



**DR. A P J ABDUL KALAM UNIVERSITY,
INDORE**

SYLLABUS
For
DIPLOMA in ELECTRICAL ENGINEERING
(PART TIME)
(3rd YEAR, 6th SEM)

College of Polytechnic Engineering

Dr. A P J Abdul Kalam University, Indore

DR. A P J ABDUL KALAM UNIVERSITY, INDORE

Syllabus for Diploma in Electrical Engineering (Part Time)

List of Subject (3rd Year, 6th Sem)

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UNIT 1 - Measuring System

Elements of a measuring system, Block diagram of system configuration, performance, standards, time lag, error, distortion and distortion meters, noise and noise factor.

UNIT 2- 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, Potentiometer, 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.

UNIT 3 Signal Conditioners

Purpose of signal conditioning, Classification, Input modifier, Operational amplifiers circuits used in instrumentation, D.C. amplifier, chopper amplifier. Instrumentation amplifier, characteristics, three amplifier configuration. A/D and D/A converters.

UNIT 4 Measurement of Physical Quantities:

Measurement of Pressure-Types of pressure measurement devices, Force summing devices, Secondary transducers, Low pressure measurement, Pirani gauge and thermocouple gauge. Resistive, Inductive and Capacitive pressure measuring devices.

Measurement of speed: Measurement of speed by stroboscope, photoelectric and reluctance pick-up devices for speed measurement. Measurement of Vibration-Necessity for Vibration Measurement, Seismic Transducer, Piezo-electric and LVDT Accelerometers. Measurement of Temperature-Temperature measuring devices, Resistance thermometers, Radiation and Optical Pyrometers. Measurement of Flow-Turbine and electromagnetic flow meters, Ultrasonic flow meter, Thermal flow meters. Measurement of Humidity-Humidity, absolute and relative humidity, Resistive and Capacitive hygrometers. Measurement of pH Value-Concept, pH scale, pH cell, pH meter. Measurement of Thermal Conductivity (gas analyzer). Measurement of level: Float and potentiometer method of flow measurement, Resistive and Capacitive methods, Ultrasonic and Gamma rays methods. Measurement of Force and Torque- Electronic weighing system, Hydraulic load cell. Torque measurement, concept, Stress and Deflection type torque measurement methods.

UNIT 5 Telemetry

Necessity, Principle, classification, current and voltage telemetry, Position telemetry, synchros. 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 format, Modulation techniques of digital data transmission, Digital multiplexers.

UNIT 6 Data Acquisition System

Introduction data acquisition system, generalized DAS, Single and multi channel DAS, Data loggers, Special encoders.

UNIT 7 Display Devices and Recorders:

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

References:-

- (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 Malvino Leach
- (4) Instrumentation By Cooper

List of Experiments:

- [1] Measurement of Distortion using wave distortion meter.
- [2] Measurement of load/weight using strain gauge and cantilever.
- [3] Measurement of linear displacement by LVDT and draw its characteristics.
- [4] Measurement of temperature by-
 - (a) Thermocouple
 - (b) Resistance Thermometer
- [5] Measurement of pressure using LVDT and diaphragm gauge.
- [6] Study and use of data conversion using ADC and DAC.
- [7] Measurement of pH value using pH meter.
- [8] Measurement of Humidity by hygrometer.
- [9] Study and use of synchros in position telemetry system.
- [10] Measurement of Vibration using piezoelectric/LVDT transducer.
- [11] Study and flow measurement using electromagnetic flow meter.
- [12] Study of time division and frequency division multiplexing.
- [13] Measurement of liquid level by resistive/capacitive transducer.
- [14] Study and measurement of temperature using optical and radiation pyrometer.
- [15] Study of strip chart recorder and magnetic tape recorder.

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UNIT 1 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 2 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_{so}, Z_{ro}, Z_{rs} in terms of generalized constants.

UNIT 3 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.

UNIT 4 Modern trends -

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

UNIT 5 Introduction to protection -

Purpose of protective system, requirement and selection. Abnormalities in a 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.

UNIT 6 Protective relay -

Type of relays- induction, electromagnetic, thermal. Primary and back up relaying. Types of back up relays, causes of failure of primary relaying. Explanation of terms used in relaying. Principle and working of different types of relays- electromagnetic and induction type. Induction type over current relay, reverse power relay, time and current settings. Differential relays., distance relays, thermal relays, inverse current characteristics.

UNIT 7 Circuit interruption devices -

Function of fuse. fusing factor, fusing characteristic. Application of isolator and circuit breakers. Circuit breaker capacities. Arc formation in C.B. and methods of arc extinction. Definition of various terms with reference to circuit interruption wave form. working principle and operation of Bulk Oil/Minimum oil/air blast/SF CB. Merits and Demerits of different types of C.B.

UNIT 8 Protection against over voltages - Causes and effects of over voltage. Traveling wave. Over-voltage protection, earth wire, lightning arresters- Multiple gap type, horn gap type, line type, station type and distribution type. Surge absorber.

UNIT 9 Protective schemes -

Protection of alternator- various abnormalities, Merz price differential protection, over current and earth fault protection.

Protection of transformer - various abnormalities, differential protection, Buchholz relay.

Feeder and transmission line protection - time graded and over current protection, current graded system, differential protection. Protection of Induction motors, use of thermal relays and under voltage protection

References

1. William Stevenson, Elements of Power System Analysis, McGraw Hill.
2. C.L. Wadhwa, Electrical Power System Analysis, New Age International.
3. D.P. Kothari, I.J. Nagrath, Modern Power System Analysis TMH, III Ed. Reprint 2008.
4. D.P. Kothari, I.J. Nagrath, Power System Engineering TMH II Ed. Reprint 2009.
5. Ashfaq Husain, Electrical Power Systems, Vikas Publishing House.
6. C.L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy”, New Age International.

List of Experiments:-

- [1]To determine the ABCD constants of a given / T network.
- [2]To determine Z_{so} , Z_{ss} , Z_{ro} , Z_{rs} for a given / T network.
- [3]Study of a HVDC system.
- [4]Study and use of CT/PT employed for protection and determine their ratio error.
- [5]Study of an Induction type O/C relay and plot the inverse characteristic.
- [6]To plot the inverse characteristic (current/time) of a given fuse wire.
- [7]To determine the fusing factor of different fuse wire.
- [8] To study the differential protection of transformer/alternator.
- [9]Visit to power station Study of different protective elements/schemes- ground

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UNIT 1 - Thyristor -

SCR - Structure, Two transistor model, 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. Thyristor family and other devices, DIAC, TRIAC, SCS, SUS, LASCR, MOSFET, IGRT, GTO, MCT.

UNIT 2 Rectification -

Single phase HW and FW converters. Mathematical relations of I_{dc} and I_{rms} . Applications Advantages of poly phase rectification.

UNIT 3 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 of Inverter

UNIT 4 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 5 Speed control of Motors -

Advantages of electronic speed control, 4-quadrant operation of DC motors, constant torque and constant horse power operation, speed control of separately excited DC motor, single and 3 phase controlled rectifiers, field failure protection and armature current limiter, speed control using chopper, dual converter.

Speed control of induction motor using rectifier, inverter and cyclo-convector (block diagram only).

Speed control of slip ring induction motor using SCRS in rotor circuit.

UNIT 6 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

1. Power electrics : Circuits, devices & applications, M. H. Rashid, PHI
2. Power Electronics, P.C. Jain, TMH

List of Experiments

- [1] Study of Characteristics of SCR.
- [2] Study of Characteristics of MOSFET.
- [3] Study of Characteristics of IGBT.
- [4] Study of single phase controlled rectifiers.
- [5] Study of emergency tube light
- [6] Study of SCR triggering circuits
- [7] Study of commutation circuits
- [8] Electronic speed control of d.c.motor
- [9] Electronic speed control of induction motor
- [10] Study of UPS
- [11] Study of chopper



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Professional Activities is not a descriptive course, as per conventional norms; therefore specific content for this course cannot be prescribed. It is a group of open-ended activities; where in variety of tasks are to be performed, to achieve objectives. However general guidelines for achieving the target and procedure for its assessment are given under the course content.

As the student has to practice this course in all the six semesters, the guidelines given therein are common and applicable to each semester.

OBJECTIVES:

- To allow for professional development of students as per the demand of engineering profession.
- To provide time for organization of student chapter activities of professional bodies) i.e. Institute of engineers, ISTE or Computer Society of India etc.)
- To allow for development of abilities in students for leadership and public speaking through organization of student's seminar etc.
- To provide time for organization of guest lectures by expert engineers/ eminent professionals of industry.
- To provide time for organization of technical quiz or group discussion or any other group activity.
- To provide time for visiting library or using Internet.
- To provide time for group discussion or solving case studies.
- To provide time for personality development of students.
- To provide time for working for social cause like awareness for environmental and ecology etc.

DETAILED INSTRUCTIONS TO CONDUCT PROFESSIONAL ACTIVITIES:

A. Study hours, if possible should be given greater time slot with a minimum of two hrs/week to a maximum of four hrs/week.

B. This course should be evaluated on the basis of grades and mark sheet of students, should have a separate mention of the grade awarded. There will be no pass/fail in professional activities (PA).

C. Following grade scale of evaluation of performance in PA has been established.

| Grades | Level of performance |
|--------|----------------------|
| A | Excellent |
| B | Good |
| C | Fair |
| D | Average |
| E | Below Expectations |

D. Grades once obtained in a particular examination shall become final and no chance of improvement in grades will be given to the students.

E. Assessment of performance in PA is to be done internally by the Institution, twice in a Semester/Term through a simultaneous evaluation of the candidate by a group of three

teachers, of the deptt. Concerned. Group of teachers will jointly award the grade to candidate in the assessment. Best of the grades obtained by the student in these two assessments shall be finally taken on the mark sheet of the respective Semester/Term.

Candidate abstaining from the prescribed course work and/or assessment planned at the Institute shall be marked ABSENT in the mark sheet, instead of any grade.

F. While awarding the grades for performance in PA, examining teacher should reach the final consensus based on the attendance, punctuality, interest, presentation skills in seminar on the topic assigned (collection of relevant data, observations, analysis, findings/conclusion) and its written report, awareness of latest developments in the chosen programme of study.

G. Institution shall maintain the record of grades awarded to all the students in PA for a period of 1 year.

H. It shall be mandatory for students to submit a compendium for his PA in the form of a Journal.

I. Compendium shall contain following:

I. Record of written quiz.

II. Report/write up of seminar presented

III. Abstract of the guest lectures arranged in the Institution.

IV. Topic and outcome of the group discussion held.

V. Report on the problems solved through case studies.

VI. Report on social awareness camps(organized for social and environmental prevention).

VII. Report on student chapter activities of professional bodies like ISTE, IE (India), CSI etc.

J. PA is not a descriptive course to be taught in the classroom by a particular teacher. Various activities involved in the achievement of objectives of this course should be distributed to a number of teachers so that the talent and creativity of group of teacher's benefit the treatment of the course content.

These activities should preferably be conducted in English language to maintain continuity and provide reinforcement to skill development.

Small groups shall be formed like in tutorials, group discussion, case studies, seminar, project methods, roll play and simulation to make the development of personality affective.

Treatment of PA demands special efforts, attention, close co-operation and creative instinct on the part of teachers of department concerned. Since this course is totally learner centered, many of the activities planned under this course shall come out from the useful interaction of student, among themselves and with the teachers. The guide teacher/s shall best act as a facilitator of these creative hunts/ exercises, which unfold many of the hidden talents of the students or bring out greater amount of confidence in them, to execute certain activity.