



SARDAR PATEL UNIVERSITY, BALAGHAT (M.P.)

SCHOOL OF ENGINEERING AND TECHNOLOGY

SYLLABUS

COURSE – DIPLOMA IN ENGINEERING
SEMESTER - 5th

BRANCH – ELECTRICAL ENGINEERING
ACADEMIC SESSION 2024-25

DEE051 INSTRUMENTATION

Course Objectives - This course aims to provide a comprehensive understanding of measuring systems, transducers, telemetry, data acquisition systems, and display devices and recorders. Students will explore the elements, configurations, and performance standards of measuring systems, as well as the several types and characteristics of transducers, including their applications. The course covers the principles and classifications of telemetry, including current, voltage, frequency, and pulse telemetry. Students will also learn about data acquisition systems, both single and multi-channel, and the functionality of different display devices and recorders, equipping them with the knowledge and skills to effectively measure, monitor, and analyze various electrical and electronic systems.

Unit I

Measuring System: Elements of a measuring system, Block diagram of system configuration, performance, standards, time lag, error, distortion & distortion meters, noise & noise factor.

Unit II

Transducers: Transducers definition and classification, mechanical devices as primary detectors, Characteristic & choice of Transducers, Electrical transducers, Advantages of electric transducers, Active and passive transducers, Classification, Resistive inductive and capacitive transducers, Potentiometric, Metallic and semiconductor strain gauges, Gauge factor, types, material used and applications. Thermistor, RTD, Inductive, LVDT, RVDT and Capacitive transducers and their application. Thermocouples, Piezo-Electric transducers, principle, materials used, mode of operation and application. Frequency generating transducers. Hall effect transducers, Opto-electronic transducers such as photo voltaic, Photo conductive, and photo conductive cells, constructional details, characteristics, and applications. Photo diodes and transistors, characteristics, and applications. Digital transducers, Optical encoders for linear and angular displacement measurement. Purpose of signal conditioning, Classification, Input modifier, Operational amplifiers circuits



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Unit II

Telemetry: Necessity, Principle, classification, current and voltage telemetry, Position telemetry, synchro's. Frequency and pulse telemetry, Principle of frequency and pulse modulation PAM, PPM and PCM. Idea about landline and R.F. telemetry and multiplexing. Pulse code

Unit IV

Data Acquisition System: Introduction of data acquisition system, generalized DAS, Single and multi-channel DAS,

Unit V

Display Devices and Recorders: Digital display system and indicators like CRT, Seven Segment LED, LED, LCD. Ultraviolet recorders, Frequency modulated (FM) recording. Digital tape recorders. Analog and digital recorders, Strip and circular chart recorder and Magnetic tape recorder,

Reference Books

- (1) Electrical and Electronic Measurement and Instrumentation by A.K. Sawhney
- (2) Instrumentation Devices and Systems by C S Rangan, G R Sharma and V S V Mani
- (3) Digital Electronics by Alvino Leach
- (4) Instrumentation By Cooper

Course Outcomes-

CO1-Classify different Analog meters and explain the principles of each device.

CO2- Explain the principles of wattmeter's, energy meters and frequency meters.

CO3- Compare different bridges and underset and the concept of potentiometers.

CO4- Find and understand proper measuring methods in magnetic fields.

C05- Explain the principles of Instrument transformers and electronic instruments.



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List of Experiment

1. Measurement of Distortion using wave distortion meter.
2. To measurement of Load/weight using strain Gauge and cantilever.
3. Measurement of linear Displacement by LVDT and draw its characteristics.
4. To measurement of temperature by (A) Thermocouple (B) Resistance Thermometer.
5. To measurement of pressure using LVDT and diaphragm gauge.
6. To study and use data conversion using ADC and DAC.
7. To Measurement of PH value using PH meter.
8. To Measurement of Humidity by Hygrometer.
9. Study and use synchronous in position telemetry system.
10. To study Spectrum analyzer.



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DEE 052

POWER SYSTEM OPERATION AND PROTECTION

Course Objectives - This course aims to provide a comprehensive understanding of power systems, covering their growth and development, interconnections, and planning in India. Students will learn to represent power systems using single-line diagrams and per unit quantities, and analyze different types of faults, both symmetrical and unsymmetrical. The course also explores modern trends such as E.H.T. lines, HVDC systems, and power line carrier communication. Finally, students will gain insights into the purpose and selection of protective systems, and the use and advantages of CT/PT and neutral earthing in ensuring the safety and reliability of power systems.

Unit I

Introduction to power system: Growth of power system in India, future schemes, various elements of power system. Interconnection, its necessity and advantages, planning, operation, and improvement of power system. Load study, type of faults. AC/DC calculating board/digital computers.

Unit II

Representation of power system: Single line diagram, use of standard symbol. Per unit quantity - definition and advantages, base impedance conversion of per unit values from one base values to other base values. Generalized ABCD constants, their values in terms of circuit parameters. To prove $AD-BC=1$ characteristics of ABCD constants. The relations of Z_{sa} , Z_{ro} , Z_{rs} in terms of generalized constants.

Unit III

Fault analysis: Type of faults - symmetrical and unsymmetrical. Phase sequence impedance, phase sequence networks, analysis of symmetrical faults. Analysis of L-G, L-L and L-L-G fault by symmetrical components, simple numerical problems.



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Unit IV

Modern trends: E.H.T Lines, bundled conductors, HVDC system, block diagram, advantages, and disadvantages. Block diagram of Power Line Carrier communication.

Unit V

Introduction to protection: Purpose of protective system, requirement, and selection. Abnormalities in power system and their effects. Reasons for failure. Self and non-self-clearing faults. Use of CT/PT in protective scheme. Definition of terms regarding CT/PT. Advantages of CT/PT. Neutral earthing, their methods, and advantages.

REFERENCE BOOKS:-

1. "Power System Engineering" by Nagrath and Kothari
2. "Electrical Power Systems" by C.L. Wadhwa
3. "Modern Power System Analysis" by I.J. Nagrath and D.P. Kothari
4. "Power System Analysis and Design" by J. Duncan Glover, Munukutla S. Sarma, and Thomas Overbye
5. "Protection and Switchgear" by Bhavesh Bhaja, R.P. Maheshwari, and Nilesh Chethana

Course Outcomes- The student will be able to

CO1- Understand different power generation systems and distribution systems.

CO2- Explain overhead transmission line performance, compensation.

CO3- Analyze Faults in Overhead transmission lines.

CO4-Classify relaying system and explain construction and principles of relays.

CO5-Classify switch gear and functions, testing and selections of circuit breakers.



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LIST OF EXPERIMENTS

1. To study various components of three phase transmission line.
2. To Study Corona losses in a model of transmission line.
3. To study ABCD constants of a transmission line.
4. To study Ferranti effect in a model of transmission line.
5. To study construction of underground cable.
6. To study characteristics of under voltage & over voltage relay.
7. To study characteristics of IDMT over current relay.
8. To study characteristics of earth fault relay.
9. To study characteristics of MCB & HRC Fuse
10. To study the performance of current transformers & potential transformers.



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DEE053

POWER ELECTRONICS AND APPLICATIONS

Course Objectives - This course aims to provide a comprehensive understanding of thyristors, inverters, converters, motor speed control, and various applications of power electronics. Students will learn about the structure, characteristics, and turn-on methods of SCRs, along with other devices in the thyristor family. The course covers rectification, inverters, and converters, focusing on their applications and advantages. It also delves into electronic speed control of motors and their operational principles. Furthermore, students will explore high frequency heating, resistance welding, and various static and dynamic circuits used in power electronics, equipping them with the skills needed for practical applications in this field.

Unit I

Thyristor -SCR - Structure, Two transistor models, characteristics, turn-on methods, factor responsible for temperature rise, circuit for over voltage, over current, voltage surge & high dv/dt , Gate production. Modes of heat transfer. Triggering circuits - Resistance phase shift, UJT, Schmitt trigger. Turn-off types of commutation, methods of commutation. SCR rating, series, and parallel connection. The Thyristor family and other devices, DIAC, TRIAC, SCS, SUS, LASCR, MOSFET, IGRT, GTO, MCT.

Rectification -

Single phase HW and FW converters. Mathematical relations of Idec and Rims. Applications Advantages of polyphase rectification.

Unit II

Inverter -Series and parallel inverter, current and voltage source inverter, emergency tube light, comparison of inverters using different types of (transistor, MOSFET, IGRT) devices, block diagram of UPS (on load / off load). Applications for Inverter

Converter -

Block diagram of DC-to-DC converter. Converter duty cycle, 4-quadrant operation of choppers, applications. Working of single phase cyclo-converter, basic concept of three phase cyclo-converter, application of cyclo-converters.

Unit III

Speed control of Motors -

Advantages of electronic speed control, 4-quadrant operation of DC motors, constant torque and constant horsepower operation, speed control of separately excited DC motors, single and three phase-controlled rectifiers, field failure protection and armature current limiter, speed control using chopper, dual converter.



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Unit IV

Speed control of induction motors using rectifiers, inverter, and cyclo-convector (block diagram only). Speed control of slip ring induction motor using SCRS in rotor circuit.

Unit V

Applications - High frequency heating - induction and dielectric, principle, applications. Resistance welding, electronic line contactor, heat control circuit. Static AC& DC switch, over voltage protection, time delay circuits, reversing switch with plugging logic. and digit circuits, PF corrections

REFERENCE BOOKS

1. "Power System Engineering" by Nagrath and Kothari
2. "Electrical Power Systems" by C.L. Wadhwa
3. "Modern Power System Analysis" by I.J. Nagrath and D.P. Kothari
4. "Power System Analysis and Design" by J. Duncan Glover, Munukutla S. Sarma, and Thomas Overbye
5. "Power System Protection" by B. S. Murthy
6. "Power Electronics" by P.S. Bimbra
7. "High-Frequency Heating and Its Applications" by Leprous
8. "High-Frequency Heating" by Thermopolis
9. "Speed Control of Induction Motors" by Electrical4U

Course Outcomes -

CO1- Learning of characteristics and comparative features of power semiconductor switches

CO2- Learning of the operation of Rectifiers and their performance parameters

CO3- Learning of types and operation of inverters

CO4- Learning of types and operation of dc choppers

CO5- Learning of speed control of ac and dc motors using power electronic circuits.



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LIST OF EXPERIMENT

1. Characteristics of Thyristor family devices S.C.R. Characteristics.
2. To study single phase-controlled rectifiers.
3. To study emergency tube light.
4. To study triggering circuit for SCR
5. To study commutation circuits for SCR.
6. To study Electronics speed control of D.C. motors.
7. To study Electronics speed control of Induction motors.
8. To study UPS.
9. To study Chopper circuit.
10. To study single phase cycloconverter



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DEE - 054

UTILIZATION OF ELECTRICAL POWER

Course Objectives - This course aims to provide comprehensive knowledge of electric drives, electric heating, welding, illumination, and power factor improvement techniques. Students will explore the merits, demerits, and selection criteria of motors, various methods of electric heating, and the principles of electric welding. The course covers the fundamentals of illumination and the principles behind different lighting schemes, as well as power factor improvements and electrochemical processes. Additionally, students will learn about the construction, maintenance, and application of storage batteries, equipping them with essential skills for practical applications in electrical engineering.

Unit I

Electric Drive Merits and demerits of electric drives, factors governing selection of motors, drive requirements. Group and individual drive, starting and running characteristics of various motors. Selection of starters, hand operated and contactor type starters, liquid resistor type starters. Speed control of motors, load equalization, use of fly wheel. Motor enclosures, selection of motors for service, size, and rating of motors.

Unit II

Electric Heating Advantages and disadvantages of electric heating, methods of electric heating. Principle of electric heating. Resistance heating, heating elements and alloys. Causes of failures of heating elements. Arc furnaces, principles, construction, working and uses. Induction heating principle, construction, and use of Ajax Wyatt (core type) and coreless type. L.F. and H.F. induction furnaces. Dielectric heating principles and uses.

Unit III

Electric welding Definition, classification of electrical welding, principle of arc welding. Qualities of a good weld. Welding defects. Resistance welding, advantages, classification, principle and working, comparison of resistance and welding process, A.C. & D.C. arc welding.

Unit IV

Illumination Electromagnetic wave spectrum, solid and plane angle, definition of electrical terms in use, sensitivity of human eye. Luminous efficiency, horizontal and vertical laws of illumination, definition of terms used in lighting, lighting scheme, various types of lamps, their use, and fittings.

Unit V

Power factor improvements Electro deposition and Faraday's laws of electrolysis, various electro-chemical processes like electroplating, electro-extraction, regions. Storage batteries, classification, construction. Battery maintenance, battery charging, circuit diagram. Application of storage batteries



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References: -

1. "Electric Drives: Principles, Control and Applications" by P.S. Bimbra
2. "Electric Motor Drives: Modeling, Analysis, and Control" by Bimal K. Bose
3. "Power Electronics and Motor Drives" by Ashish Khanna
4. "Electric Heating: Methods, Advantages & Applications" by Electrical Voice
5. "Electric Heating: Working Principle, Types, and Applications" by Leprous
6. "High-Frequency Heating and Its Applications" by Leprous
7. "Electric Arc Welding: Working Principle, Types, and Applications" by Tutorials point.
8. "Electric Arc Welding: Definition, Working Principle, and Types" by Leprous
9. "Lighting for the 21st Century: A Handbook for Lighting Professionals" by IESNA
10. "Power Factor Improvement: Definition, Formula, Method & Examples" by Textbook

Course Outcomes -

CO1- Study various lamps and fittings in use.

CO2- Study various electric heating and welding equipment used in industries.

CO3- Study Electric Drive and elevator used in industries.

CO4-Study Electric Traction system.

CO5-Study various domestic electrical appliances.

LIST OF EXPERIMENTS

1. To study Dielectric/ Induction heating.
2. To study Speed control of slip ring induction motor by rotor.
3. To draw 'V' curves of synchronous motor.
4. Load Test on three phase Induction Motor.
5. To study different types of sources of light.
6. To study Electric Arc welding, Different types of Arc welding, application.
7. To study control of 3-phase induction motor in variable frequency V/f constant mode using 3-phase.
8. To understand the power diagram, active, reactive, apparent power, distorted power, and power factor correction.



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DEE 055

ESTIMATING AND COSTING

Course Objectives - This course aims to provide a comprehensive understanding of electrical estimating, including the principles of estimating costs for materials, labor, and overheads. Students will learn to prepare estimates for domestic and industrial wiring, service connections, and various types of substations. They will also gain insights into estimating and costing for overhead lines and distribution systems, equipping them with the skills needed for accurate and efficient estimation in electrical engineering projects. Through practical applications and real-world examples, students will develop the expertise necessary for effective planning and execution of electrical installations.

Unit I

Elements of Estimating Principles of estimating, purchase procedure, cost of materials, various charges like labor, stores, overhead tools, contingency etc.

Unit II

Domestic and Industrial Wiring Various types of wiring systems including P.V.C. pipe, their merits, and demerits. Calculation of total load & selection of wire, preparation of estimates for a small residential building, big institution, or office building. Estimate for single store yard, multistory building. Estimate for a small workshop and industrial installation, agricultural pump, domestic pump, flour mills etc. Estimation of total cost.

Unit III

Service connection for a single story and multistoried building, single phase and three phase service connections, various methods of service connections. Distribution of circuits for light and power load. (Guidance may be taken by the M.P. Electricity Boards estimates).

Unit IV

Substations Various types of sub-stations, pole-mounted in-door, and out-door substations. Estimating quantity and cost for a substation of a given specification.

Unit V

Overhead lines: H.T. & H.T. lines Preparation of estimate and costing of 11KV or 33KV line. Selection of routes. Estimates for distribution lines- Location of poles for a given situation or



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locality. Providing streetlights, necessary hardware, stay arrangements, underground cables, providing services lines using underground cables.

Reference Book: -

1. "Electrical Design Estimating and Costing" by K.B. Raina and S.K. Bhattacharya
2. "Electrical Wiring Estimating and Costing" by S.L. Uppal
3. "Electrical Installation Estimating and Costing" by J.B. Gupta
4. "Electrical Substation Engineering and Practice" by S. Rao
5. "Overhead Power Lines: Planning, Design, Construction" by Friedrich Kiessling, Peter Nefzger, Ulf Kaity, and Nicolai Nola

Course Outcomes -

CO1-Interpret various electrical diagrams and drawings.

CO2- Prepare estimate of domestic and commercial electrical installations.

CO3- Prepare estimate of industrial electrical installations.

CO4- Prepare estimate of overhead and underground distribution lines.

CO5- Prepare quotation, tender and other related documents for electrical work contracts.



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DEE056P MINOR PROJECT

The objective of the course 'Project' is.

- To provide students with comprehensive experience for applying the knowledge gained so far by studying various courses.
- To develop an inquiring aptitude and build confidence among students by working on solutions to small industrial problems.
- To students an opportunity to do something creative and to assimilate real life work situation in institution.
- To adapt students for the latest developments and to handle independently new situations.
- To develop good experiences power and presentation abilities in students

Students already have a glimpse of project work as they have worked on Minor Project Work in V semester. This gives the students an opportunity to observe the work on real life projects and select some application area in which he/she will be undertaking a project. External guides from industry can also be selected for project work along with an internal guide to prepare innovative and real projects. Students also have the flexibility of extending the minor project work into Major project if the area has a scope for that.

The purpose of providing six hours per week is to orient the students' in-groups to the following objectives:

- Provide general guidelines regarding execution of work.
- Impart instructions regarding write-up work and preparation of project documents.
- Sharing and solving common problems associated with execution of project work.
- Monitor and evaluate the progress of project work.

The faculty and students should work according to the following schedule:

1. Each student undertakes substantial and individual projects in an approved area of the subject and supervised by members of staff.
2. The student must submit an outline and action plan for the project execution (time schedule) and the same be approved by the faculty concerned.
3. The development project must be conducted according to the following steps and the final write-up should have the same sequence.
 1. Project objectives.



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2. Requirement gathering.
3. Modelling projects should be done in any well-known modeling tools.
4. Analysis of Project.
5. Design of Project.
6. Implementation of project.
7. Testing on project.
8. Quality consideration of project.
9. Designing a small user manual.
10. Estimating the cost of the project.
11. Future scope and suggestions.

ACTION PLAN FOR PROJECT WORK AND EVALUATION SCHEME (SUGGESTIVE):

TASK/PROCESS

- Orientation of students by HOD/Project supervisor
- Literature survey and resource collection
- Selection and finalization of topic before a committee*
- Detailing and preparation of project (Modeling, Analysis and Design of Project work)
- Development Stage
- Testing, improvements, quality control of project
- Acceptance testing
- Report writing
- Presentation before a committee

* Committee comprises of HOD, all project supervisors including external guide from industry (if any).

The above marking scheme is suggestive, it can be changed to an alternative scheme depending on the type of project, but the alternative scheme should be prepared in advance while finalizing the topic of project before a committee and explained to the concerned student as well.



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LIST OF SUGGESTED TOPICS

S. No. Name of Topic

- 1 Solar power generating station.
- 2 Wind power generating station.
- 3 Load dispatch techniques in modern power systems.
- 4 Energy auditing of small industrial / commercial / residential / office building
- 5 Estimation and costing of wiring of industrial / commercial / residential / office building
- 6 Load survey
- 7 Software based projects.
- 8 Industry based projects
- 9 Syllabus Based project.