Manufacturing standards
- Quality assurance and standards, Certification
- Special purpose machines and Automation in manufacturing
- Site assembly and fabrication
- Typical shop layouts
- Inventory management
- Economics of manufacturing

Site Visit:
- Large-scale wind power plant
- If possible any nearby manufacturing facility for wind machines
Audit Course III

303152(B): Microcontroller MSP 430 and Applications

Teaching Scheme:

Lecture and Practicals: Total 24 Hours
Written/Assignment

- 16 bit MSP430 microcontroller architecture, Pin diagram, Memory organization of MSP430, special function registers, GPIO control.
- Interrupts and interrupt programming, Watchdog timer. System clocks.
- Programming MSP430 in embedded C, Timers and RTC using MSP430, timer modes and its programming.
- Analog interfacing and data acquisition: ADC and Comparator in MSP430.
- Case study: MSP430 based embedded system applications using ADC & PWM etc.

Text Books:


Other References:

3. RF430CL330H:
4. RF430CL331H:
5. Datasheet: RF430FRL152H:
6. CC2538:
7. CC256x:
8. CC2640:
List of Experiments:

1. Learn and understand how to configure MSP-EXP430G2 Launchpad digital I/O pins. Write a C program for configuration of GPIO ports for MSP430 (blinking LEDs, push buttons interface).
   **Exercises:**
   a. Modify the delay with which the LED blinks.
   b. Modify the code to make the green LED blink.
   c. Modify the code to make the green and red LEDs blink:
      i. Together
      ii. Alternately
   d. Alter the code to turn the LED ON when the button is pressed and OFF when it is released.
   e. Alter the code to make the green LED stay ON for around 1 second every time the button is pressed.
   f. Alter the code to turn the red LED ON when the button is pressed and the green LED ON when the button is released.

2. Learn and understand GPIO based Interrupt programming. Write a C program and associated GPIO ISR using interrupt programming technique.
   **Exercises:**
   a) Write the code to enable a Timer interrupt for the pin P1.1.
   b) Write the code to turn on interrupts globally

3. Implement Pulse Width Modulation to control the brightness of the on-board, green LED. This experiment will help you to learn and understand the configuration of PWM and Timer peripherals of the MSP430G2553.
   **Exercises:**
   a) Observe the PWM waveform on a particular pin using CRO.
   b) What is the maximum resolution of PWM circuitry in MSP430G2 Launchpad?
   c) Change the above code to create a PWM signal of 75% duty cycle on particular PWM pin.

4. The main objective of this experiment is to control the on-board, red LED by the analog input from a potentiometer. This experiment will help you to learn and understand how to configure an ADC to interface with a potentiometer.
   **Exercises:**
   a) Alter the threshold to 75% of Vcc for the LED to turn on.
   b) Modify the code to change the Reference Voltage from Vcc to 2.5V.

**Lab Manual:**

1) www.ti.com/lab-manuals
### 303146 : Power System II

#### Teaching Scheme

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<th>Theory</th>
<th>Practical</th>
<th>Credits</th>
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<td>02 Hrs./Week</td>
<td>04</td>
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<th>Examination Scheme [ Marks]</th>
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<tr>
<td>In Sem. : 30 Marks</td>
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<td>End Sem. : 70 Marks</td>
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<td>PR : 50 Marks</td>
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#### Prerequisite:
- Constants, circuit representation and generalized constants of short and medium transmission lines.
- Inductance and capacitance for symmetrical and unsymmetrical configuration of transmission lines, Efficiency and line regulation of transmission line.

#### Course Objective:

The course aims to:-
- Develop analytical ability for Power system.
- Introduce concept of EHVAC and HVDC System.
- Demonstrate different computational methods for solving problems of load flow.
- Analyse the power system under symmetrical and Unsymmetrical fault conditions.

#### Course Outcome:

Upon successful completion of this course, the students will be able to
- Solve problems involving modelling, design and performance evaluation of HVDC and EHVAC power transmission lines.
- Evaluate power flow in power transmission networks and apply power flow results to solve simple planning problems.
- Calculate currents and voltages in a faulted power system under both symmetrical and asymmetrical faults, and relate fault currents to circuit breaker ratings.

#### Unit 01: Performance of Transmission Lines

Evaluation of ABCD constants and equivalent circuit parameters of Long transmission line. Concept of complex power, power flow using generalized constants, receiving end power circle diagram for transmission line (assuming ABCD constants are already given), surge impedance loading, Line efficiency, Regulation and compensation, basic concepts. Numerical based on: ABCD constants of Long transmission line, Power flow, circle diagram.

#### Unit 02: EHV-AC transmission:

Role of EHV-AC transmission, standard transmission voltages, average values of line parameters, power handling capacity and line losses, phenomenon of corona, disruptive critical voltages, visual critical voltages, corona loss, factors and conditions affecting corona loss, radio and television interference, reduction of interference, Numerical Based on Corona, Corona loss and power handling capacity.
Unit 03: Per unit system and Load Flow Analysis (08 Hrs.)

Per unit system: Single line diagram, Impedance and reactance diagrams and their uses, per unit quantities, relationships, selection of base, change of base, reduction to common base, advantages and application of per unit system. Numerical based on network reduction by using per unit system.

Load Flow Analysis: Network topology, driving point and transfer admittance, concept of Z-bus and formulation of Y-bus matrix using Direct method, singular transformation method, Introduction to load flow analysis, power- flow equations generalization to n bus systems, classification of buses, Newton- Raphson method (using polar coordinates - Descriptive treatment only) Numerical based on Y bus Matrix.

Unit 04: Symmetrical Fault Analysis (08 Hrs.)

3-phase short-circuit analysis of unloaded alternator, sub-transient, transient and steady state current and impedances, D.C. Offset, and effect of the instant of short-circuit on the waveforms, estimation of fault current without pre-fault current for simple power systems, selection of circuit-breakers and current limiting reactors and their location in power system (Descriptive treatment Only ) Numerical Based on symmetrical fault analysis

Unit 05: Unsymmetrical Fault Analysis: (08 Hrs.)

Symmetrical components, transformation matrices, sequence components, power in terms of symmetrical components, sequence impedances of transmission line and zero sequence networks of transformer, solution of unbalances by symmetrical components, L-L, L-G, and L-L-G fault analysis of unloaded alternator and simple power systems with and without fault impedance. Numerical based on symmetrical components and unsymmetrical fault calculation.

Unit 06: HVDC Transmission (Descriptive treatment only ) (08 Hrs.)

Classification and components of HVDC system, advantages and limitations of HVDC transmission, comparison with HVAC system, introduction to HVDC control methods - constant current, constant ignition angle and constant extinction angle control, HVDC systems in India, recent trends in HVDC system.

Industrial Visit: Compulsory visit to EHV-AC substation/ HVDC substation

List of Experiments (Compulsory experiments):

1. Measurement of ABCD parameters of a medium transmission line with magnitude and angle.
5. Static measurement of sub-transient reactance of a salient-pole alternator.
Any **three experiments** are to be performed out of following:

1. Plotting of receiving end circle diagram to evaluate the performance of medium transmission line.
2. Performance study of the effect of VAR compensation on transmission line using synchronous Condenser.
4. Simulation of Symmetrical fault of single machine connected to infinite bus.
5. Simulation of Unsymmetrical fault of single machine connected to infinite bus.
6. Simulation of HVDC system.

**Guidelines for Instructor’s Manual Practical Sessions –**
The Instructor’s Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few questions related to the experiment.

**Guidelines for Student’s Lab Journal**
The Student’s Lab Journal should contain following related to every experiment –

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few short questions related to the experiment.

**Guidelines for Lab /TW Assessment**

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.
Text Books:

Reference Books:
[R10] NPTEL Web course and video course on power system analysis.

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<td>6</td>
<td>T2, T3, T4</td>
<td>R3, R7</td>
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303147 : Control System-I

Teaching Scheme | Credits | Examination Scheme [Marks]
---|---|---
Theory | 04 Hrs./Week | 04 | In Sem : 30 Marks
Practical | 02 Hrs./Week | 01 | End Sem : 70 Marks

**Prerequisite:** Laplace Transform, Ordinary differential equations.

**Course Objective:** The course aims to:-
- To understand basic concepts of the classical control theory.
- To model physical systems mathematically.
- To analyze behavior of system in time and frequency domain.
- To design controller to meet desired specifications.

**Course Outcome:** Upon successful completion of this course, the students will be able to:
- Model physical system,
- Determine time response of linear system,
- Analyse stability of LTI system,
- Design PID controller for LTI system

**Unit 01 : General**
(10 Hrs)
Basic concepts of control system, classification of control systems. Types of control system: Feedback, tracking, regulator system, feed forward system. Transfer function, Pole and zero concept. Modeling and representation of control system-Basic concept. Mechanical, Electrical and equivalent system, Electromechanical. Block diagram Algebra, signal flow graph, Mason’s gain formula.

**Unit 02 : Time domain analysis**
(08 Hrs)
Standard test signal –step, ramp, parabolic and impulse signal, type and order of control system, time response of first and second order systems to unit impulse, unit step input. steady state errors – static error coefficients. Time domain specifications of second order systems. Importance of dominant closed loop poles of higher order systems Derivation of time domain specifications for second-order under-damped system for unit step input.

**Unit 03 : Stability analysis and Root Locus**
(08 Hrs)
Unit 04 : Frequency domain analysis-I (08 Hrs)
Introduction, relation between time and frequency response for second order system. Frequency domain specifications, Polar Plot, Nyquist plot, stability analysis using Nyquist plot.

Unit 05 : Frequency domain analysis-II (08Hrs)
Introduction to Bode plot, Asymptotic approximation: Sketching of Bode plot, stability, stability analysis using Bode plot.

Unit 06 : PID controllers (06Hrs)

Control System Components: Working principle and transfer function of Lag network, lead network, potentiometer, AC and DC servo motors. Working principle of synchros.

Guidelines for Instructor's Manual
Instructor’s Manual should contain following related to every experiment –
- Theory related to the experiment
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram
- Basic MATLAB instructions for control system/ Simulink basics
- Observation table/ Expected simulation results
- Sample calculations for one/two reading
- Result table

Guidelines for Student's Lab Journal
The Student’s Lab Journal should contain following related to every experiment –
- Theory related to the experiment
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram/Simulink diagram/MATLAB program
- Observation table/ simulation results
- Sample calculations for one/two reading
- Result table, Conclusion
- Few short questions related to the experiment.

Guidelines for Laboratory Conduction
- Assessment must be based on understanding of theory, attentiveness during practical session.
- Assessment should be done how efficiently student is able to perform experiment/simulation and get the results. Understanding fundamentals and objective of experiment, timely submission of journal.
List of Experiments:

A) Minimum five experiments should be conducted.
1. Experimental determination of DC servo motor parameters for mathematical modeling, transfer function and characteristics.
2. Experimental study of time response characteristics of R-L-C second order system: Validation using simulation.
3. Experimental frequency response of Lag and Lead compensator.
4. PID control of level/Pressure/Temperature control system.
5. Transfer function of any physical systems (AC Servomotor/ Two Tank System/ Temperature control/ Level control)
6. Study of Synchro transmitter receiver.

B) Minimum three experiments should be conducted.
2. Time response of second order system effect of P,PI, PID on it.
3. Analysis of closed loop DC position control system using PID controller.
4. Effect of addition of pole-zero on root locus of second order system.

Text Books:

Reference Books:

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303148 : Utilization of Electrical Energy

Teaching Scheme | Credits | Examination Scheme [Marks]
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Theory : 03 Hrs./Week | 03 | In Sem : 30 Marks
End Sem | 70 Marks

Prerequisite:
- Basics of Electrical Engineering, Effects of electric current
- Chemical reactions in electrolyte
- Control circuit design basics, awareness about artificial lighting, refrigeration, air conditioning
- Characteristics and application of different electric motors, awareness about traction

Course Objective:
The course aims to:-
- Ensure that the knowledge acquired can be applied in various fields such as electric heating, illumination, chemical processes, and electric traction.
- Make the students aware about the importance of maximizing the energy efficiency by optimum utilization of electrical energy.
- Develop ability amongst the students to design heating element for resistance furnaces and design-illumination schemes. To develop ability amongst the students to analyze the performance of arc furnaces, electric traction, different sources of light, illumination schemes.
- Provide know how about Refrigeration, Air Conditioning
- Provide know about electrochemical processes and applications of these in practical world, modern welding techniques.
- Develop self and lifelong learning skills, introduce professionalism for successful career.

Course Outcome:
Upon successful completion of this course, the students will revise:-
- Get knowledge of principle of electric heating, welding and its applications.
- Design simple resistance furnaces and residential illumination schemes.
- Calculate tractive effort, power, acceleration and velocity of traction.
- Get knowledge of electric braking methods, control of traction motors, train lighting and signaling system.
- Understand collection of technical information and delivery of this technical information through presentations.

Unit 01: Electric Heating (06 Hrs.)
Modes of heat transfer, mathematical expressions

Electric Heating: Introduction to electric heating, Advantages of electrical heating

Heating methods: - Resistance heating – Direct resistance heating, indirect resistance heating, electric ovens, different types of heating element materials, temperature control of resistance furnaces, and design of heating element (Numerical).
Applications of resistance heating

Induction heating: Principle, core type and coreless induction furnaces, Ajax Wyatt furnace, Numerical on melting furnaces Applications of induction heating
Electric arc heating – Direct and indirect arc heating, types of arc furnaces, equivalent circuit of arc furnace, condition for maximum output, power factor at maximum output (Numerical), Heat control in arc furnace, Applications of arc heating

Dielectric heating – Principle, choice of voltage and frequency for dielectric heating (Numerical), Applications of dielectric heating

Electric Welding -Welding methods – Electric arc welding and resistance welding, Equivalent circuit of arc furnace (Numerical) Modern welding techniques like ultrasonic welding and laser welding

Unit 02: Electrochemical Process (04 Hrs.)
Need of electro-deposition. Applications of Faraday’s laws in electro-deposition. Factors governing electro-deposition. Objectives of electroplating. Equipments and accessories for electroplating plant, Electroplating on non-conducting materials, Principle of anodizing and its applications

Electrical Circuits Used in Refrigeration, Air Conditioning
Brief description of vapour compression refrigeration cycle. Description of electrical circuits used in Refrigerator, Air Conditioner

Unit 03: Illumination (04 Hrs.)
Definitions of luminous flux, solid angle, luminous intensity, illumination, luminous efficacy, depreciation factor, coefficient of utilization, space to height ratio, reflection factor; Laws of illumination.

Design of illumination schemes – Factors to be considered for design of illumination scheme, Calculation of illumination at different points, considerations involved in simple design problems for indoor installation, illumination schemes, standard illumination level. Natural day light illumination (brief information)

Different sources of light: Incandescent lamp, fluorescent lamp, comparison between them. Incandescent and discharge lamps – their construction and characteristics; mercury vapour lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, neon lamps Electroluminescent lamp-LEDs, types, LASERs Comparison of all above luminaries.

Unit 04: Electric Traction (06 Hrs.)
History of Indian railways.

Traction systems - Steam engine drive, electric drive, diesel electric drive, types of diesel locomotives, Advantages of electric traction, Brief treatment to - Indian railway engine coding terminology, WDM,WDP,WDG series and their capacity. Introduction to metro system, mono rail system.

Systems of track electrification: D.C. system, single phase low frequency A.C. system, 3 phase low frequency A.C. systems, composite systems – kando systems, single phase A.C. to D.C. system

Different accessories for track electrification - overhead wires, conductor rail system, current collector-pentograph, catenary

Electric locomotive- Block diagram with description of various equipment and accessories.

Supply system constituents- Layout and description of - Traction substation, feeding post(25kV), feeding and sectioning arrangement, sectioning and paralleling post, neutral section.

Details of major equipment in traction substation-transformer, circuit breaker, interrupter
Unit 05: Traction Mechanics (08 Hrs.)

Types of services- Urban, Sub-urban, Main line Speed time curves, trapezoidal and quadrilateral speed-time curves, average and schedule speed (Numerical), Tractive effort. Specific energy consumption. Factors affecting specific energy consumption (Numerical), Mechanics of train movement, coefficient of adhesion (Numerical).

Unit 06: Traction Motors, Control of Traction Motors, Train Lighting (08 Hrs.)


Railway signalling: - History, necessity, block system route relay interlock and necessity. Metro signalling, Electromechanical system for route relay interlock. Introduction to train tracking system, types. Anti-collision system-brief treatment only.

Industrial Visit: Visit to any one location from the following-
- Railway station (Control room)
- Loco shed
- Traction substation

Text Books:


Reference Books:

[R3] ‘Lamps and lighting’ by M. A. Cayless, J.R. Coaton and A. M. Marsden
[R4] ‘BIS, IEC standards for Lamps, Lighting Fixtures and Lighting’ By Manak Bhavan, New Delhi
[R5] ‘Illumination Engineering from Edison’s Lamp to the Laser’ Joseph B. Murdoch
[R6] ‘Two centuries of Railway signalling’ by Geoffrey, Kichenside and Alan Williams (Oxford Publishing Co-op)
[R8] ‘Electrical Powers’ S. L. Uppal, Khanna Publication
NOTE
Assignments can be given on following topics

- Types of Electric Welding- Electric arc welding and resistance welding (accessories involved and working of the system, characteristics of arc welding)
- Modern welding techniques like ultrasonic welding and laser welding
- Study of different types of lamps-Incandescent lamp, fluorescent lamp, their construction and characteristics; mercury vapour lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, neon lamps Electroluminescent lamp-LEDs, types, LASERs
- Comparison of all above luminaries.
- WDM, WDP, WDG series and their capacity. Introduction to metro system, mono rail system.

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<tr>
<th>Unit</th>
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<td>T1,T2,T5,T4</td>
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**303149: Design of Electrical Machines**

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<th>Teaching Scheme</th>
<th>Credits</th>
<th>Examination Scheme [Marks]</th>
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<tr>
<td>Theory : 04 Hrs./Week</td>
<td>04</td>
<td>In Sem : 30 Marks</td>
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<tr>
<td>Practical: 02 Hrs./Week</td>
<td>01</td>
<td>End Sem : 70 Marks</td>
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<td>OR : 50 Marks</td>
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<td>Term work : 25 Marks</td>
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**Prerequisite:**
- Knowledge of various materials used in electrical machines.
- Knowledge of types, construction and working of transformer.
- Knowledge of types, construction and working of three phase induction motor.

**Course Objective:** The course aims :-
- To design transformer.
- To understand determination of parameters of transformer.
- To understand specifications of transformer.
- To design Induction motor.
- To understand determination of parameters of Induction motor.
- To understand specifications of Induction motor.

**Course Outcome:**
Upon successful completion of this course, the students will be able to :-
- Calculate main dimensions and Design of single phase and three phase transformer.
- Calculate main dimensions of three phase Induction motor.
- Determine the parameters of transformer.
- Determine parameters of three phase Induction motor.

**Unit 01: Transformer** (7 Hrs.)
Modes of heat dissipation. Heating and cooling curves. Calculations of heating and cooling time constants. Types and constructional features of core and windings used in transformer. Transformer auxiliaries such as tap changer, pressure release valve, breather and conservator. Specifications of three phase transformers as per IS 2026(Part I).

**Unit 02: Transformer Design** (8 Hrs.)
Output equation with usual notations, optimum design of transformer for minimum cost and loss. Design of main dimensions, core, yoke and windings of transformer. Methods of cooling and tank design. Estimation of resistance and leakage reactance of transformer.
Unit 03: Performance parameters of Transformer (8 Hrs.)
Estimation of no-load current, losses, efficiency and regulation of transformer. Calculation of mechanical forces developed under short circuit conditions, measures to overcome this effect. Introduction to Computer aided design of transformer, generalized flow chart for design of transformer.

Unit 04: Three phase Induction Motor Design : Part I (9 Hrs.)
Specification and Constructional features. Design of ac windings. Output equation with usual notations, specific electrical and magnetic loadings, ranges of specific loadings, turns per phase, number of stator slots.

Unit 05: Three phase Induction Motor Design : Part II (8 Hrs.)
Suitable combinations of stator and rotor slots. Calculations for main dimensions and stator design parameters. Selection of length of air gap, factors affecting length of air gap, unbalanced magnetic pull. Design of rotor slots, size of bars, end rings for cage rotor and rotor slots, turns and area of cross section of conductor for wound rotor.

Unit 06: Performance parameters of Three Phase Induction motor (8 Hrs.)

Industrial Visit: Industrial visit to a manufacturing unit of transformer or Induction motor.

Term Work: The term work shall consist of:
1. Details and assembly of three phase transformer with design report.(Sheet in CAD)
2. Details and layout of AC winding with design report.(Sheet in CAD)
3. Assembly of 3- phase induction motor.( Sheet optional CAD or Drawing)
4. Use of Finite Element Analysis(FEA) software for analysis of electrical machines, the report should include:
   a. Schematic diagram (Diagram/FEA model/Layout)
   b. Current/Flux/Force distribution.
   c. Analysis by variation of design parameters.
5. Report based on Industrial visit to a manufacturing unit. (Transformer or Induction motor).

Text Books:
[T3] K. G. Upadhyay- Design of Electrical Machines, New age publication
[T5] Indrajit Dasgupta – Design of Transformers – TMH
Reference Books:


[R4] Bharat Heavy Electricals Limited, Transformers - TMH.

Guidelines for Instructor's Manual Practical Sessions-
The instructor's manual should contain following related to every drawing sheet-
1. Brief theory related to the concerned sheet.
2. Apparatus with their detail specification as per IS code.
3. Design as per problem statement.
4. Reference tables used for design purpose.
5. Design parameters details in tabular form.
6. Few short questions related to design.

Guidelines for Student's Lab Journal-
The Student's Lab Journal should contain following related to every drawing sheet-
1. Brief theory related to the concerned sheet.
2. Apparatus with their detail specification as per IS code.
3. Design as per problem statement.
4. Reference tables used for design purpose.
5. Design parameters details in tabular form.
6. Few short questions related to design.

Guidelines for Lab/TW Assessment
1. There should be continuous assessment for the Lab/TW
2. Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to design as per the problem statement.
3. Timely submission of design report and sheet.

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<td>R3</td>
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Teaching Scheme | Credits | Examination Scheme [Marks]
---|---|---
Theory | 03 Hrs./Week | 03 | In Sem. : 30 Marks
Practical | 02 Hrs./Week | 01 | End Sem. : 70 Marks
| | | Term Work : 25 Marks |

Prerequisite:
- Concept of power and energy in three phase and single phase
- Various electrical equipments and specifications

Course Objective:
The course aims to:-
- Understand importance of energy Conservation and energy security.
- Understand impact of use energy resources on environment and emission standards.
- Follow format of energy management, energy policy.
- Learn various tools of energy audit and management
- Calculate energy consumption and saving options with economic feasibility.

Course Outcome:
Upon successful completion of this course, the students will be able to:-
- To get knowledge of BEE Energy policies, Electricity Acts.
- Use various energy measurement and audit instruments.
- Carry out preliminary energy audit of various sectors
- Enlist energy conservation and demand side measures for electrical, thermal and utility Systems.
- Solve simple problems on cost benefit analysis.

Unit 01: Energy Scenario (6 Hrs.)

Unit 02: Energy Management (6 Hrs.)
Unit 03: Demand Management (6 Hrs.)
Supply side management (SSM), Generation system upgradation, constraints on SSM. Demand side management (DSM), advantages and barriers, implementation of DSM. Use of demand side management in agricultural, domestic and commercial consumers. Demand management through tariffs (TOD). Power factor penalties and incentives in tariff for demand control. Apparent energy tariffs. Role of renewable energy sources in energy management, direct use (solar thermal, solar air conditioning, biomass) and indirect use (solar, wind etc.) Introduction to Net Metering.

Unit 04: Energy Audit (6 Hrs.)
Definition, need of energy audits, types of audit, procedures to follow, data and information analysis, energy audit instrumentation, energy consumption – production relationship, pie charts. Sankey diagram, Cusum technique, least square method and numerical based on it. Outcome of energy audit and energy saving potential, action plans for implementation of energy conservation options. Benchmarking energy performance of an industry. Report formats

Unit 05: Energy Conservation in Applications (6 Hrs.)
a) Motive power (motor and drive system). b) Illumination c) Heating systems (boiler and steam systems) d) Ventilation (Fan, Blower and Compressors) and Air Conditioning systems e) Pumping System f) Cogeneration and waste heat recovery systems g) Utility industries (T and D Sector)

Unit 06: Financial analysis (6 Hrs.)
Financial appraisals; criteria, simple payback period, return on investment, net present value method, time value of money, break even analysis, sensitivity analysis and numerical based on it, cost optimization, cost of energy, cost of generation.

Practicals:
Minimum 8 practicals/tutorials to be conducted from following groups:
Group A (Any Two of the following)
1. Study of Clean Development mechanism
2. Study of building codes (green building)
3. Study of energy management tool
4. Study of force field analysis from energy management point of views

Group B (Any three of following)
5. Analysis and interpretation of Electricity Bills
   Students should calculate electricity charges for
   a) Residential consumer
   b) Commercial Consumer (College campus)
6. Assessment and calculations of energy generated by Solar PV or other renewable sources / Diesel generator available in college campus.
7. Use of Power Analyser for measurement of electrical parameters useful for energy audit or power quality audit.

8. Adequacy assessment of Illumination systems by using Lux Meter

9. Use of temperature measuring devices for analysis of heating systems.

10. Use of other transducers (any one)
   a) Assessment of performance of fans and blowers by using Annemo Meter.
   b) Use of Flow Meters for Pumping system analysis.
   c) Use of pressure measuring equipments useful in audit study.
   d) Smart meters and advanced energy meters

11. Execute Preliminary Energy Audit for (Any One)
   (Preferably this activity should be carried out with student group not exceeding 5)
   a) Laboratory
   b) Educational Institute
   c) Commercial Establishment
   d) Small scale industry
   e) Residential Building
   f) Agricultural Equipments
   g) Municipal Corporations

12. Calculation of energy savings for following (Minimum one)
   a) Illumination
   b) Air conditioning System
   c) Pumping Systems
   d) DG Sets
   e) UPS and Inverter Systems
   f) Lifts and elevators

13. Study of energy audit success stories (any one)
   a) Paper and Pulp Industry
   b) Sugar Industry
   c) Steel Industry
   d) Commercial Establishment
   e) Electrical Generation Plant

14. Study of combined heat power system (cogeneration)

15. Study of Ethical Practices in energy audit.

**Guidelines for Instructor’s Manual**

Instructor’s Manual shall have
a. Brief relevant theory.
b. Equipment with specifications.
   c. Connection diagram/ methodology.
   d. Format of observation table and sample results.
Guidelines for Tutorial Reports (Instruction Manual and Journal Guide lines)

1. Report on Tutorial can be written separately for different batches.
2. Report shall be based on actual case studies presented, audit conducted, and conservation studies executed.
3. Report shall include following points
   a) Objective  
   b) Procedure  
   c) Equipment  
   d) Details of Name/Place/Location  
   e) Type and nature of activity  
   f) Result and Calculations if any  
   g) Questions for assessment of Tutorial  
   h) Outcome of activity

Guidelines for Practical Assessment

1. There should be continuous assessment for TW.
2. Assessment must be based on understanding level, presentation skills, efficiency and quality of report.
3. Timely submission of act.

Text Books:


Reference Books:

[R1] Success stories of Energy Conservation by BEE (www.Bee-india.org)
[R5] Energy Auditing made simple by Balasubramanian, Bala Consultancy Services.

Websites:

[W1] www.energymanagertraining.com

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<td>W1,W2</td>
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303151: Electrical Workshop

Teaching Scheme | credits | Examination Scheme [Marks]
--- | --- | ---
Lectures | ---- | In sem | Nil
Practical | 2 hrs/week | 01 | End sem | Nil
| | | Term Work | 50

Objectives:
- To develop hardware skills such as soldering, winding etc.
- To develop debugging skills.
- To increase ability for analysis and testing of circuits.
- To give an exposure to market survey for available components
- To develop an ability for proper documentation of experimentation.
- To enhance employability of a student.
- To prepare students for working on different hardware projects.

Course Outcomes:
After successful completion of the course, student will be able to
- Integrate electrical/electronic circuits for useful applications
- Acquire hardware skills to fabricate circuits designed.
- Read data manuals/data sheets of different items involved in the circuits.
- Test and debug circuits.
- Produce the results of the testing in the form of report.

Instructions:
- The exercises must be carried out in a group of maximum 3 students.
- Minimum 5 exercises must be carried out.
- Students will present the design, procedure observations and conclusion in the form of report which will be evaluated for term work.

Group A (Minimum 2 exercises from this group)
1. Design and fabrication of reactor/ electromagnet for different inductance values.
2. Design and fabrication of single phase Induction/three phase motor stator.
4. Wiring of distribution box with MCB, ELCB, RCCB and MCCB.
5. Wiring of 40 W tube, T-5, LED, Metal Halide lamps and available latest luminaries.
6. Assembly of various types of contactors with wiring.
7. Assembly of DOL and 3 point starter with NVC connections and overload operation.
Group B (Minimum 2 Exercise from this group)

This group consists of electronic circuits which must be assembled and tested on general purpose PCB or bread boards.

1. Design and development of combined ±12 V, ±5 V regulated power supply.
2. Design and development of SCR based half controlled converter using RC trigerring.
5. Buck/boost converter using LM2596S.

Group C

(All interfacing circuits for Arduino boards must be assembled on general purpose PCB and tested.)

1. Arduino based temperature measurement and display.
3. Arduino based ramp, sawtooth waveform generation.
4. Arduino based stepper motor control.
303153(A) : Bioenergy Systems

Course Name: Bioenergy Systems
Prerequisite: Completion of FE or equivalent

Teaching Scheme:  
Lectures 2 h per week  
Field Visit: 4 h  
Practical: 4 h

Examination Schemes: Audit (P/F)  
Written / MCQ / Term paper

Description:
The following topics may be broadly covered in the classroom: Bioenergy, availability of biomass, methods to convert it to heat and electricity, technologies for biodiesel, biomass gasification, biogas, composting, introduction to organic fertilizers, introduction to design, manufacturing and construction of biogas and biodiesel plants, specific equipment for pre and post processing, characterization, quality assurance, standards, certification and economics. The field visits and practical will be designed for first-hand experience and basic understanding of the system elements.

Details:
• Introduction to Bioenergy  
• Biomass availability in India  
• Biomass and carbon cycle  
• Environment pollution and biomass  
• Energy from biomass  
• Biomass burning for energy  
• Gasification of biomass  
• Biomass reforming  
• Anaerobic digestion for biogas  
• Biogas purification  
• Biogas to electricity  
• Aerobic composting  
• Organic fertilizers  
• Biomass to liquid fuel  
• Biodiesel  
• Biomass refinery  
• Segregated organic waste management  
• Algae as source of biomass  
• Dealing with agricultural residue

Site Visit:
• Biogas plant for segregated solid waste

Practical:
• Biodiesel making
Teaching Scheme: Lectures/Practicals : 2 hrs Per week  
Total hrs: 22

Examination Scheme: Audit (P/F)  
Written/MCQ/TERM Paper/Practical

Course Name: Applications of Power Electronics

Prerequisites:
3. Study of Single phase DC-DC and AC-DC Convertor (Full convertor and Semi Convertor)
4. Fundamentals of Single phase and Three Phase DC-AC Convertor (Full convertor and Semi Convertor)

Description:
The topics may be broadly covered in the classroom. This course will introduce the hands on learning to understand power supply for real world applications. Students can analyze, simulate and optimize their PMLK Power designs online using WEBENCH Power designer.
The TI lab Kits may be used to investigate the influence of physical parameters and operation conditions of a power supply on its performance.

Broadly the topics needed to be covered are:

Lab setup requirement:
PMLK Buck Kit, PMLK LDO Kit, DC power supply 0-50V/4A with dynamic voltage mode capability, DC electronic load 20V/10A with dynamic current mode capability, 4 digital multimeters with 4 1/2-digit resolution, 250MHz 4-channels Digital Oscilloscope, 10 MHz Function Generator.

Any three out of the four experiments in lab can be performed:

1. With TPS7A4901 and TPS7A8300, study-
   - Impact of capacitor on PSRR
   - Impact of output capacitor on load-transient response
   - Impact of line and load conditions on drop out voltage
   - Impact of line and load conditions on efficiency
2. Study of DC-DC Buck converter
   • Investigate how the efficiency of a TPS54160 buck regulator depends on the line and load conditions and on the switching frequency.
   • Analyze the influence of switching frequency $f_s$ and of capacitance $C$ and resistance $ESR$ of the input and output capacitors on steady-state waveforms of TPS54160 buck regulator.

3. Study of DC-DC Boost Converter
   • Analyze the influence of Input voltage, load current and switching frequency on continuous and discontinuous mode of operation of boost converter.
   • Analyze the impact of operating conditions and of the operation mode on the power loss and efficiency of boost converter.

4. Analyze how the switching frequency $f_s$, the DC accuracy and the line noise rejection of the hysteretic buck regulator depend on line voltage, the load current, the characteristics of the output capacitor and the impact of speed-up capacitor.

Webench Experiment:
Lab Requirement: PC’s with internet service connection.

Any Two out of the three can be performed:
Design Statement 1:
Design a Low cost Boost Converter to derive 12V, 100mA from 5V USB
DESIGN SPECIFICATION
• $V_{in}(min)= 4V$ $V_{in}(max)=5V$
• $V_{out}=12V$ $I_{out}=100mA$
• The Efficiency of the converter must be greater than 80%
• The design should have a WEBENCH® tool options like Thermal solution and Electrical simulation and to export in other software’s
• The BOM count should not exceed 10 parts
• The design should not have an automatic shutdown
• Lesser BOM cost is preferable
• The solution must be designed using the IC available in DIP package.

Design Statement 2:
Design a low cost and power efficient Buck Converter that could be used as a USB charger for mobile devices deriving its power from an automotive battery.
DESIGN SPECIFICATION
• $V_{in}(min)= 9V$ $V_{in}(max)=15V$, $V_{out}=5V$ $I_{out}=500mA$
• The Efficiency of the converter must be greater than 85%
• Footprint of the Total BOM components should be minimal
• The design should have maximum WEBENCH® tool options, for eg. Thermal simulation, Electrical simulation, Simulation export etc.
• The BOM count is expected to be within 15 parts
• Lower Shut down current is desired
• Lower BOM cost is preferred
Design Statement 3:
Design a low cost synchronous buck converter.

DESIGN SPECIFICATIONS
- $V_{in} \text{(Max)}$: 15 V, $V_{out}$: 5 V, $V_{in} \text{(Min)}$: 10 V, $I_{out}$: 1 A, Ambient Temp: 30°C
- IC should operate in advance eco-mode
- The efficiency should be greater than 90%
- Foot print should be less than 130 mm²
- BOM cost should be less than $2 and the solution should have lowest BOM cost
- BOM count should be less than 10
- The design should have maximum WEBENCH® tool options, for eg. Thermal simulation, Electrical simulation, Simulation export etc
- IC should support a soft start feature
- Design should not exceed 50 Degree Celsius Temperature at IC-Die (use thermal simulation optimization if required)

Text Books:

Reference Books:
2. M. D. Singh and K. B. Khandchandani, Power Electronics, Tata McGraw Hill
5. J. Michael Jacob – Power Electronics Principal and Applications.
7. M.S. Jamil Asghar, Power Electronics, PHI.
8. V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.
9. NPTEL Web course and video course on Power Electronics
12. WEBENCH – www.ti.com/webench

Other Reference Material:
1. TPS54160: http://www.ti.com/product/TPS54160
7. CSD17313Q2Q1: http://www.ti.com/product/CSD17313Q2Q1
8. CSD25404Q3: http://www.ti.com/product/ CSD25404Q3