UTTARAKHAND BOARD OF TECHNICAL EDUCATION
JOINT ENTRANCE EXAMINATION AND TRAINING, RESEARCH DEVELOPMENT CELL, DEHRADUN
STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME

BRANCH NAME – ELECTRICAL AND ELECTRONICS ENGINEERING　　　　　　　　　　**SEMESTER – IV**

Subject Code	Subject	L	T	P	TOT	Internal		External				Total Marks	Credit Point
						Theory	Practical	Theory		Practical			
		Period/Weeks				Max Marks	Max Marks	Max Marks	Hrs.	Max Marks	Hrs.		
084001	Electrical Engineering Design and Drawing	-	-	6	6	-	50	100	3.0	50	3.0	200	4
314002	D.C Machines	5	-	3	8	20	30	50	2.5	50	3.0	150	5
314004	Industrial Electronics	4	-	4	8	20	30	50	2.5	50	3.0	150	4
314005	Programmable Logic Controller (PLC)	4	-	4	8	20	30	50	2.5	50	3.0	150	5
314001	Transformers and Batteries	4	-	3	7	20	30	50	2.5	50	3.0	150	5
314003	Digital Electronics Concept	5	-	2	7	50	-	100	3.0	-	-	150	5
314052	Industrial Exposure (Assessment at Institute Level) +	-	-	-	-	-	25	-	-	-	-	25	1
014054	General Proficiency#	-	-	4	4	-	25	-	-	-	-	25	1
314053	Industrial Training	Industrial Training of 04 weeks done after 4th Semester would be evaluated in 5th Semester through Report and Viva-voce.											1
	Total	22	-	26	48	130	220	400	-	250	-	1000	30

*　Industrial Training of 30 days done after 4th Semester would be evaluated in 5th semester through Report and Viva-voce

\#　General Proficiency will comprise of various co-curricular activities like games, hobby clubs, seminars, declamation contests, extension lectures, NCC, NSS and cultural activities, elementary mathematics, GS & G.K 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.

Branch Code - 31

20

FOURTH SEMESTER
ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRICAL ENGINEERING DESIGN AND DRAWING

Subject Code : 084001

L	T	P
-	-	6

RATIONALE

A polytechnic pass-out in electrical and electronics engineering is supposed to have ability to

i) Read, understand and interpret engineering drawings

ii) Communicate and co-relate through sketches and drawings

iii) Prepare working drawings of panels, transmission and distribution

The contents of this subject has been designed to develop requisite knowledge and skills of electrical drawings in the students of diploma in electrical engineering.

DETAILED CONTENTS (To make 25 Sheets)

1. Symbols and Signs Conventions (2 Sheets)   (06 Periods)

Various Electrical Symbols used in Domestic and Industrial Installation and Power System as per BIS

2. Panels/Distribution Boards (3 Sheets)   (18 Periods)

Design and Drawing of panels/Distribution board using MCBs, ELCB, main switches and change over switches for domestic installation, industrial and commercial installation.

3. Orthographic projections of Simple Electrical Parts (4 Sheets) (12 Periods)
- Pin type and shackle type insulator (Pin Type 11kV/66kV)
- Bobbins of a small transformer / choke
- Stay insulators/Suspension type insulators
- Free hand sketching of M.C.B. and E.L.C.B Placed on Distribution Board.

4. Orthographic Projection of Machine Parts(4 Sheets)   (12 Periods)
- Rotor of a squirrel cage induction motor
- Motor body (induction motor) as per IS Specifications (using outside dimensions)
- Slip rings of 3-phase induction Motor.
- Stator of 3 phase Induction motor (Sectional View)

5. **Contactor Control Circuits : Schematic and wiring diagram (3 Sheets)**

(24 Periods)

- DOL Starter of 3-phase induction Motor
- Forwarding / reversing of 3-phase induction motor
- Limit switch control of a 3-phase induction motor
- Sequence operation of two motors using T.D.R.
- Two speed motor control
- Automatic star-delta starter for 3-phase induction motor

6. Earthing – Layout of earthing of substation, earthing of poles, transformers (3Sheets) **(08 Periods)**
7. Key diagram of 33/11 KV substation (2 Sheets) **(06 Periods)**

8. **Design/Drawing of application circuit used in intelligent building (04sheets)**

(10 Periods)

a. Security system / intelligent camera / automatic recording/ photography system
b. Stage lighting
c. Safety system
d. Centralized air-conditioning system
e. Computer Networking

INSTRUCTIONAL STRATEGY

Teacher should identify/prepare more exercises on the pattern shown above. The teacher should make the students confident in making drawing and layouts of electrical wiring installations and doing estimation and costing. This capability will lead the students to become a successful entrepreneur. Take the students to field/laboratory and show the material and equipment.

RECOMMENDED BOOKS

1. Electrical Engineering Design and Drawings by Surjeet Singh, Dhanpat Rai and Co, New Delhi
2. Electrical Engineering Design and Drawings by SK Bhattacharya, SK Kataria and Sons, New Delhi
3. Electrical Engineering Design and Drawings by Ubhi & Marwaha, IPH, New Delhi

4. Electrical Design and Drawing by SK Sahdev, Uneek Publications, Jalandhar

5. Electrical Engineering Drawing by Surjit Singh, SK Kataria and Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	06	06
2	18	18
3	12	12
4	12	12
5	24	24
6	08	08
7	06	10
8	10	10
Total	**96**	**100**

D.C. MACHINES

L	T	P
5	-	3

Subject Code : 314002

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. 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. Fundamentals of D.C Generators and their applications   (20 Period)

Dynamically induced E.M.F, electromechanical energy conversion, simple loop generator, principle of D.C generator, functions of D.C. generator parts with neat sketches, windings, (i) Lap (ii) Wave-Classification of generators based on excitation, E.M.F equation , losses incurred in the D.C machines, Voltage and Current equations for different types of D.C Generators, simple problems.

2. Armature Reaction and Characteristics of D.C. Generators.   (20 Period)

Armature reaction, Demagnetization & Cross magnetization, Derive for ATd, ATc / Pole., simple problems, Commutation, methods of improving commutation, Method of improving Commutation by Interpole method, O.C.C., internal, external characteristics of Separately excited, Shunt, Series and Compound generators, Conditions for (i) Building up (ii) Non building up of E.M.F., Critical field resistance and critical speed from O.C.C - parallel operation of generators , Applications of D.C generators, Welding Generator.

3. Fundamentals of D.C Motors and their applications   (20 Period)

Working of D.C. motors, classification, significance of back E.M.F. Write the formulas for back E.M.F for different D.C motors, Problems on E.M.F equation, Torque equation, Armature torque (Ta), shaft torque (Tsh) and loss torque, Different losses, electrical and mechanical characteristics of D.C Shunt, Series and compound motors

4. Speed Control and Starters for D.C Motors   (16 Period)

Necessity of speed control, different methods (Flux, Armature and Voltage) of speed controls for D.C shunt motors, State the advantages and disadvantages of above methods, different methods of speed control for series motors, problems, necessity of starter, 3-point starter, 4-point starter.

5. Testing of D.C Motors   **(04 Period)**

Brake test on different types of D.C. Motors – Swinburne's Test – Hopkinson's test .

LIST OF PRACTICALS

1. Identify the terminal of the following D.C. Machines.

    a). D.C. Shunt motor. b). D.C. Series Motor.

2. Identify the terminals of a D.C. Compound motor.

3. Study the parts of D. C. 3 - Point Starter, 4 - Point Starter and Drum controlled Starter.

4. Obtain O.C.C of a DC Shunt Generator at different speeds .

5. Obtain Internal & external characteristics of D.C. Shunt Generator

6. Obtain Internal & external characteristics of D.C. Series Generator

7. Obtain Internal & external characteristics of D.C. Compound Generator

8. Overhauling of a D.C. Machine.

9. Obtain performance characteristics by conducting brake test on DC shunt motor

10. Obtain performance characteristics by conducting load test on DC series motor

11. Obtain performance characteristics by conducting load test on DC compound motor

12. Speed control of DC shunt motor by

    a) Rheostatic control b) Field control

13. Obtain the performance of a D.C. Shunt Motor by conducting Swinburne's test .

INSTRUCTIONAL STRATEGY

Electrical machines being a core subject of electrical diploma curriculum, where a student will deal with various types of electrical machines which are employed in industry, 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. Special care has to be taken on conceptual understanding of concepts and principles in the subject. For this purpose exposure to industry, work places, and utilization of various types of electrical machine for different applications may be emphasized. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.

RECOMMENDED BOOKS

1. Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, Education Pvt Ltd. New Delhi

2. Electrical Machines by SK Sahdev, Uneek Publications, Jalandhar

3. Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi

4. Electrical Machines by JB Gupta, SK Kataria and Sons, New Delhi
5. Electrical Machines by B.L.Thareja
6. Electrical Machines by P.S.Bhimbhra Khanna Publishers, Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	20	25
2	20	25
3	20	25
4	16	20
5	04	05
Total	**80**	**100**

INDUSTRIAL ELECTRONICS

L	T	P
4	-	4
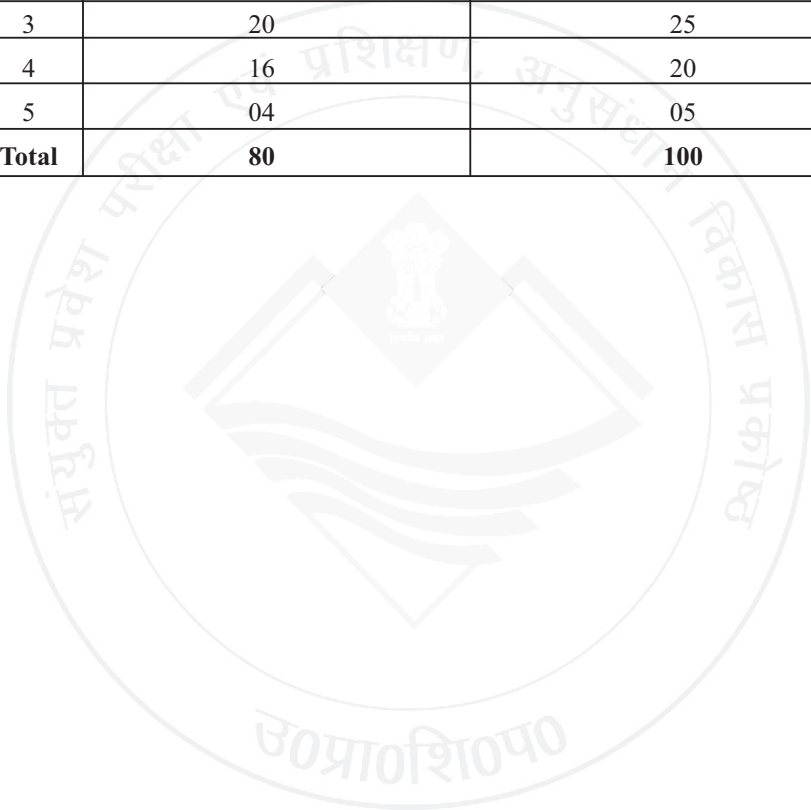
Subject Code : 314004

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 and Electronic 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. Thyristors, their characteristics and application   (20 Periods)

Introduction to Power electronics, thyristor family V-I characteristics of SCR, SUS, PUT, SCS, GTO, LASCR, DIAC and TRIAC. Principle of operation of SCR. Two transistor analogy. Turn on methods of a thyristor, Switching characteristics of thyristors during turn-on and turn-off. Gate characteristics and its protection. Firing methods of thyristors. Gate triggering circuits. Series and parallel operation of SCRs. Snubber circuits. Power dissipation. Thyristor commutation techniques:- Load commutation (Class A), Resonant-Pulse commutation (class B), impulse commutation (class D), Line commutation (class F).

2. Phase controlled techniques   (12 Periods)

Introduction to phase angle control. Single phase half wave controlled rectifiers. Single phase half controlled and full controlled bridge rectifiers. Three phase half and full controlled bridge rectifiers. Effect of resistive, inductive, resistive cum inductive and motor loads.

3. Power Electronics Converters   (16 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   (16 Periods)

4.1 DC drives control (Basic Concept)

4.2 Half wave drives, Full wave drives, Chopper drives

4.3 AC drives control

4.4 Phase control, Variable frequency a.c. drives

4.5 Constant V/F application

4.6 Voltage controlled inverter drives, Constant current inverter drives

4.7 Cyclo convertors controlled AC drives, Slip control AC drives

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. Speed-control of a DC shunt motor or universal motor

12. To observe the output wave shape on CRO of a Single phase half controlled full wave rectifier

13. Single phase controlled rectifier

14. Use of Variable Frequency Drive for running a 3 phase Induction motor

RECOMMENDED BOOKS

1. P.S. Bimbhra, Power Electronics, Khanna Publishers.

2. M.D. Singh, K.B. Khanchandani, Power Electronics, Tata Mc Graw Hill Publishing company limited.

3. M.H. Rashid, Power Electronics, PHI.
4. P.C. Sen, Power Electronics, Tata Mc Graw Hill Publishing company limited.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	20	30
2	12	20
3	16	25
4	16	25
Total	**64**	**100**
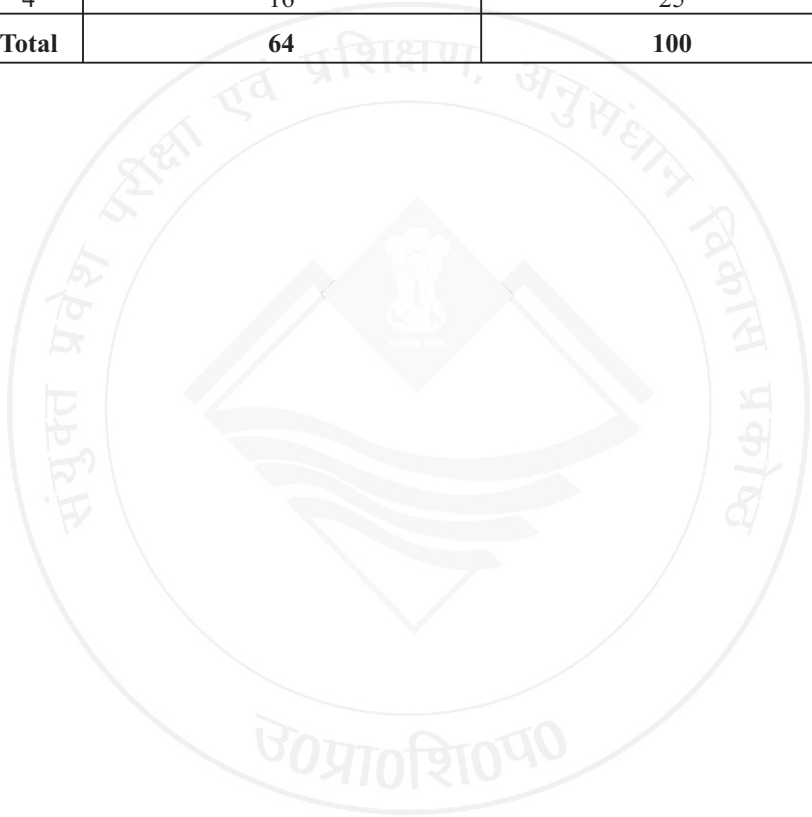
PROGRAMMABLE LOGIC CONTROLLER (PLC)

L	T	P
4	-	4

Subject Code : 314005

RATIONALE

This subject deals with the various instruments, their construction and working which control the various parameters and operations in any industry. A diploma holder in the field of Electronics employed for maintenance of electronic equipment/ gadgets is required to diagnose faults, rectify them and test the total system for good performance. Thus there is a need of introducing diploma holders to the basics of Instrumentation.

In industry, many manufacturing processes demand a sequence of operation, which are to be performed repetitively. Early automation systems were mechanical in design, timing and sequencing being effected by gears and cams. Slowly these design concepts were replaced by electrical drives which were controlled by relays and now by programmable logic controllers (PLCs). A PLC is a solid state device, designed to operate in noisy industrial environments and can perform all logic functions. PLCs are widely used in all industries for efficient control operations. A diploma holder in industry is called upon to design , modify and troubleshoot such control circuits. Looking at the industrial applications of PLCs in the modern industry, this subject finds its usefulness in the present curriculum.

DETAILED CONTENTS

1. Introduction to PLCs   (05 Periods)

What is PLC, limitations of relays. Advantages of PLCs over electromagnetic relays, Different programming languages, PLC manufacturer etc.

2. Working of PLC   (14 Periods)

Basic operation and principle of PLC, Architectural details – Processor Memory structure, I/O Structure Programming terminal, Power Supply

3. Instruction Set   (15 Periods)

Basic instructions like latch, master control self holding relays. Timer instructions like on-delay timers, off-delay timers, retentive timers, resetting of timers. Counter instructions like up-counter, down counter, resetting of counters. Sequencers, output sequencers, input sequencers time driven and event driven sequencers masking etc. Comparison instruction like equal, not equal, greater, greater than equal, less than, less than equal mask equal, limit etc.

4. **Ladder diagram programming**   **(15 Periods)**

Programming based on Basic instructions, timer counter, sequencer to comparison instruction using ladder diagrams.

5. **Applications of PLCs**   **(15 Periods)**

Assembly, Packaging, Process controls, Car parking, Doorbell operation, Traffic light control, Microwave Oven, Washing machine, Motor in forward and reverse direction, Star-Delta, DOL Starters, Paint Industry, Filling of Bottles, Room Automation

LIST OF PRACTICALS

1. Familiarization with the working of PLC

2. Components/sub-components of a PLC, learning functions of different modules of a PLC system

3. Introduction to programming language, ladder diagram concepts, instruction list for module 5.

4. Basic logic operations, AND, OR, NOT, functions

5. Logic control systems with time response as applied to clamping operation

6. Sequence control system e.g in lifting a device for packaging and counting

7. PLC based traffic light control (two ways)

INSTRUCTIONAL STRATEGY

The teacher should explain the scope of various measuring devices and their practical application in the field. The transducers and measuring devices must be shown to the students and they should be trained in the selection, operation, maintenance and calibrations. Frequent visits to nearby process industries will be of immense help to the students. The inputs shall start with theoretical inputs to architecture, instruction set, assembly language programming, Small projects may be identified, be designed and implemented. PLC ladder diagram and programming should be supplemented with visits to industry. More emphasis may be given to practical work.

RECOMMENDED BOOKS

1. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA

2. Introduction to PLCs by Gary Dunning. McGraw Hill

3. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh

4. Module on "Allen Bradlag PlC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh

5. Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	5	05
2	14	20
3	15	25
4	15	25
5	15	25
Total	**64**	**100**

TRANSFORMERS AND BATTERIES

Subject Code : 314001

L	T	P
4	-	3

RATIONALE

In the real world of work the technician is required to handle wide variety of instruments while testing, trouble shooting, calibration etc. the study of this subject will help students to gain the knowledge of working principles and operation of different instruments. During practical sessions, he will acquire the requisite skills.

DETAILED CONTENTS

1. Transformers their applications   **(30 Periods)**

   1.1 Introduction

   1.2 Constructional features of a transformer and parts of transformer

   1.3 Transformer oil, Accessories: tank & radiator, breather, conservator, Buchholz relay, bushings, pressure relief valve {PRV}& explosion vent (protection from explosion).

   1.4 Working principle of a transformer

   1.5 EMF equation

   1.6 Transformer on no-load and its phasor diagram

   1.7 Transformer–neglecting voltage drop in the windings–Ampere turn balance – its phasor diagram

   1.8 Mutual and leakage fluxes, leakage reactance

   1.9 Transformer on load, voltage drops and its phasor diagram

   1.10 Equivalent circuit

   1.11 Relation between induced emf and terminal voltage, regulation of a transformer-mathematical relation

   1.12 Losses in a transformer

   1.13 Open circuit and short circuit tests. Calculation of efficiency, condition for maximum efficiency-maintenance of Transformer, scheduled Maintenance

   1.14 Auto transformer construction, saving of copper, working and applications

   1.15 Different types of transformers including dry type transformer.

   1.16 Different types of cooling methods

   1.17 Problems - Cause of noise & vibration in transformers – Rating of transformer.

   1.18 Types- Distribution and power transformers, Dry-type transformer, New compact transformer

1.19 Methods of tap - changing. Tap changers (off load and on-load type) – practical use – Explanation of automatic control of tap-changers with block diagram.

2 Three phase Transformers and their applications   (19 Periods)

2.1 Construction of three phase transformers and accessories of transformers such as Conservator, breather, Buchholz Relay, Tap Changer (off load and on load) (Brief idea)

2.2 Types of three phase transformer i.e. delta-delta, delta-star, star-delta and star-star, Clock conventions

2.3 Conditions for parallel operation (only conditions are to be studied)

2.4 On load tap changer

2.5 Difference between power and distribution transformer

2.6 Cooling of transformer

3. Batteries and their applications   (15 Period)

Classification of Primary cell and secondary cells, Lead acid, Nickel iron and Nickel, cadmium, Chemical reaction during charging and discharging, Materials used for Separators, containers and Electrolyte in batteries, Effect of temperature on Specific gravity of electrolyte , Effect of specific gravity on EMF, Construction of Nickel Iron Cell and its chemical reactions, applications and Comparisons of Lead-Acid cell, Nickel –Iron and Nickel–Cadmium cell and comparison between them, Charging of Batteries: Constant current method and constant voltage method-Trickle charging, Capacity of Battery, Effects of temperature, rate of discharge and density of electrolyte, Ampere-hour efficiency and watt-hour efficiency, problems, Maintenance free batteries.

LIST OF PRACTICALS

1. To determine equivalent circuit parameters of single-phase transformer by performing O.C. test and S.C. test.

2. To determine the regulation & efficiency of single-phase transformer by direct loading method.

3. To operate two single-phase transformers in parallel & find out the load sharing between them.

4. To perform heat run test of a single-phase transformer.

5. To compute the efficiency of a single-phase transformer by Back-to-Back test.

6. To Check the polarity of the windings of a three phase transformer and connecting the   windings in various configurations

7. To Study the Buchholz Relay.

8. To test for primary/secondary winding of a transformer.

9. To Find the voltage and current relationships of primary and secondary of a three phase transformer under balanced load in various configurations conditions such as (a) Star-star (b) Star delta (c) Delta star (d) Delta - Delta configuring conditions.
10. To Study the Charging and Discharging of Lead Acid Batteries.

INSTRUCTIONAL STRATEGY

After making the student's familiar with measuring instruments, they should be made conceptually clear about the constructional features and make them confident in making connection of various measuring instruments. Teacher should demonstrate the application of each measuring instrument in laboratory and encourage students 1o use them independently.

RECOMMENDED BOOKS

1. Electrical Machines by S. K. Bhattacharya – Tata McGrew Hill Publications
2. Electrical machines by M. V. Deshpande – Wheeler Publication.
3. Theory & Performance of Electrical Machine by J. B. Gupta
4. D. C. Machines and Transformers by K. Mungnesh Kumar – Vikas Publication
5. A Text Book of Electrical Technology by B. L. Thereja – S. Chand publication
6. Electrical Machine by Dr. P. K. Mukherjee & S. Chakraborty
7. AC Machines by M. G. Say
8. The performance and design of D. C. machines by A. E. Clayton.
9. Fundamentals of Electric Machine by B. R. Gupta and V. Singhal _____

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	30	50
2	19	35
3	15	15
Total	**64**	**100**

DIGITAL ELECTRONICS CONCEPT

L	T	P
5	-	2

Subject Code : 314003

Rationale

To study different logic families. To introduce different logic gates, their Boolean algebra and combinational logic design using those gates. To learn how to design sequential logic using flip flop. After this course the student will be able to design simple logic circuits, assemble logic circuits, test the logic circuits, observe outputs of logic circuits and troubleshoot digital circuits.

DETAILED CONTENTS

1. Introduction To Digital Techniques and their applications (Period 10)

Analog v/s Digital systems, Digital circuit, Digital signal, Use of digital circuit and digital signal, Advantages and Disadvantages of Digital circuits, Number System - Introduction to Binary, Octal, Decimal, Hexadecimal number system. Conversion of number systems, 1's complement and 2's complement, Binary arithmetic (addition, subtraction). BCD code, BCD arithmetic (addition, subtraction). Introduction to A/D and D/A Converters.

2. Logic Gates And Boolean Algebra and their applications (Period 16)

Logical symbol, logical expression and truth table of AND, OR, NOT, NAND, NOR, EX- OR and EX-NOR gates, Universal gates – NAND and NOR gate, Logical circuits of basic gates using universal gates, Basic laws of Boolean algebra, Duality theorem, De Morgan's theorems.

3. Combinational Logic Design / Circuits and their applications (Period 22)

Simplification of Boolean expression using Boolean algebra. Construction of logical circuits forms Boolean expressions. Boolean expressions using Sum of products and product of sums forms. K-map representation of logical functions. Minimization of logical expressions using K- map (2, 3, 4 variables). Standardization of SOP & POS equations. Concept of Adders /Subtractors. Truth table, K-map, Simplified logical expression and logical circuit using basic gates and universal gates of:

(a) Half adder and full adder.

(b) Half subtractor and full subtractor.

Block diagram, Truth table, Logical expression and logic diagram of Multiplexers (4:1 and 8:1), Multiplexer IC. Block diagram and Truth table of Demultiplexer (1:4; 1:8), Demultiplexer IC. Block diagram, Truth table, working principle of Encoders & Decoders

4. Flip Flops And Sequential Logic Design and their applications

(Period 27)

One-bit memory cell, clock signal, Symbol and Logic diagram using NAND gates, working and truth table of R S flip- flop. Symbol and Logic diagram using NAND gates, working, truth table and timing diagram of Clocked R S flip flop. Triggering: edge triggering and level triggering, Symbol and Logic diagram using NAND gates, working, truth table and timing diagram of J-K flip flop. Block diagram and truth table of Master slave J-K flip flop. Symbol, working and truth table of D- flip flop and T-flip flop. Applications of flip flops, Concept, Modulus, Working, truth table, timing diagram of a counter. Asynchronous counter (3 bit, 4 bit); Design of mod N-counter: working, truth table and timing diagram, 3-bit Synchronous counter: working, truth table and timing diagram, Block diagram, Working, Truth Table and waveforms of Shift register: SISO, SIPO, PISO, PIPO (4-bit) and Universal Shift register (4-bit). Applications of Counters and Registers.

5. Memories   (Period 05)

Classification of memories RAM, ROM, PROM, EPROM, E2PROM.Circuit diagram and working of Static and dynamic RAM

List of Practical:

1) Verification and interpretation of truth tables for AND, OR, NOT NAND, NOR and Exclusive OR (EXOR) and Exclusive NOR (EXNOR) gates

2) Study the Realisation of logic functions with the help of NAND or NOR gates

3) To design the half adder & full adder using XOR and NAND gates and verification of its operation

4) Verification of DeMorgan's theorem.

5) To Construct the Half adder and Full adder.

6) Study the Implementation of Combinational Circuit using Multiplexer.

7) To Construct the 7-segment decoder driver.

8) To Verify the truth table of Flip flops.

9) To Study the Universal Shift Register

10) To study the Decade counter using IC 7490.

11) Design the 3-bit Synchronous counter.

RECOMMENDED BOOKS

1. Digital Electronics and Applications by Malvino Leach, Tata McGraw Hill Education Pvt Ltd, New Delhi.

2. Digital Logic Designs by Morris Mano, Prentice Hall of India, New Delhi.

3. Digital Electronics by Soumitra Kumar Mandal, Tata McGraw Hill Education Pvt Ltd.

4. Digital Electronics by V K Sangar , Raj Publishers, Jalandhar.

5. Digital Electronics by Tokheim, Tata McGraw Hill Education Pvt Ltd.

6. Digital Fundamentals by Thomas Floyds, Universal Book Stall.

7. Digital Electronics by RP Jain, Tata McGraw Hill Education Pvt Ltd, New Delhi.

8. Digital Electronics by KS Jamwal, Dhanpat Rai and Co., New Delhi.

9. Digital Electronics by Rajiv Sapra, Ishan Publication, Ambala.

10. Digital Electronics by BR Gupta, Dhanpat Rai& Co., New Delhi.

11. Digital Systems, Principles and Applications by RJ Tocci, Prentice Hall of India, New Delhi.

12. Digital Electronics by Rajaraman V., Prentice Hall of India, New   Delhi.

13. Fundamentals of Digital Electronics by Naresh Gupta, Jain Brothers, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	10	15
2	16	20
3	22	25
4	27	35
5	05	05
Total	**80**	**100**