STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN ELECTRICAL & ELECTRONICS ENGINEERING

Fifth Semester

Sr. No.	Subject	L	T	P	Total	Evaluation Scheme						
						Internal Assessment		External Assessment (Examination)				Total Marks
		Periods/Week				Theory	Practical	Theory		Practical		
						Max. Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
	Industrial Training	-	-	-	-	-	25	-	-	25	-	50
5.1	A.C. Machines	5	-	4	9	20	30	50	2.5	50	3.00	150
5.2	Sub-Station Switchgear and Protection	4	-	2	6	20	30	50	2.5	50	3.00	150
5.3	Electronics in Industry	3	-	4	7	20	30	50	2.5	50	3.00	150
5.4	Consumer Electronics & Trouble shooting	3	1	4	8	20	30	50	2.5	50	3.00	150
5.5	Industrial Electronics and Control of Drives	5	-	3	8	20	30	50	2.5	50	3.00	150
5.6	Process Control & Instrumentation	4	-	2	6	25	25	50	2.5	50	3.00	150
General proficiency #		-	-	4	4	-	25	-	-	-	-	25
Indrustrial Exposure (Assesment at Inst. Level)+		-	-	-	-	-	25	-	-	-	-	25
Total		24	1	23	48	125	250	300	-	325	-	1000

General Proficiency will comprise of various co-curricular activities like games, hobby clubs, seminars, declamation contests, extension lectures, NCC, NSS and cultural activities etc.

\+ Industrial visit compulsory to minimum 2 industries or Departments.

Note:- 1. Each period will be 50 minutes.

2. Each session will be of 16 weeks.

3. Effective teaching will be at least 12.5 weeks.

5.1 AC MACHINES

L T P
Periods 5 - 4

RATIONALE

Electrical machines is a subject where a student will deal with various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications

DETAILED CONTENTS

1. Synchronous Machines (30 Periods)

   1.1 Main constructional features of synchronous machine including commutator and brushless excitation system

   1.2 Generation of three phase emf

   1.3 Production of rotating magnetic field in a three phase winding

   1.4 Concept of distribution factor and coil span factor and emf equation
   Armature reaction at unity, lag and lead power factor

   1.5 Operation of single synchronous machine independently supplying a load - Voltage regulation by synchronous impedance method

   1.6 Need and necessary conditions of parallel operation of alternators
   Synchronizing an alternator (Synchroscope method) with the bus bars

   1.7 Operation of synchronous machine as a motor –its starting methods

   1.8 Effect of change in excitation of a synchronous motor

   1.9 Concept and Cause of hunting and its prevention

   1.10 Rating and cooling of synchronous machines

   1.11 Applications of synchronous machines (as an alternator, as a synchronous condenser)

2. Induction Motors (20 Periods)

   2.1 Salient constructional features of squirrel cage and slip ring 3-phase induction motors

   2.2 Principle of operation, slip and its significance

   2.3 Locking of rotor and stator fields

   2.4 Rotor resistance, inductance, emf and current

   2.5 Relationship between copper loss and the motor slip

   2.6 Power flow diagram of an induction motor

   2.7 Factors determining the torque

2.8 Torque-slip curve, stable and unstable zones

2.9 Effect of rotor resistance upon the torque slip relationship

2.10 Double cage rotor motor and its applications

2.11 Starting of 3-phase induction motors, DOL, star-delta, auto transformer

2.12 Causes of low power factor of induction motors

2.13 Testing of 3-phase motor on no load and blocked rotor test and to find efficiency

2.14 Speed control of induction motor

2.15 Harmonics and its effects, cogging and crawling in Induction Motors

3. Fractional Kilo Watt (FKW) Motors (18 Periods)

3.1 Single phase induction motors; Construction characteristics and applications

3.2 Nature of field produced in single phase induction motor

3.3 Split phase induction motor

3.3.1 Capacitors start and run motor

3.3.2 Shaded pole motor

3.3.3 Reluctance start motor

3.4 Alternating current series motor and universal motors

3.5 Single phase synchronous motor

3.5.1 Reluctance motor

3.5.2 Hysteresis motor

3.6 Comparison of 3 phase and Single phase Induction motor

3.7 Application of 3 phase and Single phase Induction motor

4. Special Purpose Machines (12 Periods)

Construction and working principle, characteristics and applications of linear induction motor, stepper motor, Servomotor, Submersible Motor, Introduction to Energy efficient Motors.

LIST OF PRACTICALS

1. Demonstration of revolving field set up by a 3-phase wound stator
2. To plot relationship between no load terminal voltage and excitation current in a synchronous generator at constant speed
3. Determination of the relationship between the voltage and load current of an alternator, keeping excitation and speed constant
4. Determination of the regulation and efficiency of alternator from the open circuit and short circuit test
5. Synchronization of poly phase alternators and load sharing
6. Determination of the effect of variation of excitation on performance of a synchronous motor
7. Study of ISI/BIS code for 3-phase induction motors
8. Perform at least two tests on a 3- phase induction motor as per BIS code

9. Determination of efficiency by (a) no load test and blocked rotor test on an induction motor (b) direct loading of an induction motor (refer BIS code)
10. Determination of effect of rotor resistance on torque speed curve of an induction motor
11. To study the effect of a capacitor on the starting and running of a single-phase induction motor by changing value of capacitor and also to reverse the direction of rotation of a single phase induction motor
12. Slip and slip measurement of three phased induction motor

INSTRUCTIONAL STRATEGY

Teacher should lay-emphasis on development of understanding amongst students about basic principles of operation and control of electrical machines. This may be achieved by conducting quiz tests and by giving home assignments. The teachers should also conduct laboratories classes themselves encouraging each student to perform with his/her own hands and draw conclusions.

RECOMMENDED BOOKS

1. Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, New Delhi
2. Electrical Machines by SK Sahdev, Uneek Publications, Jalandhar
3. Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi

   Electrical Engineering by JB Gupta, SK Kataria and sons, New Delhi
4. Electrical Machines by Samarjit Ghosh, Pearson Education (Singapore) Pvt., Ltd. 482, FIE Patparganj, Delhi 110092
5. Electrical Machines by DR Arora, Ishan Publications, Ambala City

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	30	40
2	20	25
3	18	25
4	12	10
Total	**80**	**100**

5.2 SUBSTATION, SWITCHGEAR AND PROTECTION

	L	P
Periods	4	2

RATIONALE

In view of the complexities associated with the modern interconnected power stations, the responsibilities and the job requirements of a diploma pass out have become more complex than what they used to be earlier. He is required to work with modern electrical equipment and maintain reliability of supply. The course is designed to understand the concepts, principles involved in the construction and working of generating stations and protective switch gear system so that one can handle, install, maintain them and also take decisions at his/her level in different situations. The teaching of this subject requires reinforcement in the form of visits to substations, power stations and well designed laboratory experiences. A practice-oriented approach to the teaching of this subject is suggested.

DETAILED CONTENTS

1. Substations (08 Periods)

   1.1 Brief idea about substations - outdoor grid sub-station 400, 220, 132 KV, and 66 and 33 KV;11 KV, outdoor pole and plinth mounted substations

   1.2 Layout of 33/11 KV and 11KV/400V distribution substation and various auxiliaries and equipment associated with these

2. Faults (06 Periods)

   Common type of faults in both overhead and underground systems, symmetrical/ unsymmetrical faults. Single line to ground fault, double line to ground fault, 3-phase to ground fault and open circuit. Simple problems relating to fault finding.

3. Switch Gears (15 Periods)

   3.1 Purpose of protective gear. Difference between switch, isolator and circuit breakers. Function of isolator and circuit breaker. Making capacity and breaking capacity of circuit breaker (only definition)

   3.2 Circuit breakers. Types of circuit breakers, construction and working of bulk and minimum oil circuit breakers, air blast circuit breakers, vacuum circuit breaker, SF_6 circuit breaker and circuit breaker rating

   3.3 Principles of Arc extinction blast circuit breakers in OCB and ACB. Constructional features of OCB, ACB, and their working, Method of arc extinction

   3.4 Portable circuit breakers - MCB, MCCB, ELCB, for distribution and transmission system description only

4. Protection Devices (15 Periods)

4.1 Fuses; function of fuse. Types of fuses, HV and LV fuses, rewire-able, cartridge, HRC

4.2 Earthing: purpose of earthing, method of earthing, Equipment earthing, Substation earthing, system earthing as per Indian Electricity rules. Methods of reducing earth resistance

4.3 Relays

a) Introduction - types of relays. Electromagnetic and thermal relays, their construction and working

b) Induction type over-current, earth fault relays, instantaneous over current relay

c) Directional over-current, differential relays, their functions

d) Distance relays their functions

e) Idea of static relays and their applications

5. Protection Scheme (10 Periods)

5.1 Relays for generator protection

5.2 Relays for transformer, protection including Buchholtz relay protection

5.3 Protection of feeders and bus bars, over current and earth fault protection.

5.4 Distance protection for transmission system

5.5 Relays for motor protection

6. Over-voltage Protection (10 Periods)

6.1 Protection of system against over voltages, causes of over voltages, utility of ground wire, surge absorber

6.2 Lightning arrestors, rod gap, horn gap, metal oxide type.

6.3 Transmission Line and substation protection against over-voltages and lightning

6.4 Transient over voltage protection

Note: Students may be taken to various Sub-stations/ Grid Stations. Students must be familiarized with present tariff system employed by State Electricity Boards.

LIST OF PRACTICALS

Visit to power station/substation for the conduct of following practical work:

1. Testing of the dielectric strength of transformer oil and air
2. Study of different types of circuit breakers and isolators
3. Plot the time current characteristics of over current relay
4. Perform the overload and short circuit test of MCB as per IS specifications
5. Plot the time-current characteristics of Kit-Kat fuse wire
6. Taking reading of current on any LT line with clip on meter

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of generating stations and substations be arranged and various equipment, accessories and components explained to the students. The protection schemes should be shown at the site and engineers from field may be invited for delivering expert lectures on these topics. Help of Video Films may be taken to explain the layout, construction and working of different power equipment.

RECOMMENDED BOOKS

1. Testing, Commissioning , Operation and Maintenance of Electrical Equipment by S Rao, Khanna Technical Publication, New Delhi
2. Electrical Power – II by SK Sahdev, Uneek Publications, Jalandhar (Pb)
3. Electrical Power Systems by CL Wadhwa, Wiley Eastern Ltd., New Delhi
4. Textbook of Electrical Technology by BL Theraja, S Chand and Co., New Delhi
5. Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi
6. A Course in Electrical Power by ML Soni, PV Gupta and Bhatnagar, Dhanpat Rai & Sons, New Delhi
7. Principles of Power Systems by VK Mehta, S Chand and Co., New Delhi
8. Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	08	10
2	06	10
3	15	30
4	15	30
5	10	10
6	10	10
Total	**64**	**100**

5.3 ELECTRONICS IN INDUSTRY

	L	T	P
Periods/ Weeks	3	-	4

RATIONALE

This course deals with electronic devices and circuits used in industry. It involves the study of thyristors, rectifier circuits, communication circuits and also the application of electronics in industry.

DETAILED CONTENTS

1. Thyristors and Other Power Electronics Devices (30 Periods)

   1.1 Introduction
   1.2 Applications
   1.3 Symbolic Representations
   1.4 Specifications
   1.5 Principle of Operating of an SCR
   1.6 Two-Transistor Analogy of SCR
   1.7 DIAC
   1.8 TRIAC
   1.9 Basic Triggering circuits for Thyristors
   1.10 Rectifier Circuits using SCR
   1.11 Construction and working of Gate Turn Off (GTO) thyristor
   1.12 Characteristics of Programmable Uni-junction Transistor (PUT), ASCR, LASCR, RCT, SCS
   1.13 Construction and Working of IGBT

2. Power Electronics Circuits (18 Periods)

   2.1 Commutation Circuits
   2.2 Inverters series and parallel
   2.3 Choppers: Step up, Morgan's, Jones's
   2.4 Single phase and Three Phase Converters.

3. Module 03- Application of Electronics in Industry/ Sector
   (Not to include in theory) (2 weeks)
   a. Process Industry- i) Chemical Industry ii) Sugar iii) Paper iv) Paint v) Steel vi) Fertilizer vii) Glass viii) Textile ix) Rubber
   b. Medical and Pharmaceutical Industry
   c. Computer Manufacturing Industry
   d. Consumer Goods Industry
   e. Service Sector
   f. Power Generation and Transmission Industry
   g. Communication Service providing Organisation as BSNL, Reliance, Airtel, Idea, Government Telecommunication Department etc
   h. Defence Sector
   i. Space Organisation
   j. Petroleum Industry

Student will get the exposure of equipments, flow diagram of organisation setup maintenance and service of any of 4 above industry/ sector. And will submit the report and the evaluation will be based on viva-voice.

LIST OF PRACTICALS

1. Testing of components- SCR, DIAC, TRIAC
2. To plot and verify Characteristic of an SCR
3. To plot and verify Characteristic of an TRIAC
4. To plot V-I characteristics of UJT
5. To plot V-I characteristics of DIAC
6. Assembly and testing of Half-wave Gate-controlled Rectifier using One SCR
7. Assembly and testing of Single-phase Half-controlled Full-wave Rectifier using two SCRs and two Diodes
8. Assembly and testing of Illumination/ Fan Control circuit using SCR
9. Assembly and testing of Illumination Control circuit using Triac
10. Assembly and testing of SCR Controlled Emergency light
11. Study of Integrator and Differentiator circuit using OPAMP 741
12. Study of Adder and comparator circuit using OPAMP 741
13. To visit at least four industries mentioned at module 03 and write the report.

INSTRUCTIONAL STRATEGY

Electronics in Industry is the subject related to practical implementation and exposure of electronic devices and circuits in today's industries. Thus, it requires both theoretical as well as practical exposure.

RECOMMENDED BOOKS

1. Industrial Electronics: S.K. Bhattacharya / S Chatterjee, Tata McGraw-Hill Publishing
1. Company Limited
2. Industrial Electronics: James Humphries, Leslie Sheets, 4e - Delmar Publications
3. Industrial Electronics: Biswanath Paul PHI
4. Industrial Electronics for Technicians: J.A.Sam Wilson Joseph Rissi, Prompt Publications
5. Thyristors and its Application by Ramamurthy, East West New Delhi
6. Modern Digital Electronics by R.P. Jain, McGraw Hill Publication
7. Op-amp and linear integrated circuits by Gaikwad, Eastern co. Edition PHI
8. Electrical and Electronic Measurements by A. K. Sawhney, Dhanpat rai & Sons New Delhi
9. Power Electronics by P.C. Sen, Tata McGraw-Hill Publishing, New Delhi
10. Digital Electronics by Malvino Leach, Tata McGraw-Hill Publishing, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	30	60
2	18	40
Total	**48**	**100**

54 CONSUMER ELECTRONICS AND TROUBLESHOOTING

L T P
Periods/Week 3 1 4

RATIONALE

The objective of teaching this subject is to give students an in depth knowledge of various electronic audio and video devices and systems. Further this subject will introduce the students with working principles, block diagram, main features of consumer electronics gadgets/goods/devices like audio-systems, CD systems. TV and other items like microwave ovens, Photostat machines etc. Which in-turn will develop in them capabilities of assembling, fault diagnosis and rectification in a systematic way.

DETAILED CONTENTS

1. Audio Systems: (08 Periods)

   1.1. Microphones and Loudspeakers
   a) Carbon, moving coil, cordless microphone
   b) Direct radiating and horn loudspeaker
   c) Multi-speaker system

   1.2 Sound Recording
   a) Magnetic Recording
   b) Digital Recording
   c) Optical Recording (CD system and DVD)

   1.3 Study of VCD and DVD Player systems.

2. Television

   2.1. Monochrome TV (14 Periods)
   a) Scanning and its need
   b) Need of synchronizing and blanking pulses, VSB
   c) Composite Video Signal
   d) Picture Tube
   e) Camera Tube : Vidicon and Plumbicon
   f) TV Receiver: Block diagram, function of each block, waveform at input and output of each block.

   2.2. Colour Television: (12 Periods)
   a) Primary, secondary colours
   b) Concept of Colour Mixing, Colour Triangle
   c) Camera tube
   d) PAL TV Receiver
   e) Concept of Compatibility with Monochrome Receiver
   f) NTSC, PAL, SECAM system (brief comparison)

3. LCD and LED Television: Basic principle and working of LCD & LED TV (06 Periods)

4. Cable Television: Concept and Working of Cable TV, DTH, HDTV (06 Periods)

5. Consumer Appliances- Principle, Working and troubleshooting with special emphasis on control panel (10 Periods)

a) Microwave Oven
b) Washing Machine
c) Photostat Machine
d) DTH System
e) Digital Camera

6. a) Repair, Servicing and Maintenance Concepts (8 Periods)

Mean time between failures (MTBF), Mean time to repair (MTR), Maintenance policy, potential problems, preventive maintenance and corrective maintenance.

b) Fundamental Trouble Shooting Procedures

i) Fault location
ii) Fault finding aids
- Service manuals
- Test and measuring instruments
- Special tools

iii) Trouble Shooting Techniques
- Functional Areas Approach
- Split half method
- Divergent, convergent and feedback path circuit

LIST OF PRACTICALS

1. To plot the directivity pattern and frequency response of a microphone.
2. To plot the directivity pattern and frequency response of a loudspeaker.
3. Demonstration of VCD/DVD player and study of its transport mechanism.
4. Familiarization with the different sections of B/W TV Receiver.
5. To observe the wave forms and voltage of B/W and colour TV Receiver.
6. Fault finding of colour T.V Receiver.
7. Familiarization with different section of LCD & LED TV
8. Study of cable TV network system.
9. Demonstration and Operation of Control Panel
   (a) Microwave Oven
   (b) DTH System
   (c) Photostat Machine
   (d) Washing Machine

INSTRUCTIONAL STRATEGY

This subject gives the knowledge of the various day-to-day life electronic products. So, the teacher is required to show and demonstrate the gadgets and impart practical knowledge to the students. For that one should give home assignment and frequent industrial visit should be there. Visit to TV studio and TV transmitter station should be arranged to give a practical exposure to the students.

RECOMMENDED BOOKS

1. Audio and Video Systems by RG Gupta, Tata McGraw Hill Education Pvt Ltd, New Delhi
2. Colour Television-Principles & Practice by R.R Gulati , Wiley Eastern Limited, New Delhi
3. Complete Satellite & cable Television R.R Gulati New age International Publisher, New Delhi
4. Colour Television Servicing by RC Vijay BPB Publication, New Delhi
5. Colour Television & Video Technology by A.K. Maini CSB Publishers
6. Colour TV by A. Dhake
7. Service Manuals, BPB Publication, New Delhi
8. Modern Electronic Equipment Trouble shooting, Repair and Maintenance by RS Khandpur, Tata McGraw Hill Education Pvt Ltd, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation%
1	08	15
2 a	14	15
2 b	12	20
3	06	10
4	06	10
5	10	20
6	08	10
Total	**64**	**100**

5.5 INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES

	L	P
Periods	5	3

RATIONALE

Industrial electronics plays a very vital role in the field of control engineering specifically in the modern industries as they mostly use electronic controls, which are more efficient, effective and precise as compared to the conventional methods. The old magnetic and electrical control schemes have all become obsolete. Electrical diploma holder many times has to maintain the panels used in the modern control process. Therefore, the knowledge of components like thyristors and other semiconductor devices used in such control panels is must for them in order to supervise the work efficiently and effectively. Looking in to usefulness and importance of the subject this has been incorporated in the curriculum.

DETAILED CONTENTS

1. Introduction to SCR (20 Periods)

   1.1 Construction and working principles of an SCR, two transistor analogy and characteristics of SCR
   1.2 SCR specifications and rating
   1.3 Construction, working principles and V-I characteristics of DIAC, TRIAC
   1.4 Basic idea about the selection of heat sinks for SCR and TRIACS
   1.5 Methods of triggering a Thyristor. Study of triggering circuits
   1.6 UJT, its Construction, working principles and V-I characteristics, UJT relaxation oscillator
   1.7 Commutation of Thyristors (Concept)
   1.8 Series and parallel operation of Thyristors
   1.9 Applications of SCR, TRIACS such as light intensity control, speed control of DC and universal motor, fan regulator, battery charger, temperature control
   1.10 Protection of SCR
   1.11 Snubber Circuit

2. Controlled Rectifiers (13 Periods)

   2.1 Single phase half wave controlled rectifier with resistive load and inductive load, concept of freewheeling diode.
   2.2 Single phase half controlled full wave rectifier (No mathematical derivation)
   2.3 Single phase fully controlled full wave rectifier bridge
   2.4 Single phase full wave centre tapped rectifier
   2.5 Three phase full wave half controlled bridge rectifier
   2.6 Three phase full wave fully controlled bridge rectifier

3. Inverters, Choppers, Dual Converters and Cyclo Converters (21 Periods)

   3.1 Inverter-introduction, working principles, voltage and current driven series and parallel inverters and applications
   3.2 Choppers-introduction, types of choppers and their working principles and applications
   3.3 Dual converters-introduction, working principles and applications
   3.4 Cyclo-converters- introduction, types, working principles and applications

4. Thyristor Control of Electric Drives (18 Periods)
   - 4.1 DC drives control (Basic Concept)
   - 4.2 Half wave drives
   - 4.3 Full wave drives
   - 4.4 Chopper drives
   - 4.5 AC drives control
   - 4.6 Phase control
   - 4.7 Variable frequency a.c. drives
   - 4.8 Constant V/F application
   - 4.9 Voltage controlled inverter drives
   - 4.10 Constant current inverter drives
   - 4.11 Cyclo convertors controlled AC drives
   - 4.12 Slip control AC drives

5. Uninterrupted Power Supplies (08 Periods)
   - 5.1 UPS, Stabilizers, SMPS
   - 5.2 UPS online, off line
   - 5.3 Storage devices (batteries)

LIST OF PRACTICALS

1. To draw V-I characteristics of an SCR
2. To draw V-I characteristics of a TRIAC
3. To draw V-I characteristics of a DIAC
4. To draw uni-junction transistor characteristics
5. Observe the output wave of an UJT relaxation oscillator
6. Observe the wave shape across SCR and load of an illumination control circuit
7. Fan speed regulator using TRIAC
8. Speed-control of a DC shunt motor or universal motor
9. To observe the output wave shape on CRO of a Single phase half controlled full wave rectifier
10. Single phase controlled rectifier
11. Use of Variable Frequency Drive for running a 3 phase Induction motor

INSTRUCTIONAL STRATEGY

The teachers may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. The available video films on the subject must be shown to the students.

RECOMMENDED BOOKS

1. Industrial Control Electronics. John Webb, Kevin Greshock, Maxwell, Macmillan International editions
2. Fundamentals of Power Electronics by S Rama Reddi, Narosa Publishing House Pvt. Ltd, New Delhi
3. Power Electronics, Circuits Devices and Applications by Mohammad H. Rashid
4. Power Electronics by PC Sen
5. Power Electronics by Dr. PS Bhimbra, Khanna Publishers, New Delhi

6. Industrial Electronics & Control by SK Bhattacharya & S Chatterji, New Age international Publications(P) Ltd, New Delhi
7. Industrial Electronics and Control of Drives by SK Sahdev, Uneek Publication, Jalandhar
8. Industrial Power Electronics by JC Karhava, King India Publication,
9. Fundamentals of Electrical Drives by Gopal K Dubey, Narosa Publishing House Pvt. Ltd, New Delhi
10. Power Electronics and Controls by Samir K Datta, Prentice Hall of India, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Periods)	Marks Allocation (%)
1	20	25
2	13	15
3	21	30
4	18	20
5	08	10
Total	**80**	**100**

5.6 PROCESS CONTROL AND INSTRUMENTATION

	L	T	P
Periods/ Weeks	4	-	2

RATIONALE

The technician has the responsibility of using and maintaining electronic test equipments, for measurement, design, testing and trouble shooting, with the introduction of new techniques of process control in modern industries, the use of transducing elements in agriculture and other non-engineering areas, the task of the technician has become varied and different from the previous task of measurement only.

The Course aims to develop appreciation and understanding of the use of measurement of a variety of physical quantities and their control.

(A) Process Instrumentation

1. Introduction (04 Periods)
   - Functional block diagram of instrumentation system.
   - Description of each block
   - Process
   - Process Characteristics
   - Process Variables

2. Pressure Measurement (05 Periods)
   - Types of Pressure
   - Measurement of Pressure by Manometers
   - Diaphragms
   - Bourdon Tube
   - Bellows
   - Vacuum Measurement

3. Temperature Measurement (05 Periods)
   - Temperature Measuring Devices Like Thermocouples.
   - Pyrometer
   - Resistance Thermometer.
   - Thermister
   - Bimetallic Thermometer

4. Strain Measurement (05 Periods)
   - Requirements for strain measurement
   - Strain Gauges
   - General Strain Measurement
   - Load cell

5. Vibration and Angular Velocity Measurement (05 Periods)

- Vibration Measurement Systems
- Measurement of Angular Velocity
- DC & AC Tachometer Generators
- Digital Methods

6. Flow Measurement (06 Periods)

- General
- Types of Flow
- Flow Coefficient
- Renolds No
- Flow Meters
- Venturi Meter
- Orifice Plate
- Pitot Tube
- Rotameter

7. Humidity, Moisture and Level Measurement (04 Periods)

- Hygrometer method for humidity measurement
- Moisture meter
- Electrical contact type liquid level indicators

8. Chemical, Analytical, Medical & Nuclear Instruments (07 Periods)

- Spectrophotometer, Filters
- Electrochemical Sensors
- PH Meter
- General idea and working and application of Medical Instruments as X-Ray Machine, Electronic method for BP measurement, Blood Sugar measurement, EEG and ECG machine
- Brief description of Nuclear Instrumentation

(B) Process Control

9. Introduction (02 Periods)

- Block diagram of a general open and closed loop process
- Automatic Control

10. Control System Components (06 Periods)

- Brief description and working of a potentiometer
- Differential transformer, servo motors
- Tacho Generator
- Eddy Current clutches, relay contractors, timing relay

11. Types of Control Techniques (05 Periods)

- Brief Idea and Introduction of following control techniques
- ON-OFF Control
- Proportional
- Integral
- Derivative
- PI
- PD
- PID

12. Controller (10 Periods)

- Block Diagram & Circuits of pneumatic PI,PD & PID controller, ON-OFF Controller
- Electronic Controller/Automatic Controller
- Simple Example Of
- Heating Control using SCR
- Illumination Control
- Level Control
- Pressure Control

LIST OF PRACTICALS

1. Experiment of Pressure Measurement
2. Experiment of Temperature Measurement
3. Experiment of Flow Measurement
4. Experiment of Moisture/Humidity Measurement
5. Experiment of Strain Measurement/ load cell
6. Experiment on spectrophotometer and PH meter.
7. Measurement of Level
8. Measurement of angular velocity
9. ON /OFF Controller
10. Experiment of Elex Controller
    a. Heating Control Using SCR
    b. level Control
    c. Illumination Control
    d. Pressure Control

RECOMMENDED BOOKS

1. Instrumentation Devices & Systems by By S. Ranjan; Tata McGraw-Hill Publishing
2. Electrical & Elex Measurement by A. K. Sawhney; Danpat Rai & Co.
3. Industrial Instrumentation by Tyson
4. Process Instrumentation byy Donald P. Echman
5. Process Control by Donald P. Echman
6. Instrumentation by Cirk & Rimboi
7. Instrumentation Measurement and Analysis by B. C. Nakra and K K Chaudhary; MC Graw Hill Publication

8. Electronics Instrumentation by H.S. Kalsi; McGraw Hill Publication
9. Medical Instruments by S. Ananthi; New Age International (P) Limited Publisher

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Topic	Time Allotted (Periods)	Marks Allotted (%)
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2	05	05
3	05	05
4	05	05
5	05	05
6	06	10
7	04	05
8	07	15
9	02	05
10	06	10
11	05	10
12	10	20
Total	**64**	**100**