CURRICULUM

FOR

DIPLOMA PROGRAMME

IN

ELECTRICAL ENGINEERING

2nd Year(3rd & 4th Semester)

FOR THE STATE OF HIMACHAL PRADESH

Implemented w.e.f. Session 2012-13

Prepared by:-
Composite Curriculum Development Centre
Directorate of Technical Education,
Vocational & Industrial Training, Sundernagar(H.P.)

July, 2013

CONTENTS

THIRD SEMESTER

FOURTH SEMESTER

PREFACE

India, in last two decades, has made significant progress in all major spheres of activity. Since 1947, the Technical Education System has grown into fairly large sized system, offering opportunities for education and training in vide variety of trades / disciplines at different levels. Needless to say that well trained technical manpower is the backbone of any growing economy in the era of fast industrialization. It has been the endeavor of the Technical Education Department to take decisive steps to enhance the capacities of technical institutions with major emphasis on quality and excellence in technical education .Our country is the only country in the world which has 50% population below the age of 25 years whereas America has 30% and China 40%.Working Age Population (WAP) is increasing in India whereas it is decreasing in other parts in the world. Challenge before us is to train this WAP for the world of work .Updated curriculum is one of the most powerful tools to improve the quality of training.

Curriculum Document is a comprehensive plan or a blue print for developing various curriculum materials and implementing given educational programme to achieve desired and formally pre-stated educational objectives. Moreover it (the document) is the output of exhaustive process of curriculum planning and design, undertaken by the implementers under the expert guidance of curriculum designer.
While working out the detailed contents and study and evaluation scheme, the following important elements have been kept in mind:

Major employment opportunities of the diploma holders.
Modified competency profile of the diploma holders with a view to meet the changing needs due to technological advancement and requirements of various employment sectors.
Vertical and horizontal mobility of diploma pass outs for their professional growth.
Pragmatic approach in implementing all the curricula of diploma programmes in engineering and technology in the state of H.P.

The document is an outcome of the feedback received from field organizations/ industry of different categories viz. small, medium and large scale which offer wage employment for the diploma pass outs. In every stage of planning and designing of this curriculum, suggestions and advice of experts representing industry, institutions of higher learning, research organizations etc. were sought and incorporated as per the requirement of curriculum . The document contains the study and evaluation scheme and detailed subject/course contents to enable the H.P. Polytechnics to implement revised curriculum and to achieve the desired objectives.

Time has specifically been allocated for undertaking extra-curricular activities. Emphasis has been laid on developing and improving communication skills in the students for which Communication Lab has been introduced during the first year itself.

We hope that this revision will prove useful in producing competent diploma holders in the state of Himachal Pradesh. The success of this curriculum depends upon its effective implementation and it is expected that the managers of polytechnic education system in Himachal Pradesh will make efforts to create better facilities, develop linkages with the world of work and foster conducive and requisite learning environment.

Er. L.R. Rana
Head(CCDC)
Directorate of Technical Education,
Vocational & Industrial Training,
Sundernagar, Himachal Pradesh.

2nd YEAR OF THREE YEAR DIPLOMA PROGRAMME IN ELECTRICAL ENGG.

1. SALIENT FEATURES

1) Name of the Programme : Three year Diploma Programme Electrical Engineering
2) Duration of the Programme : Three years (06 Semesters)
3) Entry Qualification : As prescribed by H.P. Takniki Shiksha Board
4) Intake : As approved by H.P. Takniki Shiksha Board
5) Pattern of the Programme : Semester Pattern
6) Curriculum for : 2nd year of Three year Diploma Programme(Technical Stream)
7) **Student Centred Activities:**

A provision of 2-4 hrs per week has been made for organizing Student Centred Activities for overall personality development of students. These activities will comprise of co-curricular & other activities such as expert lectures, games, seminars, declamation contests, educational field visits, NCC, NSS and cultural activities & hobby classes like photography, painting, singing etc.

8) **Industrial Training:-**

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of a minimum of 4 weeks duration to be organised during the semester break starting after second year i.e. after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A minimum of one visit per week by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An internal assessment of 50 and external assessment of 50 marks have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behaviour, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry.

Teachers and students are requested to see the footnote below the study and evaluation scheme of IV Semester for further details.

2. GUIDELINES

2.1 GUIDELINES FOR ASSESSMENT OF STUDENT CENTRED ACTIVITIES (SCA)

Distribution of 25 marks for SCA will be as follows:

i. 5 Marks shall be given for general behaviour

ii. 5 Marks for attendance shall be based on the following distribution:

1.	Less than 75%	Nil
2.	75-79.9%	3 Marks
3.	80-84.9%	4 Marks
4.	Above 85%	5 Marks

iii. 15 Marks shall be given for the Sports/NCC/Cultural and Co-curricular activities/other activities after due consideration to the following points:

1. For participation in sports/NCC/Cultural/Co-curricular activities at National or above level, shall be rewarded with minimum of 10 marks
2. For participation in sports/NCC/Cultural/Co-curricular activities at Inter-polytechnic level, shall be rewarded with minimum of 08 marks
3. For participation in two or more of the listed activities, 5 extra marks should be rewarded

Note: *Head of Department shall ensure that these marks are conveyed to the H.P. Takniki Shiksha Board, Dharamsala at the end of semester along with sessional record.*

2.2 GUIDELINES FOR SESSIONAL ASSESSMENT

- The distribution of marks for Internal Assessment in theory subjects and drawing shall be made as per the following guidelines:
  i. 60% of internal assessment shall be based on the performance in the tests. At least three tests shall be conducted during the semester out of which at least one should be house test. 30% weightage shall be given to house test and 30% to class test(One best out of two).
  ii. 20% marks shall be given to home assignments, class assignments, seminars etc.
  iii. 20% marks shall be given for attendance/punctuality in the subject concerned.
- The distribution of marks for Internal/External Assessment in practical subjects shall be made as per the following guidelines:
  i. 60% marks shall be awarded for performance in practical.
  ii. 20% marks shall be given for Report/Practical book and punctuality in equal proportion.
  iii. 20% marks shall be for Viva-voce conducted during the practicals.
- The distribution of mark for internal assessment in drawing subjects shall be as per following guidelines:-
  i. 60% marks for sheets ii. 40% for test.

Study & Evaluation Scheme

Third Semester Electrical Engineering

Sr. No.	Subject	Study Scheme Hrs./Week		Marks in Evaluation Scheme								Total Marks
				Internal Assessment			External Assessment					
		Theory	Pr.	Th.	Pr.	Total	Th.	Hrs.	Pr.	Hrs.	Total	
3.1	*Fundamentals Of Electrical Engineering	5	2	30	20	50	100	3	50	3	150	200
3.2	$Electronic Devices & Circuits –I	4	2	30	20	50	100	3	50	3	150	200
3.3	* Electrical Engineering Design and Drawing	-	6		50	50	100	4			100	150
3.4	*Electrical & Electronics Engineering Materials	5	-	50		50	100	3			100	150
3.5	$ Computer Programming And Applications	2	4	30	20	50	100	3	50	3	150	200
3.6	* Electrical Workshop Practice – I	-	6	-	50	50			100	3	100	150
Student Centred Activities		-	4	-	25	25						25
TOTAL		16	24	140	185	325	500		250		750	1075

* Common with Electrical & Electronics Engg.

$ Common with Electronics & Communication Engineering

Study & Evaluation Scheme

Fourth Semester Electrical Engineering

Sr. No.	Subject	Study Scheme Hrs./Week		Marks in Evaluation Scheme								Total Marks
				Internal Assessment			External Assessment					
		Th.	Pr.	Th.	Pr.	Total	Th.	Hrs.	Pr.	Hrs	Total	
4.1	* Electrical Machines-I	4	2	30	20	50	100	3	50	3	150	200
4.2	* Electrical & Electronic Measuring Instruments.	4	2	30	20	50	100	3	50	3	150	200
4.3	$ Electronic Devices and Circuits-II	4	2	30	20	50	100	3	50	3	150	200
4.4	$ Digital Electronics	4	2	30	20	50	100	3	50	3	150	200
4.5	* Electrical Power-I(Power Generation & System Protection)	4	2	30	20	50	100	3	50	3	150	200
4.6	Electrical Workshop Practice – II	-	6	-	50	50		3	100	3	100	150
# Student Centred Activities		-	4	-	25	25						25
TOTAL		20	20	150	175	325	500		350		850	1175

* Common with Electrical & Electronics Engg.

$ Common with Electronics & Communication Engineering

Detailed Contents

Of

Electrical Engineering

3rd & 4th Semester Subjects

3.1 FUNDAMENTALS OF ELECTRICAL ENGINEERING

L	T	P
5	-	2

RATIONALE

For a diploma holder in electrical engineering, it becomes essential to know the fundamentals of the subject in order to grasp the knowledge of the field. This subject will provide acquaintance with various terms, knowledge of fundamental concepts of electricity, magnetism and various principles related to it.

DETAILED CONTENTS

1 **DC Circuits** (18 Hrs)

2.1 Ohm's law, resistances in series and parallel.
2.2 Effect of temperature on resistance, temperature coefficient of resistance and specific resistance.
2.3 Kirchhoff's laws and their applications in solving electrical network Problems.
2.4 Network theorems such as Thevenin's theorem, superposition theorem Maximum power and transfer theorem and Norton's theorem.
2.5 Star-delta transformation.

2 Batteries (6 Hrs)

2.1 Working principle, construction and applications of Lead acid, Nickel. Cadmium and Silver Oxide Cells.
2.2 Charging methods used for lead acid accumulator.
2.3 Care and maintenance of a lead acid battery.
2.4 Grouping of cells in series and parallel (simple numerical problems).

3 Electrostatics (12 Hrs)

3.1 Capacitor, Capacitance, dielectric and factors affecting capacitance.
3.2 Capacitance of parallel plate capacitor & cylindrical capacitor.
3.3 Grouping of capacitors, Charging and discharging of capacitor, Time constant and energy stored in capacitor.

4. Magnetism and Electromagnetism (10 Hrs)

4.1 Introduction to electromagnetism, Magnetic field around a straight current carrying conductor and a solenoid and methods to find its direction, force between two parallel current carrying conductors.
4.2 Force on a conductor placed in the magnetic field.
4.3 Series & parallel magnetic circuits, simple problems.
4.4 Concept of hysteresis loop and hysteresis loss.

5. Electromagnetic Induction: (10Hrs)

5.1 Faraday's Laws of electromagnetic induction.
5.2 Lenz's law.
5.3 Fleming's Right and Left Hand Rule.
5.4 Principle of self and mutual induction.
5.5 Principle of self and mutually induced e.m.f. and simple problems
5.6 Inductances in series and parallel.
5.7 Energy stored in a magnetic field.
5.8 Concept of eddy currents, eddy current loss.

6 A.C. Circuits (18Hrs)

6.1 Concept of alternating current and voltage generation, Equation of instantaneous values of alternating current and voltage.
6.2 Representation of alternating sinusoidal quantities by vectors.
6.3 Phasor algebra (addition, subtraction, multiplication and division of complex quantities).
6.4 AC through pure resistance, inductance and capacitance.
6.5 Alternating voltage applied to RL, RC and RLC series and parallel circuits (impedance triangle, phasor diagram and their solutions).
6.6 Concept of susceptance, conductance and admittance.
6.7 Power in pure resistance, inductance, capacitance, RL, RC, and RLC circuits.
6.8 Active and reactive components of current and their significance.
6.9 Power factor and its practical significance, Resonance in series and parallel circuit

7 Poly-Phase systems (6 Hrs)

7.1 Advantages of 3 phase over single phase system.
7.2 Star and delta connections (relationship between phase and line voltages, phase and line currents.
7.3 Power in 3 phase circuits.
7.4 Measurement of power and power factor of a 3-phase load by two wattmeter method.

LIST OF PRACTICALS

1. (a) Determination of voltage-current relationship in a dc circuit under specific physical conditions and to draw conclusions to (verify ohm's law)
   (b) Filament lamp - measure the resistance of a cold lamp filament with the help of
   i) Multimeter measure the current drawn by the lamp at different voltages from zero to 220 volts and the resistance of lamp at different voltages, plot a graph between current and voltage.

2. (a) To verify that $R_T = R_1 + R_2 + \ldots$ where R_1, R_2 etc. are resistances connected in series

   (b) To verify $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \text{- - - - - -} + \frac{1}{R_N}$

   Where R_1, R_2, R_N etc. are resistances connected in parallel.

3. Verification of Kirchhoff's current and voltage laws applied to DC circuits
   a) To construct a circuit arrangement consisting of resistances in series, parallel combination
   b) Identification of node points in the circuit
   c) To see that algebraic sum of currents at node point is zero
   d) To see that algebraic sum of e.m.f.s. and voltage drops in a closed loop is zero

4. To find ratio of inductance values of a coil having air /iron core respectively and to see the effect of introduction of a magnetic core on coil inductance

5. To construct an RL and RC circuit and to measure
   a) Their impedance
   b) Phase angle between voltage and current
   c) Construct impedance triangle

6. To plot a graph between current and frequency of RLC series circuit for resonance conditions.

   OR

   To find resonance conditions in RLC series circuit by changing the values of L and C.

7. Measurement of power and power factor of a single phase RLC circuit. To calculate KVA and KVAR
8. Testing a battery for its changed condition and to charge it
9. Measurement of power and power factor of a three-phase balanced load by two wattmeter method

INSTRUCTIONAL STRATEGY

Basic electrical engineering being a fundamental subject need to be handled very carefully and in a manner such that students develop clear understanding of principles and concepts and develop skill in their application in solving related problems. Teacher may lay emphasis on laboratory experiments and give lot of tutorial work to students in order to give them an opportunity in mastering the basics in solving related problems

RECOMMENDED BOOKS

1. Electrical Science by VK Mehta, S Chand and Co., New Delhi
2. Fundamentals of Electrical Engineering by Sahdev, Unique International Publication, Jalandhar.
3. Electrical Engineering by DR Arora, Ishan Publications, Ambala
4. Electrical Technology by JB Gupta, SK Kataria and Sons, New Delhi
5. Electrical Technology by BL Theraja, S Chand & Co., New Delhi
6. Electrical Science by S. Chandhni, R Chakrabarti and P K Chattopadhyay. Narosa Publishing House Pvt. Ltd., New Delhi
7. Basic Electrical Engineering by Mool Singh, Galgotia Publication Pvt. Ltd., New Delhi
8. Basic Electrical Engineering by PS Dhogal, Tata McGraw Hill, New Delhi
9. Principles of Electrical Engineering by BR Gupta, S Chand & Co., New Delhi by SL Bhatia, Khanna Publishers, New Delhi Handbook of Electrical Engineering

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Alloted	Marks Allocation(%)
1.	DC Circuits	18	15
2.	Batteries	6	7
3.	Electrostatics	12	15
4.	Magnetism and Electromagnetism	10	15
5.	Electromagnetic Induction	10	15
6.	A.C. Circuits	18	25
7.	Poly-Phase systems	6	8
Total		80	100

3.2 ELECTRONIC DEVICES AND CIRCUITS-I

L T P

4 - 2

RATIONALE

Having attained basic knowledge of electronic devices like diodes, transistors, and elementary circuits, in second semester, this course will enable the students to learn about the use of transistors in analog circuits like voltage amplifier, power amplifier, multistage amplifier, tuned amplifiers, oscillators, etc. It also gives information about FET, MOSFETs, C-MOS and their applications for effective functioning in the field of electronic service industry.

1. **Current and voltage sources** (2 Hrs.)

Concept of current and voltage sources, constant voltage and current sources, their graphical representation. Conversion of voltage source into current source and vice-versa. Difference between actual voltage source and constant voltage source.

2. **Transistor as an amplifier** (05 hrs)

Three regions of operation- cutoff, active, saturation.Practical way of representing CE circuit, Different ways of taking output from CE transistor amplifier. Transistor as an amplifier in CE Configurations, Concept of DC load line and Operating point. Performance characteristics of transistor amplifier i.e. input resistance, output resistance, effective collector load, current gain, voltage gain & power gain.

3. **Transistor biasing circuits** (06 hrs)

Concept of transistor biasing and selection of operating point. Need for stabilization of operating point. Methods of transistor biasing i.e. Base resistor, Collector feedback & Voltage divider biasing circuits. Their respective stability factor.

4. **Single stage transistor amplifier** (7 hrs)

Single stage transistor amplifier circuit, Explanation of phase reversal of output voltage with respect to input voltage and its graphical demonstration. ac load line and its use in calculation of current and voltage gain of a single stage CE amplifier circuit. h- Parameters and their significance.

5. **Field effect transistors** (06 hrs)

Construction, operation and characteristics of FET; FET amplifier circuit. Construction, operation and characteristics of MOSFET in depletion and enhancement modes.

- C MOS - advantages and applications
- Comparison of FET, MOSFET and BJT

6. Multistage Amplifiers (8hrs)

Need for multistage amplifier; Gain of multistage amplifier; Different types of multistage amplifier like RC coupled, Transformer coupled, Direct coupled amplifier. Their frequency response, bandwidth and applications.

7. **Large Signal Amplifier** (8hrs)

Difference between voltage and power amplifiers; Importance of impedance matching in amplifiers. Class A, Class B, Class AB, and Class C amplifiers, collector efficiency and Distortion in class A, B & C amplifiers. Single ended power amplifier, heat dissipation curve and importance of heat sinks. Push-pull amplifier; operation of class- B push-pull amplifier.Complementary symmetry push-pull amplifier.

8. **Feedback in Amplifiers** (8 hrs)

Basic principles and types of feedback.
Derivation of expression for gain of an amplifier employing negative feedback.
Effect of negative feedback on gain, gain stability, distortion, frequency response, bandwidth and input & output impedance of an amplifier.
Use of negative feedback in the following circuits:

- RC coupled amplifier without emitter bypass capacitor.
- Emitter follower and its application.

9. Sinusoidal Oscillators (9 hrs)

Use of positive feedback; Barkhausen criterion for oscillations
Different oscillator circuits - tuned collector, Hartley, Colpitts, Phase shift, Wien Bridge, and Crystal oscillator. Their working principles (no mathematical derivation)

10. Tuned Voltage Amplifiers (5hrs)

Series and parallel resonant circuits and bandwidth of resonant circuits.
Single and double tuned voltage amplifiers and their frequency response characteristics

LIST OF PRACTICALS

1. To plot input and output characteristics of transistor in CE configuration. Calculate input and output resistance and voltage gain.
2. To measure the voltage gain of two stage RC coupled amplifier.
3. To plot the frequency response of two stage RC coupled or transformer coupled amplifier & calculate the bandwidth.
4. To measure the power gain of push-pull amplifier at 1KHz.
5. To measure the voltage gain of emitter follower circuit and plot its frequency response.
6. Plot the frequency response curve of Hartley or Colpitts Oscillator.

7. Plot the frequency response curve of Phase shift Oscillator.
8. Plot V-I characteristics of FET amplifier.

LIST OF RECOMMENDED BOOKS

1. *Basic Electronics and Linear Circuits by NN Bhargava, Tata McGraw Hills, New Delhi*
2. *Electronic Principles by Sahdev, Dhanpat Rai and Sons, New Delhi.*
3. *Electronics Principles by Malvino, Tata McGraw Hills, New Delhi*
4. *Electronic Devices and Circuits by Millman and Halkias, McGraw Hills, New Delhi*
5. *Electronics Devices and Circuits by Bhupinderjit Kaur,modern Publishers, Jalandhar Basic*
6. *Electronics by Grob, Tata McGraw Hills, New Delhi*
7. *Art of Electronics by Horowitz*
8. *Electronic Circuit Theory by Boylste*
9. *Electronic Devices and Circuits by BL Theraja, S Chand and Co Ltd. New Delhi*
10. *Operational Amplifiers and Linear Integrated Circuits by Ramakant A. Gaykwad*
11. *Electronics Devices and Circuits by Rama Reddy, Narosa Publishing House Pvt. Ltd.,New Delhi*
12. *Electronics Devices and Circuits-I by Naresh Gupta, Jyotesh Malhotra and Harish C.Saini, Eagle Prakashan, Jalandhar*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No	Topic	Time Allotted	Marks Allocation%
1	Current and voltage sources	02	5
2	Transistor as an amplifier	05	10
3	Transistor biasing circuits	06	10
4	Single stage transistor amplifier	07	10
5	Field effect transistors	06	10
6	Multistage Amplifiers	8	15
7	Large Signal Amplifier	8	10
8	Feedback in Amplifiers	8	10
9	Sinusoidal Oscillators	9	10
10	Tuned Voltage Amplifiers	05	10
Total		**64**	**100**

3.3 ELECTRICAL ENGINEERING DESIGN AND DRAWING

L T P

- - 6

RATIONALE

A polytechnic pass-out in electrical 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

1. Symbols and Signs Conventions (3 Sheets)

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

2. Wiring Diagrams : (3Sheets, 2 Question per sheet)

2.1 Design and Drawing of panels/Distribution board using MCBS, ELCB main switches.
2.2 Single line and wiring diagram for light and fan points and Power Point of a drawing room measuring 7mt x 5mt.
2.3 Single line and wiring diagram of workshop measure 10mt x 4mt containing 4 motors of 2HP each.
2.4 Simple Electric Circuit (Wiring and Single line diagram).

3. **Projections of simple electrical parts & Machine parts.** (7 Sheets)

3.1 Bus bar post
3.2 Pin type and Shackle insulator
3.3 Rotor of a squirrel cage induction motor
3.4 Pole and coil of DC machine.
3.5 Slip rings of 3-phase induction Motor.

4. Contactor Control Circuits: Schematic and wiring diagram. (4 Sheets)

4.1 DOL Starter of 3-phase induction Motor.
4.2 Forwarding/reversing of 3-phase induction motor
4.3 Limit switch control of a 3-phase induction motor

5. CAD: **(**4 Sheets **but not to be set for external exam.)**

Introduction & interpreting drawing related to substation, Industries & domestic circuits.

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted(hrs)	Marks Allocation(%)
1	Symbols and Signs Conventions	10	15
2	wiring Diagrams	20	30
3	Projections of simple electrical parts & machine parts.	30	30
4	Contactor Control Circuits:	16	25
5	CAD	20	Nil
Total		**96**	

3.4 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

L T P
5 - -

RATIONALE

A diploma holder in Electrical & Electronics Engineering will be involved in maintenance, repair and production of electrical equipment and systems. In addition, he may be required to procure, inspect and test electrical and electronic engineering materials. Knowledge of various types of materials will be needed in order to execute the above mentioned functions. He may also have to decide for an alternative when a particular material is either not readily available in the market or its cost becomes prohibitive.

DETAILED CONTENTS

1. **Classification** (5 Hrs)

Classification of materials into conducting, semi conducting and insulating materials through a brief reference to their atomic structure and energy bands

2. **Conducting Materials** (18 Hrs)

2.1 Introduction

2.2 Resistance and factors affecting it such as alloying and temperature etc

2.3 Classification of conducting material as low resistivity and high resistivity materials, Low resistance materials

2.3.1 Copper:
General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard-drawn and annealed copper, corrosion, contact resistance. Application in the field of electrical engineering.

2.3.2 Aluminium:
General properties as conductor: Rresistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solderability, contact resistance. Applications in the field of electrical engineering.

2.3.3 Steel:
General properties as conductor: Resistivity, corrosion, temperature coefficient, density, mechanical properties, solderability, Applications in the field of electrical engineering.

2.3.4. Introduction to bundle conductors and its applications.

2.3.5. Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), their practical applications with reasons for the same

2.4 Applications of special metals e.g. Silver, Gold, and Platinum etc.

2.5 High resistivity materials and their applications e.g., manganin, constantin, Nichrome, mercury, platinum, carbon and tungsten

2.6 Superconductors and their applications

3 **Insulating materials; General Properties** (17 Hrs)

3.1 Electrical Properties:
Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant.

3.2 Physical Properties:
Hygroscopicity, tensile and compressive strength, abrasive resistance, brittleness

3.3 Thermal Properties:
Heat resistance, classification according to permissible temperature rise. Effect of overloading on the life of an electrical appliance, increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity, Electro-thermal breakdown in solid dielectrics

3.4 Chemical Properties:
Solubility, chemical resistance, weatherability

3.5 Mechanical properties, mechanical structure, tensile structure

4. **Insulating Materials and their applications** (20 Hrs)

4.1 Plastics

4.1.1 Definition and classification

4.1.2 Thermosetting materials:
Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and Malamine-formaldehyde), epoxy resins - their important properties and applications

4.1.3 Thermo-plastic materials:
Polyvinyl chloride (PVC), polyethelene, silicons, their important properties and applications

4.2 Natural insulating materials, properties and their applications

- Mica and Mica products
- Asbestos and asbestos products
- Ceramic materials (porcelain and steatite)
- Cotton
- Paper (dry and impregnated)
- Rubber, Bitumen
- Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation
- Enamels for winding wires

4.3 Gaseous materials; Air, Hydrogen, Nitrogen, SF6 their properties and applications

5. **Magnetic Materials** (12 Hrs)

5.1 Introduction - ferromagnetic materials, permeability, B-H curve, magnetic saturation, hysteresis loop including coercive force and residual magnetism, concept of eddy current and hysteresis loss, curie temperature, magnetostriction effect.

5.2 Soft Magnetic Materials:

5.2.1 Alloyed steels with silicon: High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines

5.2.2 Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine

5.2.3 Nickel-iron alloys

5.2.4 Soft Ferrites

5.3 Hard magnetic materials
Tungsten steel, chrome steel, hard ferrites and cobalt steel, their applications.

6. **Special Materials** (8 hrs)

Thermocouple, bimetals, leads soldering and fuse material, mention their applications

INSTRUCTIONAL STRATEGY

The teacher should bring different materials, electronic components and devices in the class while taking lectures and explain and make students familiar with them. Also he may give emphasis on practical applications of these devices and components in the field. In addition, the students should be given exercises on identification of materials used in various electronic gadgets etc .and be encouraged to do practical work independently and confidently.

RECOMMENDED BOOKS

1. *Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi*
2. *Electronic Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi*
3. *Electrical Engineering Materials by Sahdev, Unique International Publications*
4. *Electronic Components and Materials by SM Dhir, Tata Mc Graw Hill, New Delhi*
5. *Electrical Engineering Materials by PL Kapoor, Khanna Publishers, New Delhi*
6. *Electrical and Electronics Engineering Materials BR Sharma and Others, Satya Parkashan, New Delhi*
7. *Electrical and Electronics Engineering Materials DR Arora, Ishan Publications, Ambala City*
8. *Electrical Engineering Materials by Rakesh Dogra, SK Kataria and Sons, NEW Delhi*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPERSETTER

Sr.No.	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Classification	5	10
2	Conducting Materials	18	20
3	Insulating materials; General Properties:	17	20
4	Insulating Materials and their Applications	20	25
5	Magnetic Materials:	12	20
6	Special Materials	8	5
	Total	**80**	**100**

3.5 COMPUTER PROGRAMMING AND APPLICATIONS

L T P

2 - 4

RATIONALE

Computer plays a very vital role in present day life, more so, in the professional life of Diploma engineers. In order to enable the students use the computers efectively in problem solving, this course ofers the modern programming language C along with exposure to various engineering applications of computers. The knowledge of C language will be reinforced by the practical exercises and demonstration of application software in the field of Electrical Engineering during the course of study. Introduction to data base management system is also a very significant field with vast employment potential.

DETAILED CONTENTS

1. **Algorithm and Program Development** (8 hrs)

   a) Steps in development of a program
   b) Flow-charts, algorithm development
   c) Introduction to various computer languages
   d) Concept of interpreter, compiler, high level language(HLL), machine language (ML) and Assembly Language

2. Program Structure (C Programming) (30 hrs)

a) History of 'C', data types, input output statements, arithmetic and logical operations, data assignments, precedence and associatively
b) I/O statements: Assignment, Variables, arithmetic operation- their precedence, data types standard I/O function, formulated I/O
c) Control Statements: Logical and relational operators; if-else, while, do- while, for loops, breaks, switch statements
d) Functions: Function declaration, parameter passing- by value, storage classes (Local, Global and Static variables, standard library functions
e) Arrays: Single and multi-dimensional arrays, character arrays
f) Pointers: To various data types, pointers in parameters passing, pointers to function
g) Structures: Definition of a structure, pointer to structure, union and array of structure
h) Strings: String processing, functions and standard library function
i) Data files: File handling and manipulation, file reading and writing.

3. **Software Applications in Electronics Engineering** (10 hrs)

Computer application overview through various applications software related to Electronics Engineering branch viz: ORCAD, H spice, KEIL, Circuit Maker, MATLAB, Electronic Workbench, etc.

LIST OF PRACTICALS

1. Programming exercise on executing a C Programs.
2. Programming exercise on editing a C program.
3. Programming exercise on defining variables and assigning values to variables
4. Programming exercise on arithmetic and relation operators
5. Programming exercise on arithmetic expressions and their evaluation
6. Programming exercise on reading a character
7. Programming exercise on writing a character
8. Programming exercise on formatting input using print
9. Programming exercise on formatting output using scan
10. Programming exercise on simple IF statement
11. Programming exercise on IF… ELSE statement
12. Programming exercise on SWITCH statement
13. Programming exercise on GOTO statement
14. Programming exercise on DO-WHILE statement
15. Programming exercise on FOR statement
16. Programming exercise on one dimensional array
17. Programming exercise on two dimensional array.

INSTRUCTIONAL STRATEGY

This course is a highly practical and C. self- study oriented courses. The teachers are expected to explain the theoretical part and ensure that the students execute and debug diferent programs. The PC needed to have either Turbo C.

RECOMMENDED BOOKS

1. Programming in C by Schaum series McGraw Hill
2. Programming in C by Kerning Lan and Richie; Prentice Hall of India, New Delhi
3. Programming in C by Balaguru Swamy, Tata McGraw Hill, New Delhi.
4. Let us C- Yashwant Kanetkar, BPB Publications, New Delhi
5. Vijay Mukhi Series for C and C++
6. Programming in C by R Subburaj, Vikas Publishhing House Pvt. Ltd., Jangpura, New Delhi
7. Programming in C by BP Mahapatra, Khanna Publishers, New Delhi
8. Elements of C by MH Lewin, Khanna Publishers, New Delhi
9. The Complete Reference to Visual Basic 6, by Noel Jerke, Tata McGraw Hill, New Delhi Web sitewww.Beyondlogic.org
10. Pointers in C by Yashwant Kanetkar, BPB Publishers New Delhi
11. Programming in Applications by Chandershekhar, Unique International Publications, Jalandhar
12. The essentials of Computer Organizing and Architecture by Linda Null and Julia Labur, Narosa Publishing House Pvt. Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Topic No.	Topic	Time Allotted(Hrs)	Marks Allocation
1.	Algorithm and Program	06	15
2.	Program Structure (C Programming)	20	70
3.	Software Applications	6	15
Total		**32**	**100**

3.6 ELECTRICAL WORKSHOP PRACTICE – I

L	T	P
-	-	6

RATIONALE

An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers working under him. In addition, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively in addition to conceptual understanding of the method or procedure he must possess appropriate manual skills. The subject aims at developing special skills required for repairing, fault finding, wiring in electrical appliances and installations.

DETAILED CONTENTS

1. Study of electrical safety measures as mentioned in the Electricity Rules and shock treatment including first aid
2. Simple light circuits in casing and capping (PVC) wiring and conduit system of wiring
    - 2.1 Two lamps controlled by two switches
    - 2.2 Two lamps connected in series controlled by a single way switches
    - 2.3 Two lamps connected in parallel controlled by a single way switche
    - 2.4 One lamp controlled by two switches (staircase circuit)
    - 2.4 Two lamps controlled by three switches (double staircase circuit)
3. Wiring and testing of alarm and response circuit using relay, push buttons and bells (simple single phase circuit)
    - 3.1 Bell response circuit using one bell and one relay
    - 3.2 Bell response circuit of an office (for three rooms)
    - 3.3 Traffic light control system for two roads crossing.
4. Wiring of a switch board containing at least two switches, one fan regulator and one 5/15A socket controlled by their respective switches using piano type switches and matching socket.
5. Wiring of a series test lamp board and to use it for finding out simple faults
6. Testing of domestic wiring installation using meggar
7. Internal wiring connection, fault finding (by testing of chock, starter, tube holder tube rod circuit etc.) and repair of a fluorescent tube light.
8. Assembly of distribution board/ panel using MCB, main switch, changeover switch and ELCB etc.
9. Repair and maintenance of domestic electric appliances, i.e. electric iron, geyser, fan, heat convector, Semi-automatic washing machine, room heater, electric kettle, induction heater etc.

Note: ***At least five electrical appliances as mentioned above be given to a group of 2 students for their repair and maintenance.***

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.

4.1 ELECTRICAL MACHINES - I

L T P

4 - 2

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 **Introduction to Electrical Machines** (8 hrs)

- 1.1 Definition of motor and generator and basic principle of motor and generator.
- 1.2 Torque developed due to alignment of two fields , concept of torque angle, magnitude of torque, method to produce continuous torque,
- 1.3 Electro-magnetically induced e.m.f.
- 1.4 Elementary concept of an electrical motor and generator.
- 1.5 Comparison of generator and motor.

2 **DC Machines** (26hrs)

- 2.1 Main constructional features, Types of armature winding.
- 2.2 Function of the commutator for motoring and generation action.
- 2.3 Factors determining induced e.m.f.
- 2.4 Factors determining the electromagnetic torque
- 2.5 Relationship between back e.m.f and terminal voltage in motoring and generating action and significance of back e.m.f.
- 2.6 Separately excited d.c. Machines, d.c. shunt machines, d.c. series machines, and d.c. compound machines.
- 2.7 Necessary conditions to build up induced e.m.f in a d.c. shunt generator.
- 2.8 Open circuit (internal) characteristic of d.c. shunt generator.
- 2.9 Load (external) characteristic of separately excited d.c. Generator and d.c shunt generator.
- 2.10 Performance and characteristics of different types of DC motors and applications.
- 2.11 Need of starter, three point and 4 point d.c. motor starter.
- 2.12 Speed control of dc shunt & series motors.
- 2.13 Armature Reaction.
- 2.14 Commutation, cause of sparking, method to improve commutation
- 2.15 Losses in a DC machine.
- 2.16 Determination of efficiency by direct loading method and Swinburne's method.
- 2.17 Maintenance of dc machines.

3 Transformers (single phase) (20 hrs)

3.1 Introduction
3.2 Constructional features of a transformer and parts of transformer
3.3 Working principle of a transformer
3.4 EMF equation.
3.5 Phasor diagram of a transformer on no-load .
3.6 Phasor diagram of a loaded transformer neglecting voltage drop in the windings–Ampere turn balance.
3.7 Mutual and leakage fluxes, leakage reactance
3.8 Equivalent circuit.
3.9 Transformer on load, voltage drops and its phasor diagram.
3.10 Relation between induced e.m.f and terminal voltage, voltage regulation of a transformer- mathematical relation.
3.11 Losses in a transformer.
3.12 Efficiency, condition for maximum efficiency and all day efficiency.
3.12 Estimation of losses from open circuit and short circuit test and calculation of voltage regulation and efficiency.
3.13 Auto transformer construction, working and applications.
3.14 Instrument transformers, working and applications.

4 **Transformers three phase** (10 hrs)

4.1 Construction of three phase transformers and accessories of transformers such as conservator, breather, Buchholz'srelay.
4.2 Standard method of terminal marking, position/arrangement of terminals on terminal box.
4.3 Connection of three phase transformer i.e. delta-delta, delta-star, star-delta and star-star, phase displacement between high and low voltage s side, vector groups and its representation.
4.4 Conditions for parallel operation (only conditions are to be studied)
4.6 Difference between power and distribution transformer.
4.7 Cooling of transformer.

LIST OF PRACTICALS

1. To measure the angular displacement of rotor of the three phase synchronous machine with respect to the stator on application of DC to the field winding and simultaneously to each phase-winding in sequence.

OR

Measurement of the angular displacement of the rotor of a slip-ring induction motor on application of DC to stator of motor winding in sequence and simultaneously to each phase of rotor winding.

2. Measurement of induced e.m.f of a d.c shunt generator as a function of field current.
3. Measurement of terminal voltage of a d.c shunt generator as a function of load current.
4. Speed control of dc shunt motor (i) Armature control method (ii) Field control method.
5. Measurement of the speed of a d.c. motor as a function of load torque.
6. Study of dc series motor with starter (to operate the motor on no load for a moment)
7. Determination of efficiency of DC motor by Swinburne's Test at full load.
8. Determination of efficiency and voltage regulation of a single-phase transformer at full load by determining equivalent circuit parameters from open circuit test and short circuit test data.
9. To find the efficiency and regulation of single phase transformer by actually loading it.
10. Polarity test of the windings of a three phase transformer and connecting the windings in various configurations.

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

Electrical Machines by SK Bhattacharya, Tata McGraw Hill, New Delhi
Electrical Machines by SK Sahdev, Unique International Publications, Jalandhar
Electrical Machines by Nagrath and Kothari, Tata McGraw Hill, New Delhi
Electrical Machines by JB Gupta, SK Kataria and Sons, New Delhi
Electrical Machines by BR Sharma, SatyaPrakashan, New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	**Topic**	**Time Allotted**	**Marks Allocation(%)**
1	Introduction to Electrical Machine	8	15
2	DC Machines	26	40
3	Transformers (single phase)	20	30
4	Transformers three phase	10	15
Total		**64**	**100**

4.2 ELECTRICAL & ELECTRONIC MEASURING INSTRUMENTS

L	T	P
4	-	2

RATIONALE

Diploma holders in Electrical Engineering have to work on various jobs in the field as well as in testing laboratories and on control panels, where he performs the duties of installation, operation, maintenance and testing by measuring instruments. Persons working on control panels in power plants, substations and in industries will come across the use of various types of instruments and have to take measurements. Instruments used to read and observe the general electrical quantities like current, voltage, power, energy, frequency, resistance etc and their wave shapes, have been incorporated in this subject. So the technician will know the construction and use of various types of electrical instruments.

DETAILED CONTENTS

1. **Introduction to Electrical Measuring Instruments** (8hrs)

   1.1 Concept of measurement and instruments.
   1.2 Concept of measurement of electrical quantities and instruments for their measurements.
   1.3 Types of electrical measuring instruments – indicating, integrating and recording type instruments.
   1.4 Essentials of indicating instruments – deflecting, controlling and damping torque.

2. **Ammeters and Voltmeters (Moving coil and moving iron type)** (8hrs)

   2.1 Concept of ammeters and voltmeters and difference between them.
   2.2 Construction and working principles of moving Iron and moving coil instruments.
   2.3 Merits and demerits, sources of error and application of these instruments.

3. **Wattmeter (Dynamometer Type)** (5 hrs)

   Construction, working principle, merits and demerits of dynamometer type wattmeter, sources of error.

4. **Energy meter (Induction type)** (11hrs)

   Construction, working principle, merits and demerits of single-phase and three-phase energy meters.
   4.1 Errors and their compensation.
   4.2 Simple numerical problems.
   4.3 Construction and working principle of maximum demand indicators.
   4.4 Introduction and block diagram of digital single phase and three phase energy meter.
   4.5 Introduction to intelligent energy meter.

5. **Miscellaneous Measuring Instruments** (12 hrs)

5.1 Construction, working principle and application of Meggar, Earth tester, Multimeter, Frequency meter (dynamometer type) single phase power factor meter (Electrodynamometer type). Working principle of synchroscope and phase sequence indicator, tong tester (Clamp-on meter).

5.2 Instrument Transformers: Construction, working and applications

a) CT

b) PT and their ratio and phase angle error

6. **Electronic Instruments** (10hrs)

6.1 Cathode Ray Oscilloscope: Block diagram, working principle of CRO and its various controls. Applications of CRO.

6.2 Digital multi-meter (only block diagram) and Applications.

6.3 Introduction to digital thermo scope and its block diagram.

6.4 Study of LCR meters and their applications.

7. **Transducers** (10hrs)

7.1 Introduction and classification of transducers.

7.2 Basic concept of pressure measurement, flow measurement, level measurement, displacement measurement using transducers.

7.3 Different types of thermometers, thermocouple, resistance temperature detector and their construction, principle and working.

7.4 Introduction to load cells, LVDT, RVDT and smart sensors.

LIST OF PRACTICALS

1. Use of analog and digital multimeter for measurement of voltage, current (a.c/d.c) and resistance
2. To calibrate 1-phase energy meter by direct loading method.
3. To measure the value of earth resistance using earth tester.
4. To measure power, power factor in a single-phase circuit, using wattmeter and power factor meter and to verify results with calculations.
5. Measurement of voltage and frequency of a sinusoidal signal using CRO and draw wave shape of signal.
6. Measurement of power in a 3 phase circuit using CT, PT and 3-phase load.
7. Use of LCR meter for measuring inductance, capacitance and resistance.
8. To record all electrical quantities from the meters installed in the institution premises.
9. To measure Energy at different Loads using Single phase Digital Energy meter.
10. Study of LVDT and RVDT

INSTRUCTIONAL STRATEGY

After making the students 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 to use them independently.

RECOMMENDED BOOKS

1. *Electrical Measurements and Measuring Instruments by Golding and Widdis; Wheeler Publishing House, New Delhi*
2. *Electrical Measurements and Measuring Instruments by SK Sahdev, Unique International*

Publications, Jalandhar

3. *A Course in Electrical Measurement and Measuring Instruments by AK Sawhney and PL Bhatia; Dhanpat Rai and Sons, New Delhi*
4. *Electric Instruments by D. Cooper*
5. *Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International (P) Ltd., Publishers, New Delhi*
6. *Electronics Instrumentation by Umesh Sinha, Satya Publication, New Delhi*
7. *Basic Electrical Measurements by Melville B. Staut.*
8. *Electrical Measurement and Measuring Instruments by JB Gupta, SK Kataria and Sons, New Delhi*
9. *Electrical Measurement and Measuring Instruments by ML Anand, SK Kataria and Sons, New Delhi*

Sr. No.	**Topic**	**Time Allotted**	**Marks Allocation(%)**
1	Introduction to Electrical Measuring Instruments	8	15
2	Ammeters and Voltmeters	8	15
3	Wattmeter	5	10
4	Transformers three phase	11	15
5	Energy meter	12	15
6	Miscellaneous Measuring Instruments:	10	15
7	**Transducers:**	10	15
Total		**64**	**100**

4.3 ELECTRONIC DEVICES AND CIRCUITS-II

L T P

4 - 2

RATIONALE

Having attained basic knowledge of electronic devices like diodes, transistors, and elementary circuits, in second semester, this course will enable the students to learn about the use of transistors in analog circuits like voltage amplifier, power amplifier, multistage amplifier, tuned amplifiers, oscillators, etc. It also gives information about FET, MOSFETs, C-MOS and their applications for effective functioning in the field of electronic service industry.

1. **Wave Shaping Circuits** (08 hrs)

a) General idea about different wave shapes
b) RC and RL integrating and differentiating circuits with their applications
c) Diode clipping and clamping circuits and simple numerical problems on these circuits

2. **Multivibrator Circuits** (14 hrs)

a) Working principle of transistor as switch
b) Concept of multi-vibrator: astable, monostable, and bistable and their applications
c) Block diagram of IC555 and its working and applications
d) IC555 as monostable and astable multi-vibrator

3. **Operational Amplifiers** (18hrs)

a) Characteristics of an ideal operational amplifier and its block diagram and Pin Identification
b) Definition of differential voltage gain, CMRR, PSRR, slew rate and input offset current, input offset voltage, Input Bias current, total output offset voltage, Thermal drift.
c) Open loop configurations: Differential, Inverting & Non Inverting.
d) Operational amplifier as an inverter, scale changer, adder, subtractor, differentiator, and integrator
e) Concept of Schmitt trigger circuit, Zero crossing detector, Peak Detector, and sample/hold circuit using operational amplifier and their application
f) Op-amp as saw-tooth wave generator.
g) Op-amps with negative feedback:- Block diagram representation of feedback configurations, Voltage-series feedback Amplifier, Voltage shunt feedback amplifier, current series, current shunt.

4. **Regulated DC Power Supplies** (12 hrs)

a) Concept of DC power supply. Line and load regulation
b) Concept of fixed voltage, IC regulators (like 7805, 7905), and variable voltage regulator like (IC 723)
c) Concept of SMPS

5. **Opto Electronic Devices** (06 hrs)

Working principle, characteristics and applications of photo resistors, photo diodes, photo transistors and opto couplers.

6. **IC Based oscillators & PLL.** (06 hrs)

VCO (IC 565) and Phase Locked Control (IC 566) and their Applications

LIST OF PRACTICALS

(1) To observe the output waveforms of series and shunt clipping circuits
(2) To observe the output for clamping circuits
(3) Use of IC 555 as monostable multivibrator and observe the output for different values of RC
(4) Use of IC 555 as astable multivibrator and observe the output at different duty cycles
(5) To realize positive and negative fixed voltage AC power supply using three terminal voltage regulator IC (7805, 7812, 7905)
(6) To measure the performance parameters of an Op amp.
(7) Application of Op amp as Inverting and Non Inverting amplifier.
(8) Design differentiator and Integrator using Op-Amp.

INSTRUCTIONAL STRATEGY

This subject being of fundamental importance for diploma holders in electronics engineering and related fields, emphasis on conceptual understanding may be given by taking the help of charts, simulation packages etc. Suficient exercises may given to the students in single stage and multi-stage amplifier circuits in addition to simple exercises in fabricating and testing of various simple d.c circuits. The students may be encouraged to perform some additional practical exercises preferably using breadboards apart from the list provided.

LIST OF RECOMMENDED BOOKS

1. *Basic Electronics and Linear Circuits by NN Bhargava, Tata McGraw Hills, New Delhi*
2. *Electronic Principles by Sahdev, Dhanpat Rai and Sons, New Delhi.*
3. *Electronics Principles by Malvino, Tata McGraw Hills, New Delhi*
4. *Electronic Devices and Circuits by Millman and Halkias, McGraw Hills, New Delhi 5. Electronics Devices and Circuits by Bhupinderjit Kaur,modern Publishers, Jalandhar Basic Electronics by Grob, Tata McGraw Hills, New Delhi*

6. *Art of Electronics by Horowitz*

7. *Electronic Circuit Theory by Boylstead*

8. *Electronic Devices and Circuits by BL Theraja, S Chand and Co Ltd. New Delhi*

9. *Operational Amplifiers and Linear Integrated Circuits by Ramakant A. Gaykwad 10. Electronics Devices and Circuits by Rama Reddy, Narosa Publishing House Pvt. Ltd.,New Delhi*

10 *Electronics Devices and Circuits-I by Naresh Gupta, Jyotesh Malhotra and Harish C.Saini, Eagle Prakashan, Jalandhar*

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING THE PAPER SETTER

Sr. No.	Topic	Time Allotted (hrs)	Marks Allocation%
1	Wave Shaping Circuits	08	15
2	Multivibrator Circuits	14	20
3	Operational Amplifiers	18	25
4	Regulated DC Power Supplies	12	15
5	Opto Electronic Devices	06	15
6	IC Based oscillators & PLL	06	10
Total		**64**	**100**

4.4 DIGITAL ELECTRONICS

L	T	P
4	-	2

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

Pre-Requisite -

1. Basic Electronics Engineering

DETAILED CONTENTS

1. Introduction To Digital Techniques 10 hrs

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 09 hrs

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 16 hrs

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; 1:16), Demultiplexer IC. Block diagram, Truth table, working principle of Encoders & Decoders

4. Flip Flops And Sequential Logic Design **24 hrs**

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 **05 hrs**

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

Practical:

Skills to be developed:
Intellectual Skills:
1. Interpret the results
2. Verify the tables

List of Practical:

1) Study of Digital IC datasheets and noting down the characteristics for TTL & CMOS logic families.
2) Verification of truth table of logic gates.
3) Verification of DeMorgan's theorem.
4) Construction of Half adder and Full adder.
5) Implementation of Combinational Circuit using Multiplexer.
6) Construction of 7-segment decoder driver.
7) Verification of truth table of Flip flops.
8) Universal Shift Register
9) Decade counter using IC 7490.
10) Design of 3-bit Synchronous counter.

Text Books:

Name of Authors	Titles of the Book Edition	Name of the Publisher
R.P. Jain	*Modern Digital Electronics*	*Tata McGraw Hill*
Malvino Leach	*Digital Principles*	*Tata McGraw Hill*
Tokheim	*Digital Electronics*	*Tata McGraw Hill*

Reference books :

Name of Authors	Titles of the Book Edition	Name of the Publisher
S.P. Bali	*2000 solved problems in Electronics Sigma series*	*Tata McGraw HillDigital*

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Alloted	Marks Alloted
1	10	15
2	9	15
3	16	25
4	24	35
5	5	10

4.5 ELECTRICAL POWER-1
(Power Generation and System Protection)

L	T	P
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. Power Generation (15 hrs)

1.1 Main resources of energy, conventional and non-conventional.

1.2 Different types of power stations layout of hydro, thermal and nuclear power stations. Flow diagrams and brief details of their operation, comparison of the generating stations on the basis of running cost, site, starting, maintenance etc. Classification on hydro power stations on the basis of water availability and discharge, head available. Various types of turbines and their importance and uses in hydro electric stations.

1.3 Importance of non-conventional sources of energy in the present scenario. Brief details of solar energy, bio-energy, wind energy.

2. Economics of Generation (5 hrs)

2.1 Fixed and running cost, load estimation, load curves, demand factor, load factor, diversity factor, power factor and their effect on cost of generation, simple problems there on.

2.2 Base load and peak load power stations, inter-connection of power stations and its advantages, concept of regional and national grid.

3. Switch gears (10hrs)

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, re-striking voltage and recovery voltage. (Only definition)

3.2 Principles of Arc extinction in OCB and ACB, Constructional features of OCB, ACB, VCB and their working,

3.3 Circuit breakers. Types of circuit breakers, bulk and minimum oil circuit breakers, air blast circuit breakers, SF_6 circuit breakers

3.4 Miniature circuit breakers ACB, ELCB, MCB, for distribution and transmission system (Descriptive)

4. Protection Devices (15 hrs)

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
f) Microprocessor based protective relays.

5. Protection Scheme (15 hrs)

5.1 Relays for generator protection
5.2 Relays for transformer, protection including Buchholz relay protection
5.3 Protection of feeders and bus bars,Over current and earth fault protection.
5.4. Distance protection and carrier current protection for transmission system
5.5. Relays for motor protection

6. Over-voltage Protection (4 hrs)

6.1 Protection of system against over voltages, causes of over voltages, utility of ground wire
6.2 Lightning arrestors, Rod gap, horn gap, metal oxide type.
6.3 Transmission Line and substation protection against over-voltages and lightning.

LIST OF PRACTICALS

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

1. Testing of the dielectric strength of transformer oil
2. Study of different types of circuit breakers and isolators
3. Working of different types of protective relays (such as IDMT, Differential Relay)
4. Working of CTs and PTs
5. Earthing of different equipment
6. Testing of MCB as per IS specifications

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, Unique International 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 FOR FACILITATING THE PAPERSETTER

Sr. No.	Topic	Time Allotted (Hrs)	Marks Allocation (%)
1	Power Generation	15	25
2	Economics of Generation	5	10
3	Switch gears	10	15
4	Protection Devices	15	20
5	Protection Scheme	15	20
6	Over-Voltage Protection	4	10
Total		**64**	**100**

4.6 ELECTRICAL WORKSHOP PRACTICE – II

L	T	P
-	-	6

RATIONALE

An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers or artisans working under him. In addition to these persons, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively in addition to conceptual understanding of the method or procedure he must possess appropriate manual skills. The subject aims at developing special skills required for repairing, faultfinding, wiring in electrical appliances and installations.

DETAILED CONTENTS

1. Field study of pipe/plate earthing for a small house and 3-phase induction motor. Testing the earthing using earth tester.
2. Connections of single phase and 3-phase motors, through an appropriate starter and to change their direction of rotation.
3. Wiring, testing and fault finding of the following contactor control circuits operating on 3-phase supply:
    a) Remote control circuits
    b) Time delay circuits
    c) Inter locking circuits
    d) Sequential operation control circuits
    e) Automatic star-delta starter using TDR

Note: *Students may be asked to study control circuit of a passenger lift, automatic milling machine, etc. using relays and limited circuits*

4. Winding/re-winding of a fan (ceiling and table) and choke
5. Power cable jointing using epoxy based jointing kits
6. Demonstration of laying of underground cables at worksite
7. Dismantling/assembly of star-delta/DOL starter and slip-ring induction motor starter.
8. Dismantling and assembly of voltage stabilizers
9. Study and testing of armature, commutator and field pole winding of Mixer Motor, Drill Machine etc.
10. Testing of inverter at its rated load and verification of its. Backup Hrs. according to specification, batteries AH and grouping to increase backup Hrs.