अधिसूचना / पाठ्यक्रम

विषयः– विज्ञापन संख्या–40 / उ0 अ0से0च0आ0 / 2021 दि0 10–12–2021 के अन्तर्गत विज्ञापित पदों की परीक्षा हेतु पाठ्यक्रम के सम्बन्ध में।

आयोग के विज्ञापन संख्या– 40 / उ0अ0से0च0आ0 / 2021 दिनॉक 10.12.2021 के अनुसार समूह "ग" के अन्तर्गत उत्तराखण्ड़ जल विद्युत निगम लिमिटेड के अवर अभियन्ता प्रशिक्षु जानपद (सिविल) के 25 पदों, उत्तराखण्ड़ पावर ट्रांसमिशन कार्पोरेशन लिमिटेड (पिटकुल) के अवर अभियन्ता प्रशिक्षु जानपद (सिविल) के 05 पदों एवं उत्तराखण्ड अक्षय ऊर्जा विकास संस्था के अवर अभियन्ता के 10 पद तथा उत्तराखण्ड़ जल विद्युत निगम लिमिटेड के अन्तर्गत अवर अभियन्ता प्रशिक्षु (विद्युत एवं यांत्रिकी) के 25 पदों हेतु पद विज्ञापित हुए है। इस सन्दर्भ में अभ्यर्थियों को सूचित किया जाता है कि उक्त पदों हेतु शैक्षिक योग्यता मान्यता प्राप्त पॉलीटैक्निक / संस्थान से सम्बन्धित विषय से 03 वर्षीय डिप्लोमा उत्तीर्ण होना आवश्यक है।

एतद्द्वारा अभ्यर्थियों को सूचित किया जाता है कि अवर अभियन्ता (सिविल), अवर अभियन्ता (यांत्रिकी), अवर अभियन्ता (विद्युत) हेतु उत्तराखण्ड़ प्राविधिक शिक्षा परिषद के सिविल, मैकेनिकल एवं विद्युत के 03 वर्षीय डिप्लोमा के सेमेस्टर 03 से 06 तक के पाठ्यक्रम को अवर अभियन्ता परीक्षा हेतु आयोग की साइट पर प्रकाशित किया गया है।

साथ ही उक्त विज्ञापन में अवर अभियन्ता (पर्यावरण संरक्षण एवं प्रदूषण नियंत्रण बोर्ड) के 11 पद भी विज्ञापित है। जिसकी परीक्षा हेत अवर अभियन्ता पद की शैक्षिक योग्यता के अनुसार परीक्षा हेतु पाठ्यक्रम आयोग की साइट पर प्रकाशित किया गया है।

29/12

(संतोष बडोनी)
सचिव

उत्तराखण्ड पर्यावरण संरक्षण नियंत्रण बोर्ड के अवर अभियंता पद हेतु लिखित प्रतियोगी परीक्षा का पाठ्यक्रम

UNIT 1

Properties of matter: Elasticity, Pressure, Surface tension, Viscosity, Force and it's measurement, Normality, molarity, molality, percentage composition, molecular weight, Types of reaction, Arrhenius law, molecularity and order of reaction, heat of reaction ,heat of formation and heat of combustion

Definition, scope, brief history & branches of ecology; Definition, scope and the importance of environment, sustainable development; Definition, components and function of ecosystem, energy flow in ecosystem, food chains, food web, ecological pyramids, ecotone, edge effect, ecological niche

Solid waste management: types, sources and properties of solid waste, method to reduce solid waste, hazardous and hospital waste management

UNIT 2

Definition, causes, effect and control measures of water, air, soil, noise and thermal pollution

Quality of water – physical, chemical, biological tests and their significance, unit system and processes – screening, sedimentation, coagulation, flocculation and filtration, sources of waste water generation, sewer appurtenance, sewage treatment – primary, secondary and tertiary treatment of water, disposal of sewage and sludge – disposal methods, self purification of water bodies, oxygen sag curve, sludge digestion, conditioning and dewatering, septic tank, water standards (drinking, irrigation and industry), water borne diseases

UNIT 3

Types and properties of fluid, flow measurement and flow meters, humidity, absolute humidity and relative humidity, temperature measurement, pressure measurement, fuel, calorific value of fuel, solid, liquid and gaseous fuels, Types of non-conventional energy sources

Environmental Impact Assessment (EIA), elements for preparing EIA, environmental auditing, Environmental, statements, green audit, energy budget, green energy, green labelling certification

Hydrological cycle, rainfall, definition of rain gauges, rainwater harvesting, instrumentation – flame photometry, spectrophotometry, atomic absorption spectrophotometer, nephelometer, DO meter, pH meter, noise level meter, lux meter, PM 10, PM 2.5 (analysis)

UNIT 4

Introduction to conduction, convection, radiation, distillation, extraction, drying, adsorption, absorption, fermentation

Sampling methods – sampling technique of air and water, air pollution abatement techniques, stack sampling, odour and their control, threshold concentration, definition, importance and conservation methods of biodiversity – in-situ and ex-situ conservation methods

Geological classification of rocks (igneous, sedimentary and metamorphic rocks), types and properties of soil

UNIT 5

Environmental protection act (1986), Air (prevention and control of pollution) act 1981, Water (prevention and control of pollution) act 1972, Forest conservation act (1980), concept of hygiene and sanitation, clean India program, ecological and public health impacts of raw sewage and domestic liquid discharge, socio economic and environmental impact of tourism, coal mining and hydro electric development project

Meaning and nature of natural disasters – types and effects, manmade disasters, disaster risk reduction strategy, National disaster management act (2005), cloud bursting and cloud seeding

Principles of clean production, eco-mark, eco-labelling, ecological and carbon footprints.

3.1 FUNDAMENTALS OF ELECTRICAL ENGINEERING

	L	P
Periods/week	5	3

RATIONALE

For a diploma holder in electrical engineering, it becomes imperative 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. (a) Application and Advantages of Electrical Energy (04 Periods)

- Different forms of energy
- Advantages of electrical energy
- Uses of electrical energy

(b) Basic Electrical Quantities

- Basic concept of charge, current, voltage, resistance, power, energy and their units
- Conversion of units of work, power and energy from one form to another

2. DC Circuits (12 Periods)

2.1 Ohm's law, resistances in series and parallel

2.2 Kirchhoff's laws and their applications in solving electrical network problems

2.3 Network theorems such as Thevenin's theorem, superposition theorem Maximum power and transfer theorem and Norton's theorem

3. Batteries (15 Periods)

3.1 Basic idea about primary and secondary cells

3.2 Working principle, construction and applications of Lead acid, Nickel Cadmium and Silver Oxide Cells

3.3 Capacity and efficiency of lead acid battery

3.4 Charging methods used for lead acid accumulator

3.5 Care and maintenance of a lead acid battery

3.6 Grouping of cells in series and parallel (simple numerical problems)

3.7 Testing of lead Acid battery for fully charged conditions and their specifications

3.8 Application of lead acid battery

3.9 Idea about batteries used in UPS

4. Magnetism and Electromagnetism: (08 Periods)

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 magnetic circuits, simple problems

4.4 Concept of hyteresis, loop and hysteresis loss.

5. Electromagnetic Induction: (10 Periods)

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. AC Fundamentals (06 Periods)

6.1 Concept of a.c. generation (single phase and three phase)

6.2 Difference between a.c and d.c

6.3 Concept of alternating current and voltage, equation of instantaneous values, average value, r.m.s value, form factor, power factor etc.

6.4 Concept of phasor and phase difference

6.5 Representation of alternating sinusoidal quantities by vectors

6.6 Phasor algebra (addition, subtraction, multiplication and division of complex quantities)

7. AC Circuits (15 Periods)

7.1 AC through pure resistance, inductance and capacitance

7.2 Alternating voltage applied to RL,RC and RLC series and parallel circuits (impedance triangle, phasor diagram and their solutions)

7.3 Concept of susceptance, conductance and admittance

7.4 J-notation and its application in solving problems in ac circuits

7.5 Power in pure resistance, inductance, capacitance and series RL, RC, RLC circuits

7.6 Active and reactive components of current and their significance

7.7 Power factor and its practical significance

8. Poly-Phase Systems (10 Periods)

8.1 Advantages of 3 phase over single phase system

8.2 Star and delta connections (derive relationship between phase and line voltages, phase and line currents in star delta connections

8.3 Power in 3 phase circuits and measurement by two wattmeter method

8.4 Measurement of power and power factor of a 3-phase load by two wattmeter method using balanced/unbalanced load.

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 calculations.
   - 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 $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \text{- - - - - -} + \frac{1}{R_m}$

   Where R_1, R_2 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 emfs and voltage drops in a closed loop is zero

4. To observe the a.c and d.c wave shapes on CRO.

5. 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

6. To construct an RL and RC circuit and to measure

a) Impedance of the circuit
b) Phase angle between voltage and current
c) Construct impedance triangle

7. Measurement of power and power factor of a single phase RLC circuit. To calculate KVA and KVAR

8. Measurement of power and power factor of a 3-phase circuit by using 2- wattmeter method using induction motor as a load and to calculate KVA and KVAR

9. Testing a battery for its charged condition i.e testing of gravity

Note: The results should be verified analytically also.

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 given them an opportunity in mastering the basics in solving related problems.

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	04	05
2	12	15
3	15	15
4	08	10
5	10	15
6	06	05
7	15	20
8	10	15
Total	**80**	**100**

3.2 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

	L	P
Periods/week	4	2

RATIONALE

A diploma holder in Electrical 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 (03 Periods)

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

2. Conducting Materials (12Periods)

   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

   a. 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

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

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

   Introduction to bundle conductors and its applications

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

   2.4 Applications of special metals e.g. Silver, Gold, Platinum etc.
   2.5 High resistivity materials and their applications e.g., manganin, constantin, nichrome, mercury, platinum, carbon and tungsten, Tantalum
   2.6 Superconductors and their applications

3. Review of Semi-conducting Materials (05 Periods)

Semi Conducting material such as Germanium, Silicon, Carbon-their atomic structure/application/against , pure and impure semi conductors and their use for making electronic devices. Material used for special purpose semiconductor, diode, contacts, power transistor, substrate, integrated circuits and power handling devices.

4. Insulating materials; General Properties (12 Periods)

4.1 Electrical Properties
Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant

4.2 Physical Properties
Hygroscopicity, tensile and compressive strength, abrasive resistance, brittleness

4.3 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

4.4 Chemical Properties
Solubility, chemical resistance, weatherability

4.5 Mechanical properties, mechanical structure, tensile structure

5. Insulating Materials and their applications (13Periods)

5.1 Plastics

a. Definition and classification
b. Thermosetting materials:
Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and melamine - formaldehyde), epoxy resins - their important properties and applications

c. Procedure of preparation of plastic (PVC)

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

5.2 Natural insulating materials, properties and their applications

a. Mica and Mica products
b. Asbestos and asbestos products
c. Ceramic materials (porcelain and steatite)
d. Glass and glass products
e. Cotton
f. Silk
g. Paper (dry and impregnated)
h. Rubber, Bitumen

i. Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation
j. Enamels for winding wires
k. Glass fibre sleeves

5.3 Gaseous materials; Air, Hydrogen, Nitrogen, SF6 $^{\text{their}}$ properties and applications

6. Magnetic Materials (11 Periods)

6.1 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, method of reduction of eddy current loss and hysteresis loss

6.2 Soft Magnetic Materials

a) Alloyed steels with silicon: High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines
b) Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine
c) Nickel-iron alloys
d) Soft Ferrites

6.3 Hard magnetic materials - Tungsten steel, chrome steel, hard ferrites and cobalt steel, their applications

7. Special Materials (04 Periods)

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

8. Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc (04 Periods)

LIST OF PRACTICALS

1. A market survey of different Electrical and Electronics materials available in market will be conducted by students. They will submit a report, which will include names, types, specifications, identification, testing of components, manufacturing details and related cost.
2. Case study/data manuals of different wires/cables/fuses/sockets etc.. A report will be submitted by the students.

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

Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi

Electronic Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi

Electrical Engineering Materials by Sahdev, Uneek International Publications

Electronic Components and Materials by SM Dhir, Tata Mc Graw Hill, New Delhi

Electrical Engineering Materials by PL Kapoor, Khanna Publishers, New Delhi

Electrical and Electronics Engineering Materials BR Sharma and Others, Satya Parkashan, New Delhi

Electrical and Electronics Engineering Materials DR Arora, Ishan Publications, Ambala City

Electrical Engineering Materials by Rakesh Dogra, SK Kataria and Sons, NEW Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Period)	Marks Allocation (%)
1	03	05
2	12	20
3	05	05
4	12	20
5	13	25
6	11	15
7	04	05
8	04	05
Total	**64**	**100**

3.3 ELECTRONICS DEVICES AND CIRCUITS

	L	P
Periods/week	5	3

RATIONALE

At present, electronics gadgets are being extensively used in various manufacturing processes in industries, power system operations, communication systems, computers etc. Even for an electrical diploma holder, it is absolutely necessary to have a basic understanding of electronic components, their function and applications. This understanding should facilitate in operation and maintenance equipment, which are electronically controlled.

In this course, topics like semi-conductor theory, semi-conductor Diodes, Bipolar transistors, rectifiers, single stage and multistage amplifiers and field effect transistors have been included.

DETAILED CONTENTS

1. Introduction (04 Periods)

   1.1 Brief history of development of electronics
   1.2 Active and passive components

2. Semi-conductor Theory (10 Periods)

   2.1 Atomic structure, crystalline structure
   2.2 Energy band theory of crystals, energy band structure of insulator, semiconductor and conductor, generation and recombination of electron hole pairs. Energy band structure of Silicon and Germanium
   2.3 Concept of Doping, intrinsic and extrinsic semiconductors
   2.4 Effect of temperature on intrinsic and extrinsic semiconductors

3. Semiconductor Diodes (14 Periods)

   3.1 PN Junction, mechanism of current flow in PN junction, drift and diffusion currents, depletion layer, potential barrier, effect of forward and reverse biasing in a PN junction. Concept of junction capacitance in forward and reverse biased conditions. Breakdown mechanism
   3.2 Ideal diode, Semiconductor diode characteristics, static and dynamic resistance
   3.3 Use of diode as half wave and full wave rectifiers (centre tapped and bridge type), ripple factor, rectifier efficiency
   3.4 Operation of filter circuits
   3.5 Diode ratings/specifications
   3.6 Various types of diodes such as zener diode, varactor diode, Schottky diode, light emitting diode, tunnel diode, photo diode; their working characteristics and applications
   3.7 Use of zener diode for voltage stabilization

4. Bi-polar Transistors (10 Periods)

   4.1 Concept of junction transistor, PNP and NPN transistors, their symbols and mechanism of current flow
   4.2 Transistor configurations: common base (CB), common emitter (CE) and common collector (CC), current relation and their input/output characteristics; comparison of the three configurations

5. Transistor Biasing and Stabilization (12 Periods)

5.1 Transistor biasing, its need, operating point, effect of temperature on the operating point of a transistor and need of stabilization of operating point.
5.2 Different biasing circuits, limitations
5.3 Use of data book to know the parameters of a given transistor

6. Single-Stage Transistor Amplifiers (10 Periods)

6.1 Single stage transistor amplifier circuit in CE configuration, function of each component
6.2 Working of single stage transistor amplifier, physical and graphical explanation, phase reversal
6.3 Frequency response of a single stage transistor amplifier

7. Multi-Stage Transistor Amplifiers (08 Periods)

7.1 Need of multi-stage transistor amplifiers – different types of couplings, their purpose and applications.
7.2 RC coupled two-stage amplifiers, circuit details, working, frequency response, applications
7.3 Loading effect in multistage amplifiers
7.4 Elementary idea about direct coupled amplifier, its limitations and applications
7.5 Transformer coupled amplifiers, its frequency response.

8. Field Effect Transistor (FET) (06 Periods)

8.1 Construction, operation, characteristics and applications of a N channel JFET and P channel JFET
8.2 JFET as an amplifier
8.3 Types, construction, operation, characteristics and applications of a MOSFET
8.4 Comparison between BJT, JFET and MOSFET

9 Operational Amplifiers (08 period)

- Characteristics of an ideal operational amplifier and its block diagram
- Definition of differential voltage gain, CMRR, PSRR, slew rate and input offset current
- Operational amplifier as an inverter, scale changer, adder, subtractor, differentiator, and integrator

LIST OF PRACTICALS

1. a) Identification and testing of electronic components such as resistor, inductor, capacitor, diode, transistor and different types of switches used in Electronic circuits

b) Measurement of resistances using multimeter and their comparison with colour code values

2. V-I characteristics of a Semiconductor diode and to calculate its static and dynamic resistance
3. a) V-I characteristics of a zener diode and finding its reverse breakdown voltage
   b) Fabrication of a zener diode voltage stabilizer circuit using PCB
4. Observation of input and output wave shapes of a half-wave rectifier
5. Observation of input and output wave shapes of a full wave rectifier
6. Plotting input and output characteristics of a transistor in CB configuration
7. Plotting input and output characteristics of a transistor in CE configuration
9. To study the effect of coupling capacitor on lower cut off frequency and upper cut off frequency by plotting frequency response curve of a two stage RC coupled amplifier
10. To plot V-I characteristics of a FET
11. To use IC 741 (op-amplifier) as

    i) Inverter, ii) Adder, iii) Subtractor iv) Integrator

INSTRUCTIONAL STRATEGY

This subject gives the knowledge of fundamental concepts of basic electronics. The teacher should give emphasis on understanding of concepts and various term used in the subject. The students be made familiar with diodes, transistors, resistors, capacitors, inductors etc. and electrical measuring instruments etc. Practical exercises will reinforce various concepts. Application of Semiconductor Diodes, Transistors, Field Effect Transistors etc must be told to students.

RECOMMENDED BOOKS

1. Basic Electronics and Linear Circuit by NN Bhargava, Kulshreshta and SC Gupta, Tata McGraw Hill Education Pvt Ltd, New Delhi
2. Electronic Principles by SK Sahdev, Dhanpat Rai & Co., New Delhi
3. Principles of Electrical and Electronics Engineering by VK Mehta; S Chand and Co., New Delhi
4. Electronic Components and Materials by SM Dhir, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi
5. Principles of Electronics by SK Bhattacharya and Renu Vig, SK Kataria and Sons, Delhi
6. Electronics Devices and Circuits by Millman and Halkias; McGraw Hill

7. Principles of Electronics by Albert Paul Malvino; Tata McGraw Hill Education Pvt Ltd, New Delhi
8. Basic Electronics – Problems and Solutions by Albert Malvino and David J. Bates; Tata McGraw Hill Education Pvt Ltd, New Delhi
9. Basic Electronics by J.S. Katre, Sandeep Bajaj, Tech. Max. Publications, Pune
10. Analog Electronics by DR Arora, Ishan Publications, Ambala City
11. Analog Electronics by JC Karhara, King India Publication, New Delhi
12. Electrical Devices and Circuits by Rama Reddy, Narosa Pulishing House Pvt. Ltd., New Delhi
13. Electronic Devices and Circuits by Dharma Raj Cheruku and Battula Tirumala Krishna: Pearson Education (Singapore) Pvt Ltd., Indian Branch, 482 F.I.E Patparganj, Delhi- 92
14. Basic Electronics by JB Gupta, SK Kataria and Sons, New Delhi
15. Grob's Basic Electronics- A text Lab Manual (Special Indian Edition) by Schultz, Tata McGraw Hill Education Pvt Ltd, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Period)	Marks Allocation (%)
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4	10	10
5	12	15
6	10	10
7	08	10
8	06	10
9	06	10
Total	**80**	**100**

3.4 FUNDAMENTALS OF MECHANICAL AND CIVIL ENGINEERING

	L	T	P
Periods/week	5	-	3

RATIONALE

A diploma holder has to assist in activities of installation, operation and maintenance etc of different machines and equipment. These activities are not branch specific and instead require him to know basics of civil and mechanical engineering. The subject of Fundamentals of Mechanical and Civil Engineering has been included to impart basic knowledge of Civil and Mechanical engineering to the students.

DETAILED CONTENTS
PART-A

MECHANICAL ENGINEERING

Theory

1. Transmission of Power (20 Periods)

    1.1 Transmission of power through belt, rope drives and pulleys, gears and chains
    1.2 Different type of pulleys and their application
    1.3 Chain drives and its comparison with belt drive
    1.1 Gear drives, types of gears, simple gear trains and velocity ratio

2. Air Conditioning System (24 Periods)

    2.1 Basic principle of refrigeration and air conditioning
    2.2 Working of centralized air conditioner
    2.3 Concept of split air conditioner and its applications

3. Pumps - Types and their uses (06 Periods)

PART B

CIVIL ENGINEERING

Theory

4. Construction Materials (12 Periods)

    Properties and uses of various construction materials such as stones, bricks, lime, cement and timber along with their properties, physical/ field testing and uses, elements of brick masonry

5. Foundations (08 Periods)

    i) Bearing capacity of soil and its importance
    ii) Types of various foundations and their salient features, suitability of various foundations for heavy, light and vibrating machines

6. Concrete (06 Periods)

Various ingredients of concrete, different grades of concrete, water cement ratio, workability, physical/ field testing of concrete, mixing of concrete

7. RCC (04 Periods)

Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building

LIST OF PRACTICLES

1. Observe operation of a centrifugal pump and location of common faults
2. Decide the type of foundation too be used for various types of electrical machinery and installation. Prepare a foundation for installation of a motor/ generator.
3. Identify various types of drives used in an IC engines and describe their function
4. Observe operation of air conditioning system. Identify locations of faults.
5. Trace the various paths of hot gases, cool gases, control system in a split air conditioner model. Identify the possible location of faults/ malfunctioning.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on basic principles and use charts in class, visits to Labs and industry may be arranged to demonstrate certain materials and practices.

RECOMMENDED BOOKS

Mechanical Engineering

1. General Mechanical Engineering by M. Adithan; TTTI, Chandigarh

2. Basic Civil and Mechanical Engineering by Jayagopal; Vikas Publications, New Delhi

3. IC Engines and Automobile Engineering by Dr.MP Poonia, Standard Publishers, New Delhi

4. Refrigeration and Air Conditioning by RK Rajput; SK Kataria and sons; Ludhiana

5. Theory of Machines by RS Khurmi and JK Gupta; S. Chand and Company Ltd., New Delhi

Civil Engineering

1. Textbook of Concrete Technology 2nd Edition by Kulkarni, PD Ghosh RK and Phull, YR; New Age International (P) Ltd., Publishers, New Delhi
2. Materials of Construction by Ghose; Tata McGraw Hill Publishing Co., Ltd., New Delhi
3. Civil Engineering Materials by TTTI, Chandigarh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
4. Concrete Technology by Gambhir; Tata McGraw Hill Publishing Co., Ltd., New Delhi
5. Building Construction by J Jha and Sinha; Khanna Publishers, Delhi
6. Building Construction by Vazirani and Chandola; Khanna Publishers, New Delhi Delhi
7. Civil Engineering Materials by SV Deodhar and Singhai; Khanna Publishers, New Delhi Delhi
8. Soil Mechanics and foundation Engineering by SK Garg; Khanna Publishers, New Delhi Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1	20	17
2	24	27
3	06	06
4	12	25
5	08	10
6	06	08
7	04	07
Total	**80**	**100**

3.5 ELECTRICAL MEASURMENT AND MEASURING INSTRUMENTS

	L	P
Periods/week	5	3

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 be 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 (07 Periods)

    1.1 Concept of measurement and measuring instruments
    1.2 Types of electrical measuring instruments – indicating, integrating and recording type instruments
    1.3 Essentials of indicating instruments – deflecting, controlling and damping torque

2. Ammeters and Voltmeters (Moving coil and moving iron type) (15 Periods)

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

3. Wattmeters (Dynamometer Type) (06 Periods)

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

4. Energy meter (Induction type) (08 Periods)

    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

5. Miscellaneous Measuring Instruments (22 Periods)

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), signal generator, AC milivoltmeter, tachometer

5.2 Instrument Transformers: Construction, working and applications
a) CT
b) PT and their ratio and phase angle error

6. Electronic Instruments (10 Periods)

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

6.2 Digital multi-meter, basic principle, constructional brief, display system

7. LCR meters (07 Periods)

Study of LCR meter and its applications
Digital LCR and Q meter

8. Power Measurements in 3-Phase Circuits by (05 Periods)

(i) 2 wattmeter method in balanced and unbalanced circuits and simple problems
(ii) Three wattmeter method

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 power and power factor of a three-phase balanced load by two wattmeter method.
6. Measurement of voltage and frequency of a sinusoidal signal using CRO time base as well as Lissagous pattern and draw wave shape of signal.
7. Measurement of power in a 3 phase circuit using CT, PT and 3-phase wattmeter.
8. Use of LCR meter, digital LCR meter for measuring inductance, capacitance and resistance.
9. To record all electrical quantities from the meters installed in the institution premises.
10. To measure Energy at different Loads using Single phase Digital Energy meter.

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

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Period)	Marks Allocation (%)
1	07	10
2	15	20
3	06	05
4	08	10
5	22	25
6	10	10
7	07	10
8	05	10
Total	**80**	**100**

3.6 ELECTRICAL WORKSHOP PRACTICE

	L	P
Periods/week	-	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. Types of wiring and to make different light control circuits in the following types of wiring Casing and capping, (PVC) conduct, baten wiring

3. Study of ISI standard for MCBs and ELCBs Conduct one test on MCB on above basis

4. Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and MCBs Types of wiring and to make different light control circuits in the following types of wiring.

   4.1 Casing and Capping (PVC) wiring
   4.2 Conduit wiring (surface/concealed)

5. Construction of distribution and extension board with two 5A sockets and two I5A sockets, a fuse and indicator with series test lamp provision controlled by their respective switches.

6. Testing of domestic wiring installation using meggar.

7. Fault finding and repair of a tube light circuit.

8. Carry out pipe/ plate earthing for a small house and 3 phase induction motor. Testing the earthing using earth tester.

9. Connection of single phase and three phase motors through an appropriate starter.

10. Winding/ rewinding of a fan (ceiling and table) and choke.

11. Repair of domestic electric appliances such as electric iron, geyser, fan, heat convector, desert cooler, room heater, electric kettle, electric oven, electric furnace and weighing machine.

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

4.1 ELECTRICAL ENGINEERING DESIGN AND DRAWING

	L	P
Periods/week	-	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 (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 KVA 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	6
2	18	18
3	12	12
4	12	12
5	24	24
6	08	08
7	06	10
8	10	10
Total	**96**	**100**

4.2 D.C. MACHINES AND TRANSFORMERS

	L	P
Periods/week	5	3

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 (08 Periods)

    1.1 Definition of motor and generator, concept of torque
    1.2 Torque development due to alignment of two fields and the concept of torque angle
    1.3 Electro-magnetically induced emf
    1.4 Elementary concept of an electrical machine
    1.5 Comparison of generator and motor

2. DC Machines (30 Periods)

    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 emf
    2.4 Factors determining the electromagnetic torque
    2.5 Types of dc generation on the basis of excitation, voltage built up in a dc shunt generator
    2.6 Significance of back e.m.f., the relation between back emf and Terminal voltage
    2.7 Armature Reaction
    2.8 Commutation methods to improve commutation
    2.9 Performance and characteristics of different types of DC motors
    2.10 Speed control of dc shunt/series motors
    2.11 Need of starter, three point dc shunt motor starter and 4-point starter
    2.12 Applications of DC motors
    2.13 Losses in a DC machine
    2.14 Determination of losses by Swinburne’s test

3. Transformers (single phase) (30 Periods)

    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 Transformer on no-load and its phasor diagram
3.6 Transformer – neglecting voltage drop in the windings – Ampere turn balance – its phasor diagram
3.7 Mutual and leakage fluxes, leakage reactance
3.8 Transformer on load, voltage drops and its phasor diagram
3.9 Equivalent circuit
3.10 Relation between induced emf and terminal voltage, regulation of a transformer-mathematical relation
3.11 Losses in a transformer
3.12 Open circuit and short circuit test. Calculation of efficiency, condition for maximum efficiency-maintenance of Transformer, scheduled Maintenance
3.13 Auto transformer construction, saving of copper, working and applications
3.14 Different types of transformers including dry type transformer.

4. Transformers three phase (12 Periods)

4.1 Construction of three phase transformers and accessories of transformers such as Conservator, breather, Buchholz Relay, Tap Changer (off load and on load) (Brief idea)
4.2 Types of three phase transformer i.e. delta-delta, delta-star, star-delta and star-star
4.3 Conditions for parallel operation (only conditions are to be studied)
4.4 On load tap changer
4.5 Difference between power and distribution transformer
4.6 Cooling of transformer

LIST OF PRACTICALS

1. 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. Speed control of dc shunt motor (i) Armature control method (ii) Field control method
3. Study and connection of dc series motor with starter (to operate the motor on no load for a moment)
4. Study and connection of 3 point starter for starting D.C. shunt motor and change its direction of rotation. Also draw load characteristics
5. To perform open circuit and short circuit test for determining: (i) equivalent circuit (ii) the regulation and (iii) efficiency of a transformer from the data obtained from open circuit and short circuit test at full load
6. To find the efficiency and regulation of single phase transformer by actually loading it.
7. Checking the polarity of the windings of a three phase transformer and connecting the windings in various configurations
8. Finding 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
9. To test primary/ secondary windings of a transformer.

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 Fitzgerald
6. Electrical Machines by Smarajit Ghosh-Pearson Publishers, Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	08	10
2	30	40
3	30	35
4	12	15
Total	**80**	**100**

4.3 DIGITAL ELECTRONICS AND MICROPROCESSOR

	L	P
Periods/week	5	3

RATIONALE

The syllabus has been designed to make the students having knowledge about the fundamental principles of digital electronics, microprocessor and to get familiar with the available IC chips. This subject aims to give a background in the broad field of digital systems design and microprocessors.

DETAILED CONTENTS

(A) Digital Electronics

1. Introduction (02 Period**)**

Distinction between analog and digital signal, Applications and advantages of digital signals.

2. Number System (06 Period**)**

Binary, Octal and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa, binary addition, subtraction, multiplication and division including binary points. 1's and 2's complement method of addition/subtraction.

3. Codes and Parity (06 Period**)**

Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and Gray code, Concept of parity, single and double entry and error detection, Alpha numeric codes : ASCII and EBCDIC

4. Logic Gates and Families (05 Period**)**

Concept of negative and positive logic, Definition, Symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND and NOR as universal gates, Logic family classification: Definition of SSI, MSI,LSI, VLSI,TTL and CMOS families.

5. Logic Simplification (08 Period**)**

Postulates of Boolean algebra, De Morgan's Theorems . Various identities. Formulation of truth table and Boolean equation for simple problem. Implementation of Boolean (logic) equation with gates. Karnaugh map (upto 4variables) and simple applications in developing combinational logic circuits.

6. Arithmetic Circuits (06 Period**)**

Half adder and Full adder circuit, design and implementation, Half and Full subtractor circuit, design and implementation, 4 bit adder/subtractor, Adder and Subtractor IC

7. Decoders, Multiplexers and De Multiplexers (06 Period**)**

Four bit decoder circuits for 7 segment display and decoder/driver ICs, Multiplexers and De-Multiplexers, Basic function and block diagram of MUX and DEMUX. Different types and ICs.

8. Latches and flip flops (06 Period**)**

Concept and types of latch with their working and applications, Operation using waveforms and truth tables of RS, T, D, Master/Slave JK flip flops, Difference between a latch and a flip flop.

9. Counters (06 Period**)**

Introduction to Asynchronous and Synchronous counters, Binary counters, Divide by N ripple counters, Decade counter, Up/Down counter, Ring counter.

10. Shift Register (06 Period**)**

Introduction and basic concepts including shift left and shift right : Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out.

11. A/D and D/A Converters (02 Period**)**

Working principle of A/D and D/A converters.

(B) MICROPROCESSORS

12. Evolution and Architecture of a Microprocessor (08 Period**)**
(With reference to 8085 microprocessor)

Typical organization of a microcomputer system and functions of its various blocks. Concept of Bus, bus organization of 8085, Function block diagram of 8085, Pin details of 8085, Steps to execute a stored program.

13. Programming (With respect to 8085 microprocessor) (12 Period**)**

Brief idea of machine and assembly languages, Machines and Mnemonic codes. Instruction format and Addressing mode. Identification of instruction as to which addressing mode they belong. Concept of instruction set. Explanation of the instructions of the following groups of instruction set. Data transfer group, Arithmetic Group, Logic Group, Stack, I/O and Machine Control Group. Programming exercises in assembly language.(Examples can be taken from the list of experiments)

LIST OF PRACTICALS

1. Verification & interpretation of truth tables for AND, OR, NOT NAND, NOR and Exclusive OR (EXOR) gates.
2. To design a half adder & full adder using gates and verification of their operation construction of a full adder circuit using XOR and NAND gates and verify its operations.
3. To design a half subtractor & full subtractor circuit with the help of gates & verify their operation.
4. 4 bit adder /subtractor circuit using an IC verify the operation.
5. Verify of truth table for decoder ICs.

6. Verification of truth table of JK & JK Master slave flip flops.
7. To design a 4bit SISO, SIPO, PISO, PIPO shift registers using JK/D flip flop and verification of their operation.
8. Design decode counter and it's verification.
9. Design Analog to Digital & Digital to Analog converters and their verification.
10. To design a 4 bit binary counter & verify its truth table.
11. Steps to enter, modify data/program and to execute a program on 8085 kit.
12. Writing and execution of ALP for addition and subtractions of two 8 bit numbers.
13. Writing and execution of ALP for multiplication and division of two 8 bit numbers.
14. Writing and execution of ALP for arranging 10 numbers in ascending/descending order

Section 1.01 INSTRUCTIONAL STRATEGY

The digital systems and microprocessors have significant importance in the area of electronics. Adequate competency needs to be developed by giving sufficient practical knowledge in microprocessors (programming as well as interfacing), A/D, D/A Converters and other topics. Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. Programming exercises other than the tested in circulation may be given to the students.

(a) LIST OF RECOMMENDED BOOKS

1. Digital Electronics: Principles and Integrated Circuits by A.K Maini, Wiley-India Pvt Ltd. Daryaganj, New Delhi
2. Digital Electronics and Applications by Malvino Leach, Tata McGraw Hill Education Pvt Ltd, New Delhi
3. Digital Logic Designs by Morris Mano, Prentice Hall of India, New Delhi
4. Digital Electronics by Soumitra Kumar Mandal, Tata McGraw Hill Education Pvt Ltd,
5. Digital Electronics by V K Sangar , Raj Publishers, Jalandhar
6. Digital Electronics by Tokheim, Tata McGraw Hill Education Pvt Ltd,
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

14. Microprocessor Architecture, Programming and Applications with 8080/8085 by Ramesh S Gaonker, Willey Eastern Ltd. New Delhi

15. Introduction to Microprocessor by Mathur ,Tata McGraw Hill Education Pvt Ltd , New Delhi

16. Microprocessor and Applications by Badri Ram: Tata McGraw Hill Education Pvt Ltd , New Delhi

17. Microprocessor 8086/88 by B.B. Brey

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Period)	Marks Allotted (%)
1	02	03
2	06	06
3	06	08
4	06	08
5	08	08
6	06	08
7	06	08
8	06	08
9	06	10
10	06	06
11	02	03
12	08	08
13	12	08
Total	**80**	**100**

4.4 GENERATION, TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER

	L	P
Periods/week	5	3

RATIONALE

The majority of the polytechnic passouts who get employment in State Electricity Boards have to perform various activities in the field of Generation, Transmission and Distribution of Electrical power. The range of these activities vary from simple operation and maintenance of equipment, lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in power stations, transmission and distribution networks in addition to administrative jobs including public relations. They should also be made aware of recent developments, current practices in the electricity departments, corporations and boards to keep them abreast with modern techniques in Transmission and Distribution of Electrical Power.

DETAILED CONTENTS

1. Power Generation (15 Periods)

    1.1 Main resources of energy, conventional and non-conventional
    1.2 Different types of power stations, thermal, hydro, gas, diesel 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.
    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 (10 Periods)

    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
    2.3 Plant capacity factor, plant use factor, Daily load curve.

3. Transmission Systems (25 Periods)

    3.1 Layout of transmission system, selection of voltage for H.T and L.T lines, advantages of high voltage for Transmission of power in both AC and DC
    3.2 Comparison of different systems: AC versus DC for power transmission, conductor material and sizes from standard tables
    3.3 Constructional features of transmission lines: Types of supports, types of insulators, Types of conductors, Selection of insulators, conductors, earth wire and their accessories, Transposition of conductors and string efficiency of suspension type insulators, Bundle Conductors.
    3.4 Mechanical features of line: Importance of sag, calculation of sag, effects of wind and ice related problems; Indian electricity rules pertaining to clearance

3.5 Electrical features of line: Calculation of resistance, inductance and capacitance without derivation in a.c. transmission line, voltage regulation, and concept of corona. Effects of corona and remedial measures

3.6 Transmission Losses

4. Distribution System (16 Periods)

4.1 Lay out of HT and LT distribution system, constructional feature of distribution lines and their erection. LT feeders and service mains; Simple problems on AC radial distribution system, determination of size of conductor

4.2 Preparation of estimates of HT and LT lines (OH and Cables)

4.3 Constructional features of LT (400 V), HT (II kV) underground cables, advantages and disadvantages of underground system with respect to overhead system.

4.4 Calculation of losses in distribution system

4.5 Faults in underground cables-determine fault location by Murray Loop Test, Varley Loop Test

5. Power Factor (04 Periods)

5.1 Concept of power factor

5.2 Reasons and disadvantages of low power factor

5.3 Methods for improvement of power factor using capacitor banks, VAR Static Compensator (SVC)

6. Various types of Tariffs (10 Periods)

6.1 Concept of Tariffs

6.2 Block rate, flat rate, maximum demand and two part tariffs simple problems

LIST OF PRACTICALS

Structured visit to the substations, power stations, and LT/HT lines, student will prepare report and present in a seminar. Evaluation will be based on report s well as presentation.

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of power generating stations and substations including grid stations be arranged and various equipment, accessories and components explained to the students before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 3 visits during the semester. The students may be asked to prepare notes while on visit and submit the report and give seminar. In addition, viva-voce be conducted to evaluate the knowledge gained during the field visit.

RECOMMENDED BOOKS

1. Electrical Power System and Analysis by CL Wadhwa, 3rd edition, New Age International Publishers, New Delhi
2. Substation Design and Equipment by Satnam and PV Gupta, Dhanpat Rai & Sons, New Delhi
3. Electrical Power –I by SK Sahdev, Uneek Publications, Jalandhar
4. Electrical Power System by VK Mehta, S Chand and Co., New Delhi
5. Electrical Power System by JB Gupta, SK Kataria and Sons, New Delhi
6. Sub-Station Design by Satnam, Dhanpat Rai and Co., New Delhi
7. Electrical Power Distribution System by AS Pabla, Tata McGraw Hill, New Delhi
8. Electrical Power System by S Channi Singh, Tata McGraw Publishing Co. New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	15	15
2	10	10
3	25	35
4	16	20
5	04	10
6	10	10
Total	**80**	**100**

4.5 INDUSTRIAL INSTRUMENTATION AND CONTROL

	L	P
Periods/week	5	3

RATIONALE

This subject deals with the various instruments, their construction and working which control the various parameters and operations in any industry. Electrical supervisor employed for maintenance of electrical equipment/ machinery 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. Basics of instrumentation has been dealt with in this subject

DETAILED CONTENTS

1. Measurements (05 Periods)

   Importance of measurement, Basic measuring systems, advantages and limitations of each measuring systems, generalized measurement system, process and process variables

2. Transducers (08 Periods)

   Theory, types of transducers construction and use of various transducers like resistance, inductance, capacitance, electromagnetic, piezoelectric type

3. Measurement of Displacement and Strain (10 Periods)

   Displacement Measuring Devices: wire wound potentiometer, LVDT, strain gauges and their different types such as inductance type, resistive type, wire and foil type etc. Gauge factor, gauge materials, and their selections, sources of errors and its compensations. Use of electrical strain gauges, strain gauge bridges and amplifiers.

4. Force and Torque Measurement (10 Periods)

   Different types of force measuring devices and their principles, load measurements by using elastic Transducers and electrical strain gauges. Load cells, proving rings. Measurements of torque by brake, dynamometer, electrical strain gauges, speed measurements; different methods, devices.

5. Pressure Measurement- Manometers, diaphragms (08 Periods)

   Bourdon, bellows, manometer, diaphragm pressure gauges, basic principles, constructional brief and use, pickups, their principle, construction and applications. Use of pressure cells, Dead weight tester

6. Flow Measurement (06 Periods)
   Basic principles of magnetic and ultrasonic flow meters, flow coefficient, Reynolds number and rotameter.

7. Measurement of Temperature (10 Periods)

   Bimetallic thermometer, pressure thermometers, thermoelectric thermometers, resistance thermometers, thermocouple, thermisters and pyrometer, errors in temperature measurements in rapidly moving fluids, industrial thermocouple

8. Measurement of other non electrical quantities such as humidity, pH level and vibrations, light measurement, speed measurement using Tachometer and Stroboscope (08 Periods)

9. Signal conditioning and telemetry with small simple examples (05 Periods)

10. Recorder and display system brief idea (04 Periods)

11. Control System – Types of control system, open loop and close loop system, components and the circuit, brief description and application in industry, idea about automation (06 Periods)

INSTRUCTIONAL STRATEGY

The teacher should explain the scope of various measuring devices and their practical applications in the field. The transducers and measuring devices must be shown to the students and they should be trained in the reaction, operation, maintenance and calibrations. Frequent visits to nearby process industries will be of immense help to the students.

RECOMMENDED BOOKS

1. Electronic Measurement and Instrumentation by Dr Rajendra Prasad
2. Electronic Measurement and Instrumentation by JB Gupta, SK Kataria and Sons, New Delhi
3. Electrical and Electronics Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and Co., New Delhi
4. Electronic Instrumentation and Measurement Techniques by WD Cooper, AD Helfrick Prentice Hall of India Pvt. Ltd. New Delhi
5. Industrial Instrumentation by Umesh Rathore, SK Kataria and Sons, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	05	06
2	08	10
3	10	12
4	10	12
5	08	10
6	06	06
7	10	16
8	08	10
9	05	06
10	04	06
11	06	06
Total	**80**	**100**

4.6 ESTIMATING AND COSTING IN ELECTRICAL ENGINEERING

	L	P
Periods/week	6	-

RATIONALE

A diploma holder in electrical engineering should be familiar to Indian Standards and relevant Electricity Rules. Preparation of good estimates is a professional's job, which requires knowledge of materials and methods to deal with economics. The contents of this subject have been designed keeping in view developing requisite knowledge and skills of estimation and costing in students of diploma in electrical engineering.

DETAILED CONTENTS

1. Introduction (12 Periods)

   Purpose of estimating and costing, proforma for making estimates, preparation of materials schedule, costing, price list, preparation of tender document (with 2-3 exercises), net price list, market survey, overhead charges, labour charges, electrical point method and fixed percentage method, contingency, profit, purchase system, enquiries, comparative statements, orders for supply, payment of bills. Tenders – its constituents, finalization, specimen tender.

2. Types of wiring (18 Periods)

   IE rules and safety cods, Cleat, batten, casing capping and conduit wiring, comparison of different wiring systems, selection and design of wiring schemes for particular situation (domestic and Industrial). Selection of wires and cables, wiring accessories and use of protective devices i.e. MCB, ELCB etc. Use of wire-gauge and tables (to be prepared/arranged)

3. Estimating and Costing (42 Periods)

   3.1 Domestic installations; standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate (for house of two room set along with layout sketch), single storey building, auditorium hospital, cinema hall, computer networking, schools and others

   3.2 Industrial installations; relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with singe-phase, 3-phase motor load and the light load (3-phase supply system)

3.3 Service line connections estimate for domestic upto 10 KW and Industrial loads upto 20 KW (over-head and underground connections) commercial load upto 100 KW, agriculture load 10 hp motor from pole to energy meter.

4. Estimating the material required for (24 Periods)

a) Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations. Estimating of stay and poles, crossing of telephone lines, railway lines and bridge

b) Substation - Types of substations, substation schemes and components, estimate of 11/0.4 KV pole mounted substation up to 200 KVA rating, methods of earthing of substations, Key Diagram of 66 KV/11KV and 11 KV/0.4 KV Substation and foundation preparation.
Single line diagram, layout sketching of outdoor, indoor 11kV sub-station or 33kV sub-station

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 leading to preparation of small tender document.. 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 Installation, Estimating and Costing by JB Gupta, SK Kataria and Sons, New Delhi
2. Estimating and Costing by SK Bhattacharya, Tata McGraw Hill, New Delhi
3. Estimating and Costing by Surjeet Singh, Dhanpat Rai & Co., New Delhi
4. Estimating and Costing by Qurashi
5. Estimating and Costing by SL Uppal, Khanna Publishers, New Delhi
6. Electrical Estimating and Costing by N Alagappan and B Ekambaram, TMH, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	12	15
2	18	20
3	42	40
4	24	25
Total	**96**	**100**

4.7 INDUSTRIAL TRAINING

Industrial training 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.

For this purpose, students at the end of fourth semester need to be sent for industrial training for a minimum of 4 weeks duration to be organised during the semester break starting 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 teacher may guide a group of 4-5 students. A minimum of one visit 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.

Internal assessment and external assessment 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, if any. The components of evaluation will include the following.

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with workers	15%
d)	Industrial training report	55%

5.1 AC MACHINES

L T P
Periods 5 - 4

RATIONALE

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

DETAILED CONTENTS

1. Synchronous Machines (30 Periods)

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

   1.2 Generation of three phase emf

   1.3 Production of rotating magnetic field in a three phase winding

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

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

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

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

   1.8 Effect of change in excitation of a synchronous motor

   1.9 Concept and Cause of hunting and its prevention

   1.10 Rating and cooling of synchronous machines

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

2. Induction Motors (20 Periods)

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

   2.2 Principle of operation, slip and its significance

   2.3 Locking of rotor and stator fields

   2.4 Rotor resistance, inductance, emf and current

   2.5 Relationship between copper loss and the motor slip

   2.6 Power flow diagram of an induction motor

   2.7 Factors determining the torque

2.8 Torque-slip curve, stable and unstable zones

2.9 Effect of rotor resistance upon the torque slip relationship

2.10 Double cage rotor motor and its applications

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

2.12 Causes of low power factor of induction motors

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

2.14 Speed control of induction motor

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

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

3.1 Single phase induction motors; Construction characteristics and applications

3.2 Nature of field produced in single phase induction motor

3.3 Split phase induction motor

3.3.1 Capacitors start and run motor

3.3.2 Shaded pole motor

3.3.3 Reluctance start motor

3.4 Alternating current series motor and universal motors

3.5 Single phase synchronous motor

3.5.1 Reluctance motor

3.5.2 Hysteresis motor

3.6 Comparison of 3 phase and Single phase Induction motor

3.7 Application of 3 phase and Single phase Induction motor

4. Special Purpose Machines (12 Periods)

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

LIST OF PRACTICALS

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

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

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

SUGGESTED DISTRIBUTION OF MARKS

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

5.2 SUBSTATION, SWITCHGEAR AND PROTECTION

	L	P
Periods	4	2

RATIONALE

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

DETAILED CONTENTS

1. Substations (08 Periods)

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

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

2. Faults (06 Periods)

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

3. Switch Gears (15 Periods)

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

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

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

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

4. Protection Devices (15 Periods)

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

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

4.3 Relays

a) Introduction - types of relays. Electromagnetic and thermal relays, their construction and working
b) Induction type over-current, earth fault relays, instantaneous over current relay
c) Directional over-current, differential relays, their functions
d) Distance relays their functions
e) Idea of static relays and their applications

5. Protection Scheme (10 Periods)

5.1 Relays for generator protection

5.2 Relays for transformer, protection including Buchholtz relay protection

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

5.4 Distance protection for transmission system

5.5 Relays for motor protection

6. Over-voltage Protection (10 Periods)

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

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

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

6.4 Transient over voltage protection

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

LIST OF PRACTICALS

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

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

SUGGESTED DISTRIBUTION OF MARKS

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

5.3 INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENTS

	L	P
Periods	6	4

RATIONALE

In his career as a supervisor, an electrical engineering technician will be called upon to inspect, test and modify the work done by skilled workers or artisans working under him. Many a times it will become necessary for him to demonstrate the correct method and procedure of doing certain operations. Normally manufacturers of heavy electrical equipment provide service manuals, instructions for installation, maintenance and fault location. Indian Electricity Rules and Indian Standard Specifications also provide enough guidelines.

This syllabus has been designed to provide certain guidelines and broad principles regarding the above activities. Appropriate field trips will reinforce the learning by students.

DETAILED CONTENTS

1. Tools and Accessories (11 Periods)
   Tools, accessories and instruments required for installation, maintenance and repair work
   Knowledge of Indian Electricity rules, safety codes, causes and prevention of accidents, artificial respiration of an electrocuted person, workmen's safety devices

2. Installation (35 Periods)

   2.1 Domestic Installation
   Introduction, testing of electrical installation of a building, testing of insulation resistance to earth, testing of insulation and resistance between conductors continuity or open circuit test, short circuit test, testing of earthing, continuity, location of faults

   2.2 Installation of transmission and Distribution Line
   - Erection of steel structures, connecting jumpers, tee-off points, joints and dead ends; crossing of roads, streets, power/telecommunication lines and railway line, clearances; earthing of transmission lines and guarding, spacing and configuration of conductors: Types of arrangement for suspension and strain insulators, bird guards, anti-climbing devices and danger plates; sizes of conductor, earthwire and guy wires, Testing and Commissioning.
   - Laying of service lines, earthing, provision of service fuses, installation of energy meters

   2.3 Laying of Underground Cables
   Inspection, storage, transportation and handling of cables, cable handling equipment, cable laying depths and clearances from other services such as: water pipes, sewerage, gas pipes, power and telecommunication cables and coordination with these services, excavation of trenches, direct cable laying, laying of cable from the drum, laying of cable in the trenches, back filling of trenches with earth or sand, laying protective layer of bricks etc, laying of cables into pipes and conduits and within buildings, introduction to cable filling compounds, epoxy resins and hardeners, cable jointing and terminations, testing and commissioning.

2.4 Elementary idea regarding, inspection and handling of transformers; pole mounted substations, plinth mounted substations and grid substation, busbars, isolators, voltage and current transformers, lightning arrestors, control and relay panels, HT/LT circuit breakers, LT switches, installation of power/distribution transformers, dehydration. Earthing system, fencing of yard, equipment foundations and trenches etc..

2.5 Handling and inspection of electric motors and generators (AC and DC), drying out medium voltage distribution panels, testing and commissioning

3. Maintenance Preventive, Predictive, Breakdown maintenance (50 Periods)

3.1 Types of maintenance, maintenance schedules, procedures

3.2 Maintenance of Transmission and Distribution System

- Authorized persons, danger notice, caution notice, permit to work, arranging of shutdowns personally and temporary earths, cancellation of permit and restoration of supply
- Patrolling and visual inspection of lines - points to be noted during patrolling from ground; special inspections and night inspections
- Location of faults using Magger, effect of open or loose neutral connections, provision of proper fuses on service lines and their effect on system, causes of dim and flickering lights

3.3 Maintenance of Distribution Transformers

- Transformer maintenance and points to be attended to in respect of various items of equipment
- Checking of insulation resistance, transformer oil level BDV test of oil and measurement of earth resistance, maintenance of breathers and oil level indicators

3.4 Maintenance of Grid Substations
Checking and maintenance of busbars, isolating switches, HT/LT circuit breakers, LT switches. Power transformers

3.5 Maintenance of Motors
Over hauling of motors, preventive maintenance, trouble shooting of electric motors

LIST OF PRACTICALS

1. Preventive maintenance of different electrical equipments available in electrical laboratories
2. Corrective maintenance of different equipments which may occur faulty during experiments/use
3. Trouble shooting of

- Water Boiler
- Geyser
- Generator set
- Pumping set
- Heating ovens

4. Patrolling inspection and fault finding of lines
5. Open circuit/Short circuit/earth fault finding of machines
6. Installation of motors, Diesel Generating set
7. Laying of underground cables
8. Detecting of faults in underground cables
9. Case study of maintenance department of industry/electricity board

INSTRUCTIONAL STRATEGY

This subject needs theoretical and practical inputs. Demonstration at actual site may be arranged for conceptual understanding. The subject teacher should plan in advance about the visits to the actual sites and establish liaison with the appropriate authorities/ persons with the help of HOD and Principal of the institution. The students be taken to actual workplace and explained various test procedures.

RECOMMENDED BOOKS

1. Testing, Commissioning, Operation and Maintenance of Electrical Equipment by S Rao, Khanna Technical Publication, New Delhi

2. Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	11	05
2	35	40
3	50	55
Total	**96**	**100**

5.4 ENERGY MANAGEMENT

	L	P
Periods	6	-

RATIONALE

One of the reasons for India not been able to catch up with the desired extent of modernization of industrial processes in light of challenges posed by multinationals is the non-availability of required energy supply. The solution primarily lies in tapping all possible energy generation sources and efficient use of available energy important. Energy management focuses on these aspects. This course will develop awareness amongst the diploma engineers and will enable them to practice the energy management techniques in whatever field they are engaged in.

DETAILED CONTENTS

1. Energy Management (10 Periods)

    1.1 Overview of energy management, need for energy conservation, Environmental Aspects
    1.2 Need for energy conservation with brief description of oil and coal crisis
    1.3 Alternative sources of energy
    1.4 Energy efficiency- its significance

2. Energy Conservation (20 Periods)

    2.1 Energy conservation opportunity and measures
    2.2 Energy conservation in Domestic sector- Lighting, Home appliances
    2.3 Energy conservation in Industrial sector-Industrial lighting, Distribution system, Motor Pumps, Fans, Blowers etc
    2.4 Energy conservation in Agriculture sector Tubewell pumps, Diesel-generating sets, Standby energy sources
    2.5 Macro Level approach for energy conservation at design stage

3. Energy Efficient Devices (25 Periods)

    3.1 Energy efficient technology an overview
    3.2 Need for energy efficient devices
    3.2 Initial cost versus life cycle, cost analysis on life cycle basis
    3.3 Energy efficient motors as compared to standard motors.
    3.4 BIS standards for energy efficient motors, BIS salient design features,
    3.5 Efficiency as a function of load, safety margins
    3.6 Energy efficient lighting system different sources, lumens/watt, LEDs, role of voltage on efficiency
    3.7 Distribution system- Optimum cable size, amorphous core transformer, role of power factor, use of compensating capacitors-manual and automatic, location of capacitors

4. Energy Audit (21 Periods)

    4.1 Energy audit methodology
    4.2 Efficiency of energy conversion processes, monitoring system

4.3 Specific energy consumption –three pronged approach, fine tuning, technical up gradation, avoidable losses.

4.4 Case studies of energy audit of distribution system, AC motors, Industries, audit activities.

5. Environmental Impact Assessment (10 Periods)

5.1 Need for environmental impact assessment

5.2 Standard format for assessment and its completion

5.3 Evaluation of the assessment

6. Case study of energy management (10 Periods)

INSTRUCTIONAL STRATEGY

While explaining the need and energy management, the teacher should give students home assignments based on energy conservation. The students should be made familiar with the energy efficient devices, various approaches to conserve energy and energy auditing procedure etc. Best learning will take place if students are given real life problems on energy audit.

RECOMMENDED BOOKS

1. Manual on Energy Efficiency at Design Stage, CII Energy Management Cell
2. Manual on Energy Efficiency in Pumping System, CII Energy Management Cell
3. Manual on Variable Speed Drives for Energy Efficiency CII Energy Management Cell
4. Energy Conservation-case studies in ceramic industry, sugar industry, fertilizer industry, cement industry. CII, Energy Management Cell etc.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation %
1	10	10
2	20	20
3	25	25
4	21	25
5	10	10
6	10	10
Total	**96**	**100**

5.5 INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES

	L	P
Periods	5	3

RATIONALE

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

DETAILED CONTENTS

1. Introduction to SCR (20 Periods**)**

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

2. Controlled Rectifiers (13 Periods**)**

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

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

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

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

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

LIST OF PRACTICALS

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

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

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

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

SUGGESTED DISTRIBUTION OF MARKS

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

5.6 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

	L	T	P
Periods	5	-	-

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

DETAILED CONTENTS

SECTION – A ENTREPRENEURSHIP

1. Introduction (23 Periods)

- Concept /Meaning and its need
- Qualities and functions of entrepreneur and barriers in entrepreneurship
- Sole proprietorship and partnership forms of business organisations
- Schemes of assistance by entrepreneurial support agencies at National, State, District level: NSIC, NRDC, DC:MSME, SIDBI, NABARD, Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP)

2. Market Survey and Opportunity Identification (17 Periods)

- Scanning of business environment
- Salient features of National and State industrial policies and resultant business opportunities
- Types and conduct of market survey
- Assessment of demand and supply in potential areas of growth
- Identifying business opportunity
- Considerations in product selection

3. Project report Preparation (14 Periods)

- Preliminary project report
- Detailed project report including technical, economic and market feasibility
- Common errors in project report preparations
- Exercises on preparation of project report

SECTION –B MANAGEMENT

4. Introduction to Management (06 Periods)

- Definitions and importance of management
- Functions of management: Importance and Process of planning, organising, staffing, directing and controlling
- Principles of management (Henri Fayol, F.W. Taylor)
- Concept and structure of an organisation
- Types of industrial organisations

  a) Line organisation
  b) Line and staff organisation
  c) Functional Organisation

5. Leadership and Motivation (05 Periods)

a) Leadership

- Definition and Need
- Qualities and functions of a leader
- Manager Vs leader
- Types of leadership

b) Motivation

- Definitions and characteristics
- Factors affecting motivation
- Theories of motivation (Maslow, Herzberg, McGregor)

6. Management Scope in Different Areas (10 Periods)

a) Human Resource Management

- Introduction and objective
- Introduction to Man power planning, recruitment and selection
- Introduction to performance appraisal methods

b) Material and Store Management

- Introduction functions, and objectives
- ABC Analysis and EOQ

c) Marketing and sales

- Introduction, importance, and its functions
- Physical distribution
- Introduction to promotion mix
- Sales promotion

d) Financial Management

- Introductions, importance and its functions
- Elementary knowledge of income tax, sales tax, excise duty, custom duty and VAT

7. Miscellaneous Topics (05 Periods)

a) Customer Relation Management (CRM)

- Definition and need
- Types of CRM

b) Total Quality Management (TQM)

- Statistical process control
- Total employees Involvement
- Just in time (JIT)

c) Intellectual Property Right (IPR)

- Introductions, definition and its importance
- Infringement related to patents, copy right, trade mark

Note: In addition, different activities like conduct of entrepreneurship awareness camp extension lecturers by outside experts, interactions sessions with entrepreneurs and industrial visits may also be organised.

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment or seminar method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided.

RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development published by Tata McGraw Hill Publishing Company Ltd., New Delhi
3. Entrepreneurship Development in India by CB Gupta and P Srinivasan; Sultan Chand and Sons, New Delhi
4. Entrepreneurship Development - Small Business Enterprises by Poornima M Charantimath; Pearson Education, New Delhi
5. Entrepreneurship : New Venture Creation by David H Holt; Prentice Hall of India Pvt. Ltd., New Delhi

6. Handbook of Small Scale Industry by PM Bhandari
7. Principles and Practice of Management by L M Prasad; Sultan Chand & Sons, New Delhi.
8. Entrepreneurship by Alpana Trehan; Dream Tech. Press
9. Entrepreneurship by Manimali; Viz Tantra Publications
10. Patterns of Entrepreneurship by Kalpana; Wiley India Publications.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	23	28
2	17	20
3	14	16
4	06	10
5	05	06
6	10	14
7	05	06
Total	**80**	**100**

6.1 UTILIZATION OF ELECTRICAL ENERGY

	L	P
Periods	5	2

RATIONALE

This subject assumes importance in view of the fact that an electrical technician has to work in a wide spectrum of activities wherein he has to make selection from alternative schemes making technical and economical considerations; e.g. to plan and design an electrical layout using basic principles and handbooks, to select equipment, processes and components in different situations. The contents have been designed keeping the above objectives in view. Besides giving him basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements. To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas

DETAILED CONTENTS

1. Illumination: (12 Periods)

1.1 Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light

1.2 Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux.

1.3 Laws of illumination – simple numerical

1.4 Different type of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for filament lamp, mercury vapour sodium lamp, fluorescent lamp, halogen lamp, neon lamp, compact fluorescent lamp(CFL), LED Lamp, comparison of incandescent, fluorescent, CFL & LED

1.5 Calculation of number of light points for interior illumination, calculation of illumination at different points, considerations involved in simple design problems. Illumination schemes; indoor and outdoor illumination levels

1.6 Main requirements of proper lighting; absence of glare, contrast and shadow

1.7 Awareness about time switches, street lighting, flood lighting, monument lighting and decorative lighting, light characteristics etc.

2. Electric Heating (10 Periods)

2.1 Advantages of electrical heating

2.2 Heating methods:

2.2.1 Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances, thermostat control circuit

2.2.2 Induction heating; principle of core type and coreless induction furnace, their construction and applications

2.2.3 Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace

2.2.4 Dielectric heating, applications in various industrial fields

2.2.5 Infra-red heating and its applications (construction and working of two appliances)

2.2.6 Microwave heating and its applications (construction and working of two appliances)

2.2.7 Solar Heating

2.3 Calculation of resistance heating elements (simple problems)

3. Electric Welding (08 Periods)

3.1 Advantages of electric welding

3.2 Welding method

3.2.1 Principles of resistance welding, types – spot, projection, seam and butt welding, welding equipment

3.2.2 Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method and their applications. Power supply requirement. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminum and copper

4. Electrolytic Processes (10 Periods)

4.1 Need of electro-deposition

4.2 Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing and buffing

4.3 Equipment and accessories for electroplating

4.4 Factors affecting electro-deposition

4.5 Principle of galvanizing and its applications

4.6 Principles of anodizing and its applications

4.7 Electroplating of non-conducting materials

4.8 Manufacture of chemicals by electrolytic process

4.9 Power supplies for electroplating

5. Electrical Circuits used in Refrigeration, Air Conditioning and Water Coolers (10 Periods)

5.1 Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants

5.2 Description of Electrical circuit used in

a) Refrigerator,

b) Air-conditioner, and

c) Water cooler

6. Electric Drive (20 Periods)

6.1 Advantages of electric drives

6.2 Characteristics of different mechanical loads

6.3 Types of motors used as electric drive

6.4 Electric braking

6.4.1 Plugging

6.4.2 Rheostatic braking

6.4.3 Regenerative braking

6.5 General idea about the methods of power transfer by direct coupling by using devices like belt drive, gears, chain drives etc.

6.6 Examples of selection of motors for different types of domestic loads

6.7 Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel.

6.8 Specifications of commonly used motors e.g. squirrel cage motors, slip ring induction motors, AC series motors, Fractional kilo Watt(FKW) motors

6.9 Selection of motors for Domestic Appliances

7. Electric Traction: (10 Periods)

7.1 Advantages of electric traction over other types of traction.

7.2 Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main line and their speed-time curves

7.3 Different accessories for track electrification; such as overhead catenary wire, conductor rail system, current collector-pentagraph

7.4 Factors affecting scheduled speed

7.5 Electrical block diagram of an electric locomotive with description of various equipment and accessories used.

7.6 Types of motors used for electric traction

7.7 Power supply arrangements

7.8 Starting and braking of electric locomotives

7.9 Introduction to EMU and metro railways

7.10 Train Lighting Scheme

LISIT OF PRACTICALS

Students should be taken for (1)visit to nearest electrified railway track and railway station(2) visit to study the electric traction system (3) industrial visit to study the electric installation in a building, (4) visit to electrolysis process. They have to prepare report prepare a report. The evaluation of practical work will be made on the basis of report and presentation.

INSTRUCTIONAL STRATEGY

It is desired to give ample practical examples in the class while teaching this subject. Teacher must supplement his/her classroom teaching with aids such as models, charts, and video films from time to time. This subject requires demonstrations and exposure to actual workplace/industry/field. For this purpose, the subject teacher should do advance planning for visits/studies related to each topic in consultation with HOD and Principal of the polytechnic/institution.

RECOMMENDED BOOKS

1. Art and Science of Utilization of Electrical Energy by H Partap, Dhanpat Rai & Sons, Delhi
2. Utilization of Electrical Energy by JB Gupta, Kataria Publications, Ludhiana
3. Utilization of Electrical Energy by Sahdev, Uneek Publication, Jalandhar
4. A Text Book. of Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi
5. Modern Electric Traction by H Partap, Dhanpat Rai & Sons, Delhi
6. Utilization of Electrical Energy by OS Taylor, Pitman Publications
7. Generation, Distribution and Utilization if Electrical Power by CL Wadhwa, Wiley Eastern Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	12	15
2	10	15
3	08	10
4	10	10
5	10	10
6	20	25
7	10	15
Total	**80**	**100**

6.2 MICRO HYDEL AND NON CONVENTIONAL ENERGY SOURCES

	L	T	P
Periods	5	-	3

RATIONALE

Energy is a crucial input in the process of economic, social and industrial development. High energy consumption has traditionally been associated with higher quality of life, which in turn is related to Gross National Project (GNP). Since the conventional energy resources are under depletion, it is high time to tape the non conventional energy sources like solar and bio- energy. Uttarakhand is rich in hydro energy and lot of potential for self employment exists in setting up Micro Hydro plant. This subject is included to take care of special need of the state.

DETAILED CONTENTS

1. Micro Hydel Plants (20 Periods)

- Small and Micro Hydro Electric Power Plants: An Overview
- Advantages and Disadvantages of Small and Micro Hydro Schemes
- Layout of a Micro Hydro Scheme
- Main Elements of a Micro Hydro Plant
- Water turbines
- Turbine Classifications, Characteristics and Selection
- Generators
- Specifications of Turbine, Generator and Governor System used in Small and Micro Hydro Electric Power Plants

2. Micro Hydro Electric Power Plants: Automation, Control and Case Studies (8 Periods)

- Power Generation in Micro Hydro Electric Power Plants
- Automation, Control and Monitoring of Micro Hydro Electric Power Plants
- Efficiency and Limitations
- Case Studies

3. Micro Hydro Electric Power Plants: Erection and Commissioning, Operation and Maintenance (8 Periods)

- Erection
- Commissioning

- Operation
- Maintenance

4. Non-Conventional Sources of Energy (6 Periods)

Importance of Non conventional sources of energy, Present Scenario, Future Prospects, Economic Criteria

5. Solar Energy (8 Periods)

Physical Principal of the conversion of Solar radiation into heat, Photo-voltaic cell, Electricity generation, Solar water heaters, Solar Furnaces, Solar cookers, Solar Stills solar pumping.

6. Bio-energy (7 Periods)

Bio-mass Conversion Technologies- wet and dry processes. Methods for obtaining energy from Biomass. Power Generation by using gassifiers

7. Wind Energy (7 Periods)

Wind Energy Conversion, Wind mills, Electricity generation from wind- Types of wind mills, local control, energy storage

8. Geo-thermal and Tidal Energy (8 Periods)

Geo-thermal sources, Ocean thermal electric conversion, open and closed cycles, hybrid cycles. Prime movers for geo-thermal energy conversion. Steam Generation and electricity generation.

9. Chemical Energy Sources (8 Periods)

Design and operating principles of a fuel cell, conversion efficiency, work output and emf of fuel cells, applications storage battery characteristics, types, applications, maintenance of batteries.

Practical: Students should be taken to site of Micro Hydro Plant and Non Conventional Energy Sources units. They may be asked to prepare report of the visits and make presentation in the class.

RECOMMENDED BOOKS

1. Solar Energy – Principles of thermal collection and Storage SP Sukhatme, Tata McGraw Hill Publication, New Delhi.

2. Solar Energy Utilization; GD Rai; Khanna Publishers, New Delhi.

3. Reviews of Renewable Energy Sources, Vol. 3, Edited by MS. Sodha, S.S. Mathur, MAS Malik, TC Kandpal ; Wiley Eastern Limited, New Delhi.

4. Renewable Energy Sources and Conversion Technology by NK Bansal,Manfred Kleemann, Michael Meliss, Tata McGraw Hill Publishing Co. Ltd New Delhi.

5. Energy Today and Tomorrow; Maheshwar Dayal; Publications Division, Ministry of Information and Broadcasting, Govt. of India, New Delhi.

6. Energy Technology (non-conventional, renewable and conventional) by S Rao and BB Parulekar, Khanna Publishers, New Delhi

7. Non Conventional Energy Sources by B.H Khan, A tata McGraw Hill Publication New Delhi

8. Micro Hydel Design Manual by Adam Harvey, Intermediate technology Publications

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1.	20	25
2.	08	10
3.	08	10
4.	06	07
5.	08	08
6.	07	10
7.	07	10
8.	08	10
9.	08	10
Total	**80**	**100**

6.3 PLC & MICROCONTROLLERS

	L	P
Period	5	3

RATIONALE

A diploma holder when employed in automated industrial process controls or in automated power station will be required to know the basics of Programmable Logic Controllers, their working and their programming. 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.

Microcontrollers have also assumed great significance in the field of electronics and common goods industry, and thus considered to be an important field of engineering. This subject aims to expose the students to both of these and give them adequate knowledge of these topics.

DETAILED CONTENTS

1. Introduction to PLC (07 Periods)

   What is PLC, concept of PLC, Building blocks of PLC, Functions of various blocks, limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc.

.2. Working of PLC (09 Periods)

- Basic operation and principles of PLC
- Architectural details processor
- Memory structures, I/O structure
- Programming terminal, power supply

3. Instruction Set (09 Periods)

- Basic instructions like latch, master control self holding relays.
- Timer instruction like retentive timers, resetting of timers.
- Counter instructions like up counter, down counter, resetting of counters.

- Arithmetic Instructions (ADD, SUB, DIV, MUL etc.)
- MOV instruction
- RTC(Real Time Clock Function)
- Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal

4. Ladder Diagram Programming (07 Periods)

Programming based on basic instructions, timer, counter, sequencer, and comparison instructions using ladder program.

5. Applications of PLCs (05 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

6. Micro Controller Series (MCS)-51 Over View (11 Periods)

- Pin details
- I/o Port structure
- Memory Organisation
- Special function registers

7. Instruction Set Addressing Modes (07 Periods)

- Timer operation
- Serial Port operation
- Interrupts

8. Assembly language programming (07 Periods)

- Assemblers and Compilers
- Assembler Directives

9. Design and Interface (05 Periods)

Examples like: keypad interface, 7- segment interface, LCD, stepper motor. A/D, D/A, RTC interface

10. Introduction of PIC Micro controllers (06 Periods)

11. Application of Micro controllers like in relays, buzzer working machine, oven

(07 Periods)

LIST OF PRACTICALS

PLCs

1. Components/sub-components of a PLC, Learning functions of different modules of a PLC system
2. Practical steps in programming a PLC (a) using a Hand held programmer (b) using computer interface
3. Introduction to step 5 programming language, ladder diagram concepts, instruction list syntax
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. Use of PLC for an application(teacher may decide)

Micro Controllers

1. Familiarization of Micro Controllers (8051) kit
2. Testing of general input/output on Micro controller board
3. Development of Electrical , Instrumentation applications using 8051 micro-controller
4. Use of Microcontroller

INSTRUCTIONAL STRATEGY

Introduce the subject and make the students familiar with applications of PLCs and Microcontrollers. 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. Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar
5. Module on "Allen Bradlag PlC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh
6. Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh
7. The 8051 Micro controller by 1 Scot Mackenzie, Prentice Hall International, London
8. The 8051 Micro controllers Architecture, programming and Applications by Ayala; Penram International
9. Process Control Instrumentation Technology by Johnson, Curits; EE Edition, Prentice Hall of India, New Delhi
10. Microcontrollers by Ayala
11. Microcontrollers by Mazidi
12. Microcontrollers by Neil Makanzie
13. Microcontrollers by Deshmukh

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1.	07	10
2.	09	15
3.	09	10
4.	07	10
5.	05	5
6.	11	15
7.	07	10
8.	07	10
9.	05	5
10.	06	5
11.	07	5
Total	**80**	**100**

6.4 ELECTRICAL INSTALLATION IN BUILDINGS

	L	P
Periods	5	-

Rationale

The electrical installation plays vital role in the utilization of building, constructed for different use, e.g. residences, offices, hotels, shopping complexes, theatres, sport stadiums, auditoriums, especially multi-storied building and intelligent building.

The basic electrical installations are lighting. The other electrical installations like air conditioning, various sound systems, protection against lightning and fire, lift, diesel generating sets, computer networking are various optional installation in various buildings. Protection against lightning and fire are mandatory in buildings as per building manual. The earthing is essential in electrical installations and therefore it has to be mastered by diploma holders. Stage lighting, sound systems are essential in building used for various purpose like conference hall, auditorium, places of worship, studios and audio video broadcasting stations. Telecommunication and networking has become very useful electrical installation now-a-days. All these electrical installations have been discussed completely in this subject. The contents will help architects, and engineers associated with building projects, in their construction, maintenance, design and estimating and costing.

DETAIL CONTENTS

1. Introduction (02 Periods)

2. Electrical Wiring (06 Periods)

   2.1 Introduction

   2.2 System of Wiring

   - Selection of wiring System

   2.3 Wiring Network

   2.4 Rising Main

   - Main board & distribution board
   - Types, design with example

   2.5 Estimating and Costing

3. Lighting (08 Periods)

   3.1 Consideration planning and design of lighting

   3.2 Design of lighting scheme

   - Residential Building
   - Non-Residential Building

   3.3 Factory Lighting

3.4 Industrial Fitting

3.5 Flood Lighting

3.6 Street Lighting

3.7 Stage Lighting

3.8 Various Kind of Lights

- Profile Light
- Plano Convex Light
- Fresnel light
- Par Light
- Effect Light
- Sound Active Light
- Cone Light
- H.M.I light
- Solar Light
- F.O.H. light

3.9 Fitting of light

- Wiring & Operation
- Precaution, Estimating & Costing

4. Air Conditioning (09 Periods)

4.1 Introduction

4.2 Refrigeration

- Refrigerant
- Classification of refrigerant

4.3 Air Conditioning

- Air Conditioning
- Air Conditioning Cycle
- Heat & moisture transfer
- Unit of Air Conditioner or Refrigeration Plant\

4.4 Mixing process in Air Conditioning

- Components of Refrigeration or Air Conditioning Unit
- Evaporator
- Compressor
- Condenser
- Refrigerant Control Valve
- Air Outlet
- Thermostatic switch/controls
- Equipment used in Air conditioning System

4.5 Classification of Air Conditioning

- According to Purpose
- According to Season of year
- According to Arrangement of equipment
- Unitary Air Conditioner
- Window Air Conditioner
- Split Air Conditioner
- Central Air Conditioner

4.6 Chilling Machine

4.7 Design of Duct

- Design of Air Outlet
- VRF air conditioning
- Design of capacity of Air Conditioner
- Design of Heating Plant

4.8 Estimating & Costing

5. Sound System (09 Periods)

5.1 Intelligibility

- Loudness & Intensity
- Ambient Noise Level (ANL)
- Requisite Loudness
- Echo & Reverberation
- Acoustic of Building

5.2 Loud Speaker System

- Conference System
- Communication System
- Recording
- Broadcasting
- Film or Video Production

5.3 Musical Performance

5.4 Basic Equipment

- Public Address System
- PA system for a school
- System for places of worship
- Conference system
- Musical system
- Fore Ground Musical Sound System
- Paging Background Music System
- Auditorium Sound Reinforcement System

5.5 Estimating & Costing

6. Diesel Generating Set (09 Periods)

6.1 Classification

6.2 Brushless Alternator

- A C Generators

6.3 Prime Movers

- Control Panel

6.4 Installation

- Selection of Site
- Foundation
- Earthing System

6.5 Exhaust Piping

- Fuel Piping
- Cable Connection
- Change over Switch

6.6 Design of D.G. Set

6.7 Battery

6.8 Commissioning of D.G. Set

6.9 Estimating & Costing

7. Lift (09 Periods)

7.1 Terminology

- Codes & Standard
- Rules & Act

7.2 Classification

- Lift Layout

7.3 Components of Lift

7.4 Safety Features

7.5 Inverter or Converter

7.6 Programmable Logic Control (PLC)

7.7 Installation of Lift

7.8 Selection of Lift

- Design of Lift

7.9 Estimating & Costing

8. Fire Protection & Protection System (09 Periods)

- Related Terminology
- Fire Protection System
- Fire Detection & Alarm System
- Conventional Fire Alarm System
- Sector Indicates Panel
- Analogue and Addressable Fire Alarm
- Design Heat Detector
- Design of Fire Alarm
- Fire Fighting System
- Estimating & Costing

9. Computer Networking (09 Periods)

9.1 Classification
9.2 Network Topology
9.3 Internet work
9.4 Basic Hardware Component
- Open System

9.5 Inter Connecting Modes
9.6 Installation of Computer Network
9.7 Design Of Computer Network
9.8 Estimating & Costing

10. Rope & Roping System (05 Periods)

10.1 Introduction
- Types

10.2 Design
10.3 Installation
10.4 Estimating & Costing

11. Earthing (05 Periods)

- Special Feature of Earthing
- Type of Earthing
- Effect of Electrocution
- Earth Leakage Protection
- Testing of Earthing
- Estimating and Costing

RECOMMENDED BOOKS

1. Electrical Installation in Building by Hari Mohan Johari; KW Publishers Pvt Ltd
2. Electrical Installation in Building Vol.1 By H.M.Johari
3. Basic Electrical Installation Work by Trevor-Linsely
4. BWK of Design of Electrical Installation by Jain
5. Electrical Installation and Practice by Allan Smith

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	02	02
2	06	08
3	08	10
4	09	12
5	09	10
6	09	10
7	09	12
8	09	10
9	09	10
10	05	08
11	05	08
Total	**80**	**100**

6.5 APPLICATION OF COMPUTER SOFTWARES IN ELECTRICAL ENGINEERING

	L	P
Periods	2	4

RATIONALE

In the present time electrical power system and service sector uses different type of software for different functions viz. planning and design, management, operation, quality control and optimization etc. Multi story building and special building designs are executed by using specialized computer software. It saves a lot of time and is cost effective. Many times alternative designs are also developed using softwares like AUTO CAD and CAD (Computer Aided Design) etc.

Most of the work of estimating and costing of big installations is done by using software. Software for electrical system are available for low voltage Electrical Installation, Maintenance Training. Electrical Trouble Shooting, Simulation, Planning the Electrical Power Distribution etc. It is desirable that the present diploma holders should be well versed with the potential and use of commonly used software in the field. Hence this subject.

DETAILED CONTENTS

Computer application over view through following software students will use at least three software for solving different electrical problems.

- PSIM
- Multi SIM
- PSPICE
- MAT LAB
- MI Power
- ETAP

INSTRUCTIONAL STRATEGY

Teacher will select at least three softwares out of mention above and available in the market. Students will be given problems related to the functional areas of design and drawing of electrical control system, design of electrical distribution system, estimating and costing of the project etc. They will be asked to work on these problems manually. Then they will be asked to study the operational manuals of software for basic concepts and applications. Once they have understood, they will be asked to use the software for problem solving and comparing with the results done by the manual approach. Teachers will be required to prepare simple problems relating to the various software for developing competency in the diploma students. In addition the students must be exposed to different software and their capabilities demonstration by experts.

RECOMMENDED BOOKS

1. PSPICE for circuit theory and Electronic Devices by Paul Tobin
2. MAT LAB by Rudra Pratap
3. Lab Manuals of various softwares like PSPICE, MULTI SIM/ MAT LAB etc. Supplied by Companies

6.6 EMPLOYABLE SKILLS

	L	T	P
Periods per week	-	-	4

RATIONALE

Diploma holders are required to not only possess subject related knowledge but also soft skills to get good jobs and to rise steadily at their workplace. This subject is included to develop employability skills amongst the students.

DETAILED CONTENTS

1. Industrial Scenario Engineering Education and expectations of competences from an engineer by employer (04 periods)

2. Personality types, characteristic and features for a successful engineer (04 periods)

3. Professional Engineer desirable values and ethics and their development. Relation between engineering profession, society and environment (04 periods)

4. Managing project (16 periods)

   - Leadership
   - Motivation
   - Time management
   - Resource management
   - Computer Software
   - Interpersonal relationship
   - Engineer economics and fundamentals

5. Effective Communication (08 periods)

   - Listening
   - Speaking
   - Writing
   - Presentation Technique/Seminar
   - Group discussion

6. Preparing for Employment (08 periods)

   - Searching for job/job hunting
   - Resume Writing
   - Interview technique in personal interview telephonic interview, panel interview, group interview, video conference

7. Managing Self (06 periods)

- Managers body, mind, emotion and spirit
- Stress Management
- Conflict resolution

8. Continuing professional development (04 periods)

- Organising learning and knowledge
- Use of computer for organising knowledge resource

9. Creativity, Innovation and Intellectual property right (06 periods)

- Concept and need in present time for an engineer

10. Basic rules, laws and norms to be adhered by engineers during their working (04 periods)

6.7 PROJECT WORK

	L	P
Periods	-	6

Project work aims at developing skills in the students whereby they apply in totality the knowledge and skills gained through the course in the solution of a practical problem undertaken as a project work. The students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective departments may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The students should identify themselves or be given project assignment at least two to three months in advance. The project work identified in collaboration with industry/field organization should be preferred.

Each teacher is expected to guide the project work of 5-6 students at a time. The project assignments may consist of:

a) Projects related with repair and maintenance of machine parts
b) Estimating and costing projects
c) Design of components/ parts/ jigs / fixtures
d) Projects related to quality control
e) Project work related to increasing productivity
f) Project connected with work study
g) Projects relating to erection, installation, calibration and testing
h) Projects related to wastage reduction
i) Projects related to energy audit

For Students of Electrical Engineering Diploma Programme the project work can be grouped under the following four groups. A number of projects have been mentioned under each section. A student should take at least two projects both of which should not be from the same group. If more than two projects are taken to make up a total of 256 hours, then more than 1 may be taken from the same group as long as at least two groups are covered. A student is read to choose one project from each section.

Report for all the four project should be prepared and will give a seminar. The same will be assessed for internal and external assessment.

NOTE: (Two, only one from one group)

SECTION A

1.1 **Electrical Machines and Equipment:**

1.1.1 Design and Construction of a small transformer (100 VA to 1 kVA)

1.1.2 Construction of hot air blower

1.1.3 Design and Fabrication of Automatic curtain operator

1.1.4 Fabrication of Automatic Star-Delta starter

1.1.5 Construction of Automatic Water level controller

1.1.6 Construction of Choke for fluorescent tubes

1.1.7 Design and construction of loading rheostats minimum 5kw

1.1.8 Design and construction of Geyser

1.1.9 Erection/installation and commissioning of rotating electrical machine

1.1.10 Design and assembly of contactor control circuit for various applications

SECTION B

1.2 **Electrical Power:**

1.2.1 Drawing, estimating and costing of electrical installation of the institution from supplier's pole to the institution distribution board.

1.2.2 Drawing, estimating and costing of electrical installation of a workshop having a given number of electrically operated appliances/machines.

1.2.3 To study the laying of underground distribution cable for a small colony starting from main distribution pole

1.2.4 To study the erection erect a 5 pole span overhead line for a small distance for distribution of electrical energy. To energize it and prepare list of material and cost estimates.

1.2.5 Energy audit for the workshop of your institution and to suggest remedies to have low Electricity Bill

1.2.6 Case study of Electrical fire detection and protection system provided in a building

1.2.7 To survey the load of given area in a village, small colony, calculate the effective load and find out the sizes of the cables/conductors for the proposed distribution system

1.2.8 Designing of light and fan scheme for a institutional or commercial building

1.2.9 To prepare a plan for augmentation of a nearby pole mounted sub station

1.2.10 To prepare a proposal for substation of your institution, calculating the total load (estimating and costing)

1.2.11 Power factor improvement in a industry

SECTION C

1.3 Electronics Based Projects:

Fabrication of:

1.3.1 Voltage Stabilizer for refrigerator, air-conditioner

1.3.2 Emergency light using SCR

1.3.3 Power amplifier

1.3.4 Low cost intercom for home

1.3.5 Analog computer

1.3.6 Regulated power supply 30V/1Ampere

1.3.7 Fabrication of online UPS

1.3.8 Inverter circuit 500 watt/1 KVA.

1.3.9 Solid State Control of Traffic Lights

1.3.10 To develop a computer network (LAN) in building

1.3.11 Lighting control by small circuit

1.3.12 Design of safety measures in intelligent building

SECTION D

1.4 Fabrication and Testing of:

1.4.1 SCR operated automatic water level controller

1.4.2 SCR based speed controller for DC shunt motor

1.4.3 Three phase full wave rectifier using power diodes

1.4.4 Timer circuit using 555-IC

1.4.5 SCR controlled rectifier circuit

1.4.6 Inverting and non-inverting amplifiers using OP AMP(741)

1.4.7 Comparator circuits using OP AMP (741)

1.4.8 Project using PLC

1.4.9 Project relating to Microprocessor

1.4.10 Project relating to Microcontroller

Special Project: If a group of student develops a small entrepreneurial product, then other project is not to be done by them.

Note: The quality of end-product and process adopted by the students in its execution should be taken into consideration along with other parameters while evaluating the students

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

Sr. No.	Performance criteria	Max. marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	15	15	12	10	07	04
2.	Planning and execution of considerations	15	15	12	10	07	03
3.	Quality of performance	25	25	16	12	08	04
4.	Providing solution of the problems or production of final product	25	25	16	12	08	04
5.	Sense of responsibility	15	15	12	10	07	03
6.	Self expression/communication skills	10	10	08	06	04	02
7.	Interpersonal skills/human relations	10	10	08	06	04	02
8.	Report writing skills	15	15	12	10	07	04
9.	Viva voce	20	20	16	14	08	04
Total marks		**150**	**150**	**112**	**90**	**60**	**30**

The overall grading of the practical training shall be made as per following table.

In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance to improve and re-evaluated before being disqualified and declared “not eligible to receive diploma ”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

	Range of maximum marks	Overall grade
i)	More than 80	Excellent
ii)	79 <> 65	Very good
iii)	64 <> 50	Good
iv)	49 <> 40	Fair
v)	Less than 40	Poor

Important Notes

1. **The internal and external examiner must follow these criteria and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.**

2. **The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.**

3. **The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the student's performance as per the above criteria.**

4. **It is also proposed that two students or two projects, which are rated best, be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.**

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project items prepared by the students and invite leading Industrial organisations in such an exhibition. It is also proposed that two students or two projects, which are rated best, be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.

3.1 APPLIED MECHANICS

	L	T	P
Periods/week	4	-	2

RATIONALE

The subject Applied Mechanics deals with basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion and simple machines which are required by the students for further understanding of other allied subjects. The subject enhances the analytical ability of the students.

DETAILED CONTENTS

1. **Introduction** **(08 period)**

1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics.

1.2 Definition, basic quantities and derived quantities of basic units and derived units

1.3 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another density, force, pressure, work, power, velocity, acceleration

1.4 Concept of rigid body, scalar and vector quantities

2. **Laws of forces** **(12 period)**

2.1 Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force

2.2 Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position

2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components

2.4 Free body diagram

2.5 Equilibrant force and its determination

2.6 Lami's theorem (concept only)

[Simple problems on above topics]

3. **Moment** **(10 period)**

3.1 Concept of moment

3.2 Moment of a force and units of moment

3.3 Varignon's theorem (definition only)

3.4 Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support)

3.5 Parallel forces (like and unlike parallel force), calculating their resultant

3.6 Concept of couple, its properties and effects

3.7 General conditions of equilibrium of bodies under coplanar forces and beams, fixed support, roller, support, over hanging, Uniformly distributed load, point load, varying load

3.8 Position of resultant force by moment

[Simple problems on the above topics]

4. **Friction** **(10 period)**

4.1 Definition and concept of friction, types of friction, force of friction

4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction

4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane, friction in simple screw jack

4.4 Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force:

a) Acting along the inclined plane Horizontally

b) At some angle with the inclined plane

[Simple problems on the above topics]

5. **Centre of Gravity** **(08 period)**

5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies

5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion

5.3 Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed

[Simple problems on the above topics]

6. **Moment of Inertia** **(06 Period)**

Concept of moment of inertia and second moment of area and radius of gyration, theorems of parallel and perpendicular axis, second moment of area of common geometrical sections: rectangle, triangle, circle *(without derivations).* Second moment of area for L, T and I sections, section modulus.

7. **Simple Machines** **(10 period)**

7.1 Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines

7.2 Simple and compound machine (Examples)

7.3 Definition of ideal machine, reversible and self locking machine

7.4 Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency

7.5 System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency

7.6 Working principle and application of wheel and axle, different pulley blocks, simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application

[Simple problems on the above topics]

LIST OF PRACTICALS

1. Verification of the following laws:
   a) Parallelogram law of forces
   b) Triangle law of forces
   c) Polygon law of forces
2. To verify the forces in different members of jib crane.
3. To verify the reaction at the supports of a simply supported beam.
4. To find the Mechanical Advantage, Velocity Ratio and efficiency in case of an inclined plane.
5. To find the Mechanical Advantage, Velocity Ratio and efficiency of a screw jack.
6. To find the Mechanical Advantage, Velocity Ratio and efficiency of worm and worm wheel.
7. To find Mechanical Advantage, Velocity Ratio and efficiency of single purchase crab.
8. To find out center of gravity of regular lamina.
9. To find out center of gravity of irregular lamina.
10. To determine coefficient of friction between three pairs of given surface.

RECOMMENDED BOOKS

1. A Text Book of Applied Mechanics by S Ramamurtham, Dhanpat Rai Publishing Co. Ltd.
2. A Text Book of Engineering Mechanics (Applied Mechanics) by RK Khurmi; S Chand and Co. Ltd., New Delhi.
3. A Text Book of Applied Mechanics by RK Rajput; Laxmi Publications, New Delhi.
4. Text Book of Applied Mechanics by Birinder Singh, Kaption Publishing House, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	08
2	12	16
3	10	18
4	10	18
5	08	10
6	06	08
7	10	16
Total	**64**	**100**

3.2 MATERIAL SCIENCE AND METALLURGY

L T P
4 – 3

RATIONALE

Materials play an important role in the construction and manufacturing of equipment/tools. Right selection of materials add to the economy, working and life of machinery. A diploma holder must be conversant with the properties, uses, availability and costs of materials used for construction/fabrication to enable him to perform his functions confidently. The subject of Engineering Materials has been designed to cover the above aspects.

DETAILED CONTENTS

1. Importance of Materials **08 Period**

1.1 Classification: Metals and non-metals, Ferrous and non-ferrous metals and their alloys.
1.2 Crystalline and non-crystalline structures; unit cells, Bravais space lattices, cubic closed pack structures, coordination number, miller indices, crystallographic planes and directions.
1.3 Structural imperfections- point, line, planar and volume defects, structure property relationship.
1.4 Names of common metals, their alloys and non-metals used in Industry
1.5 Properties of metals and alloys
1.6 Physical properties - Appearance, luster, colour, density and melting point
1.7 Thermal and electrical conductivity
1.8 Corrosion, causes, effects and prevention.
1.9 Study of creep and fatigue.

2. Ferrous Metals and Alloys **12 Period**

2.1 Flow diagram for the production of ferrous metals from their ores, constituents of iron, iron carbon diagram.
2.2 Classification, composition and uses of cast iron and plain carbon steels. IS, BS and SAE Grades
2.3 Effect of alloying elements such as Aluminium, chromium, Nickel, Cobalt, Manganese, Molybdenum, tungsten, Vanadium, Silicon, Sulphur and Phosphorous on steels.
2.4 Composition, properties, and uses of special steels such as High speed steel, Stainless steels, Silicon steels, Heat resistant steels, Spring steel.
2.5 Heat Treatment: Iron-carbon diagram, objectives of heat treatment. Brief description and uses with examples of principal heat treatment processes,
Annealing, Normalizing, Tempering, Hardening, Carburising, Nitriding and Cyaniding and applications, case hardening

3. Iron Carbon Equilibrium Diagram **(02 Period)**
3.1 Phase transformation
3.2 Nucleation and growth

4. T-T-T Diagram **02 Period**

4.1 Importance of critical cooling rate.
4.2 Martensite transformation
4.3 Nucleation and growth

5. Non-ferrous Metals and Alloys **12 Period**

5.1 Copper: Properties and uses
5.2 Composition, properties and uses of copper alloys.
5.3 Brasses: Cartridge brass, Nickel silver
5.4 Bronzes: Phosphor bronze, Al-bronze, Mn-bronze, and Gun metal.
5.5 Properties and uses of Aluminium.
5.6 Composition, properties and uses of Al-alloys e.g., Duralumin, Yellow metal, Magnalium and Hindalium
5.7 Properties and uses of alloys of lead, tin and magnesium.
5.8 Bearing Metals: Requisite qualities. Composition, properties and uses of white metal bearing, copper based bearing metals. Aluminium based bearing metals. Use of nylon/PTFE for bushes/bearings, bi-metallic and trimetallic bushes

6. Identification and Examination of Metals and Alloys **02 Period**

Microscope principle and methods, Identification tests - Appearance, sound, filing, weight, magnetic, spark, bend and
microstructure.

7. Other Important Materials **10 Period**

7.1 Plastics: Definition, classification of plastics, fibre glass, reinforced plastics. Major applications of various plastics and their uses and grades.
7.2 Composite materials.
7.3 Heat insulating materials: Properties and uses of asbestos, glass wool, thermo Cole, cork, mica.
7.4 Electrical insulating materials. Properties and uses of china clay, leather, bakelite, ebonite, glass wool, rubber, felt.
7.5 Sound insulating materials: Cork, fibre boards.
7.6 Fabrication materials: Wood, plywood, rubber – natural and synthetic, Glass – plate glass, toughened glass, safety glass.
7.7 Refractory materials: General characteristics and uses of dolomite, ceramics.
7.8 Protective coating materials: Paints, primers, varnishes, enamels, putti, electroplating materials, rubasil, Teflon coating.
7.9 Sealant and adhesives – Application and availability of sealant and adhesives for industrial user.
7.10 Smart materials.

8. Diffusion **02 Period**

Ficks Laws of Diffusion and practical examples

9. Powder Metallurgy and Mechanical Working of Metals **08 Period**

9.1 Introduction of powder metallurgy
9.2 Advantage and limitations of powder metallurgy
9.3 Powder metallurgy processes
9.4 Principles of hot and cold working
9.5 Effect on properties and limitations

10. Selection, specifications and commercial availability of materials **06 Period**

10.1 Practical considerations for selection of material for different purposes
10.2 ISO/Bureau of Indian standard specifications for metals, non-metals, various components and materials.

LIST OF PRACTICALS

1. Classification of about 25 specimen of materials/parts into

   - Metals and Non Metals
   - Metals and Alloys
   - Ferrous and non ferrous metals
   - Ferrous and non ferrous alloys

2. Given a set of specimen of metals and alloys (copper, brass, aluminum, cast iron, HSS, Gun metal), identify and indicate the various properties possessed by them
3. Study of heat treatment furnace
4. Study of metallurgical microscope and a specimen polishing machine.
5. To prepare specification of following materials for microscopic examination and to examine the micro structure of specimens of following materials

   (i) Brass (ii) Copper (iii) Grey CI (iv) Malleable CI (v) Low carbon Steel (vi) High carbon steel (vii) HSS
6. To anneal a given specimen and find out difference in hardness as a result of annealing
7. To normalize a given specimen and to find out the difference in hardness as a result of normalizing
8. To temper a given specimen to find out the difference in hardness as a result of tempering
9. Study of Ball Mills used in preparation of powder.
10. Study of Pallet Press.

INSTRUCTIONAL STRATEGY

While imparting instructions, teacher should show various types of engineering materials to the students. Students should be asked to collect samples of various materials available in the market. Visits to industry should be planned to demonstrate use of various types of materials in the industry.

RECOMMENDED BOOKS

1. Material Science by R.K.Rajput; Laxmi Publications, Darya Ganj, New Delhi.
2. Advances in material Science by R.K.Dogra and Dr.A.K.Sharma;S.K.kataria & sons; New Delhi.
3. Material Science by GBS Narang; Khanna Publishers New Delhi
4. Material Science and Metallurgy by D.S. Nutt. SK Kataria and Sons, Delhi.
5. Material Science and Engineering by Dr. P.L Shah

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1.	08	10
2.	12	20
3.	02	05
4.	02	05
5.	12	20
6.	02	05
7.	10	10
8.	02	05
9.	08	10
10.	06	10
Total	64	100

3.3 WORKSHOP TECHNOLOGY

L T P

4 - 6

RATIONALE

This subject provides knowledge about various welding processes and foundry work and machine work. Welding is very useful for fabrication work and foundry for production of castings used for manufacturing of machines and machine work is also use for manufacturing which is included in this subject and it is very essential for diploma holders.

DETAILED CONTENTS

UNIT-1 **13 Period**

Principle of welding, Classification of welding processes, Advantages and limitations, Industrial applications of welding, Welding positions and techniques, symbols.

Gas Welding , Principle of gas welding, Types of gas welding flames and their applications, Gas welding equipments, Gas welding torch, Oxy acetylene cutting torch, Blow pipe, Pressure regulators, Filler rods and fluxes.

Arc Welding, Principle of operation, Arc welding machines and equipment, A.C. and D.C. arc welding, Effect of polarity, current regulation and voltage regulation, Electrodes, Flux for arc welding.

Other Welding processes, Resistance welding: Principle, advantages, limitations, working and applications of spot welding, seam welding, projection welding and percussion welding. Shielded metal arc welding, submerged arc welding, welding defects, methods of controlling welding defects and inspection of welded joints.

Modern Welding Methods, Principle of operation, advantages, disadvantages and applications of: Tungsten inert gas (TIG) welding, Metal inert gas (MIG) welding, Thermit welding, Electro slag welding.

UNIT-2 **13 Period**

Pattern Making, Types of pattern, Pattern material, Pattern allowances, Pattern codes as per B.I.S. Introduction to cores, core boxes and core materials, Core making procedure , Core prints, positioning of cores.

Moulding Sand , Properties of moulding sand, permeability, refractoriness, adhesiveness, cohesiveness, strength, flow ability, collapsibility etc. Various types of moulding sand and testing of moulding sand.

Mould Making, Types of moulds, Molding boxes, hand tools used for mould making, Molding processes: Bench molding, floormolding, pit molding and machine molding.

Special Casting Processes Principle, working and applications of Die casting: hot chamber and cold chamber, Investment and lost wax process, Centrifugal casting, Continuous casting process

Gating and Risering system , Elements of gating system, Pouring basin, sprue, runner, gates Types of risers, location of risers.

Melting Furnaces Construction and working of: Pit furnace, Cupola furnace, Crucible furnace –tilting type.

Casting Defects, Different types of casting defects and their reasons, testing of defects: radiography, magnetic particle inspection, and ultrasonic inspection.

UNIT-3 **13 Period**

Elementry theory of metal cutting, chip formation, continuous chip, continuous chip with BUE, discontinuous chips. Mechanism of chip formation, Geometry of chip formation, forces of chip, Merchant circle diagram. Tool life, Economics of tool life.

Cutting Tools and Materials, Various types of single point cutting tools and their uses, Single point cutting tool geometry, tool signature and its effect, Heat produced during cutting and its effect, Cutting speed, feed and depth of cut and their effect, Properties of cutting tool material, Study of various cutting tool materials viz. High speed steel, tungsten carbide, cobalt steel, cemented carbides, stellite, ceramics and diamond.

UNIT-4 **13 Period**

Lathe, Principle, Description and function of various parts of a lathe , Classification and specification of various types of lathe, Drives and transmission, Work holding devices, Lathe tools: Parameters/Nomenclature and applications, Lathe operations :- Plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling. Cutting parameters –Speed, feed and depth of cut for various materials and for various operations, machining time. Speed ratio, preferred numbers of speed selection. Lathe accessories:- Centers, dogs, chucks, collets, face plate, angle plate, mandrel, steady rest, taper turning attachment, tool post grinder.

UNIT-5 **12 Period**

Drilling, Principle of drilling. Classification of drilling machines and their description. Various operations performed on drilling machine –drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping. Speeds and feed during drilling, machining time. Types of drills and their features, Types of reamers.

Boring Principle of boring, Classification of boring machines and their brief description. Specification of boring machines.

Shaping, Planing and Slotting ,Working principle of shaper, planer and slotter. Quick return mechanism applied to shaper, slotter and planer machine. Types of tools used and their geometry. Specification of shaper, planer and slotting machine. Speeds and feeds in above processes.

Cutting fluids and Lubricants, Function of cutting fluid ,Types of cutting fluids, Difference between cutting fluid and lubricant, Selection of cutting fluids for different materials and operations,Common methods of lubrication of machine tools.

PRACTICAL EXERCISES

1. Single point cutting tool grinding.
2. A composite job involving turning, taper turning, thread cutting and knurling.
3. Marking and drilling practice using column and knee type drilling machine and radial drilling machine.
4. A job on drilling, reaming, counter boring and counter sinking.
5. Prepare a V- block on shaper machine.
6. Exercise on key way cutting..
7. Planning of C.I. block

8. Preliminary joining practice by gas welding.
9. Exercises of gas welding on the following Aluminum, Brass, Copper, C.I.
10. Gas cutting of the following types

    (a) Preliminary gas cutting practice

    (b) Stock cutting by oxy acetylene
11. Making following types of joints by arc welding:

    (a) Preliminary joining practice by arc welding

    (b) Butt and lap joint (invertical position, travel up and down)

    (c) Welding of outside corner joint
12. Exercise on spot welding
13. Exercise on brazing
14. Exercise on TIG/MIG welding
15. Testing & Inspection of welding defects visually
16. Pattern making: Preparation of solid pattern (single piece), Preparation of split pattern
17. Preparation of the following types of moulds. Floor molding.
18. Testing moisture content of moulding sand
19. Moulding and casting of (a) a solid pattern b) a split pattern
20. Testing and inspection of casting defects visually

INSTRUCTIONAL STRATEGY

1. Teachers should lay special emphasis in making the students conversant with concepts, principles, procedures and practices related to various manufacturing processes.
2. Focus should be laid in preparing jobs using various machines/equipment in the workshop.
3. Use of audiovisual aids/video films should be made to show specialized operations.

RECOMMENDED BOOKS

1. Welding Technology by R.L. Agarwal and Tahil Maghanani; Khanna Publishers, Delhi.
2. Principles of Foundry Technology by Jain; Tata Mc Graw Hill Publishers, New Delhi.
3. Workshop Technology by B S Raghuvanshi; Dhanpat Rai and Sons, Delhi.
4. Manufactuiring Technolgoy by M Adithan and AB Gupta, New Age International (P) Ltd., Delhi.
5. Elements of Workshop Technology by SK Chaudhry and Hajra; Asia Publishing House, Delhi.
6. Workshop Technology Vol. I, II, III by Chapman; Standard P ublishers Distributors, New Delhi.
7. Practical Handbook for Mechanical Engineers by Dr. A B Gupta; Galgotia Publications, New Delhi.

8. Production Technology by HMT; Tata McGraw Publishers, New Delhi.

9. Production Engineering and Science by Pandey and Singh; Standard Publishers Distributors, New Delhi.

10. Workshop Practice by R.K. Singal, S K Kataria and Sons, New Delhi.

11. A Text Book of Production Engineering by P.C. Sharma; S. Chand and Company Ltd., New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1.	13	25
2.	13	25
3.	13	15
4.	13	25
5.	12	10
Total	**64**	**100**

3.4 MACHINE DRAWING

L	T	P
2	-	6

RATIONALE

Diploma holders are required to read and interpret drawings .Therefore, it is essential that they have competency in preparing drawings and in sketching various machine parts and this will also improve their imagination skill.

NOTE:

1. Third angle projection is to be followed.
2. SP46- 1988 should be followed.
3. Instruction relevant to various drawing may be given along with appropriate demonstration, before assigning drawing practice to the students.
4. The drawing should include dimensions with tolerance, wherever necessary, and material list as per BIS/ ISO specifications.

DETAILED CONTENTS

	L	P
	2	-

1. Introduction to Machine Drawing

1.1 Graphic language, classification of machine drawing, conventional representation.
1.2 System of orthographic projections. Third angle projection, first angle Projection No. of views required. One view, Two views, Three views drawing
1.3 Sectioning- Material convention, important types of section- full section, half Section ,revolved section and aligned section
1.4 Temporary and permanent fasteners

2. Bearings (3 sheets)	**L**	**P**
	3	**10**

2.1 Bush bearing
2.2 Foot Step bearing
2.3 Simple wall bracket

3. Pulleys (2 sheets)	**L**	**P**
	4	**8**

3.1 Flat belt pulley
3.2 V belt pulley
3.3 Cone or stepped pulley
3.4 Fast and loose pulley

4. Pipe Joints (4 sheets)	**L**	**P**
	4	**13**

4.1 Flange joint
4.2 Spigot and socket joint
4.3 Threaded pipe joint
4.4 Expansion joint
4.5 piping joint

5. Assembling drawing from detail drawing (13 sheets) **L P**
12 40

5.1 Stuffing box
5.2 Eccentric
5 3 Blow off cock
5.4 Cross head
5.5 Connecting rod
5.6 Ram's bottom safety valve
5.7 Stop valve
5.8 Plummer block
5.9 Tail stock
5.10 Shaper tool head
5.11 Machine vice
5.12 Screw jack
5.13 Swivel Bearing

6. Gears and Gearing (2 sheets) **L P**
3 8

6.1 Spur gear- Nomenclature, gear formula, method to draw base circle, involute curve, tooth profile of internal and external gears.
6.2 Bevel gear- Nomenclature, gear formula, method to draw Bevel gear

7. Free hand sketches (2 sheets) **L P**
2 8

7.1 Cutting tool of lathe, shaper, milling cutter, drilling tools, broaching tools.
7.2 Gear puller, C clamp
7.3 Square and hexagonal nut bolt assembly
7.4 Cotter joint
7.5 Knuckle joint
7.6 Pipe joints

8. Jig, fixture and Gauges (2 sheets) **L P**
2 9

8.1 Concept of jig and fixture, types of jig and fixture and applications
8.2 Simple plate drill jig, drill jig for batch production
8.3 Indexing fixture
8.4 Introduction to gauges, use of Go-No Go gauge and ring gauge

INSTRUCTIONAL STRATEGY

1. Teachers should show model or realia of the component/part whose drawing is to be made.
2. Emphasis should be given on cleanliness, dimensioning, layout of sheet.
3. Teachers should ensure use of IS codes related to drawing.
4. Focus should be on the proper selection of drawing instrument and its proper use.

RECOMMENDED BOOKS

1. Machine Drawing by P.S. Gill; Kataria and Sons, Ludhiana.
2. A Text book of Machine Drawing by R.K. Dhawan , S.Chand and Company Ltd.,New Delhi.
3. Machine Drawing by GR Nagpal; Khanna Publishers, New Delhi.
4. Machine Drawing by ND Bhatt, Charotar Book Depot, Anand.
5. Fundamentals of Machine Drawing by Sadhu Singh and P.L. Shah
6. Machine Drawing by Laxmi Narayan
7. A Textbook of Machine Drawing by Er. R. K. Dhawan

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1.	02	05
2.	03	10
3.	04	15
4.	04	15
5.	12	35
6.	03	10
7.	02	05
8.	02	05
Total	32	100

3.5 THERMODYNAMICS

L T P
4 - 2

RATIONALE

Looking at the needs of various industries and departments, the following topics lay a firm foundation for the advanced knowledge of topics like thermal power plants, internal combustion engines etc.

DETAILED CONTENTS

1. Fundamental Concepts **06 Period**

Introduction, thermodynamic system, surrounding, boundary, state, universe,thermodynamic systems – closed, open, isolated, adiabatic, homogeneous andheterogeneous, macroscopic and microscopic, properties of system – intensive and extensive, thermodynamic equilibrium, quasi – static process, reversible andirreversible processes, concept of work and heat, equality of temperature, Zeroth law of thermodynamics, definition of properties likepressure, volume, temperature, enthalpy, internalenergy, Simple numerical problems.

2. Laws of Perfect Gases **06 Period**

Definition of gases, concept of perfect gas,explanation of perfect gas laws – Boyle's law, Charle's law, Avagadro's law, Regnault's law, Universal gas constant, Characteristic gasequations, derivation, (Simple numerical problems)Specific heat at constant pressure, specific heat at constant volume of gas, derivation of an expression for specific heats with characteristics, simple problems on gas equation

3. Thermodynamic Processes on Gases **06 Period**

Types of thermodynamic processes – isochoric, isobaric, isothermal, hyperbolic, isentropic, polytropic and throttling processes, equations representing the processes Derivation of work done in various processes change in internal energy.

4. Laws of Thermodynamics **12 Period**

Law of conservation of energy, first law of thermodynamics (Joule'sexperiment), Application of first law of thermodynamics to non-flow systems –Constant volume, constant pressure, Adiabatic and polytropic processes, steadyflow energy equation, Application of steady flow energy equation to turbines, pump, boilers, compressors, nozzles, evaporators. Limitations.Heat source and heat sinks, statement of second laws of thermodynamics: KelvinPlanck's statement, Classius statement, equivalence of statements, Perpetual motion Machine of first and second kind, Carnot engine,concept of irreversibility, entropy, Introduction to third law of thermodynamics (Simple numerical problems)

5. Ideal and Real Gases **06 Period**

Concept of ideal gas, enthalpy and specific heat capacities of an ideal gas, P – V –T surface of an ideal gas, triple point, real gases, Vander-Wall's equation, Amagat's experiment, equation of states Mass fraction, mole fraction, partial pressure, introduction to compressibility of gases

6. Properties of Steam **06 Period**

Formation of steam and related terms, thermodynamics properties of steam, steam tables, internal latent heat, internal energy of stream, entropy of water, entropy of steam, T- s diagrams, Mollier diagram (H – s Chart), Expansion of steam,Hyperbolic, reversible adiabatic and throttling processes Quality of steam (dryness fraction), measurement of dryness fraction, throttlingcalorimeter, separating and throttling calorimeter

7. Steam Boiler **05 Period**

Type of steam Generators, Working principle of boilers, need of high pressure modern boilers, characteristics of modern boilers. Working principle of Sterling, La-mont, Loeffler, Benson, Velox, Ramsin and Schmidt- Hartmann boiler

8. Steam turbines **06 Period**

-Function and use of steam turbine
-Steam nozzles- types and applications
-Steam turbines, impulse, reaction, simple and compound, construction and working principle
-Governing of steam turbines

9. Steam condensers **05 Period**

-Function of a steam condenser, elements of condensing plant
-Classification-Jet condenser, surface condenser
-Cooling pond and cooling towers

10. Air compressors **06 Period**

Function of air compressor, type of air compressor - single stage, multi stage reciprocating compressors, inter-cooling of compressors, rotary compressor, Construction and working

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching-learning.
2. Expose the students to real life problems.
3. Plan assignments so as to promote problem solving abilities and develop continued learning skills.

RECOMMENDED BOOKS

1. Engineering Thermodynamics by PK Nag; Tata McGraw Hill, Delhi.
2. Basic Engineering Thermodynamics by Roy Chaudhary; Tata McGraw Hill,Delhi.
3. Engineering Thermodynamics by CP Arora, Tata McGraw Hill, Delhi.
4. A Treatise on Heat Engineering by VP Vasandani and DS Kumar; Metropolitan Book Company.
5. Thermal Engineering by R.K.Rajput
6. Thermal Engineering by R.S.Khurmi

LIST OF PRACTICLES

1 Demonstration of steam turbines through models and visit
2 Demonstration of steam condensers through models and visits
3. Study of modern high pressure steam boilers (at least one)
4 Demonstration of boiler Accessories and mounitings
5 Demonstration/ study of an impulse turbines
6 Demonstration/ study of a reaction turbine
7 Demonstration of air compressor

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1.	06	10
2.	06	10
3.	06	10
4.	12	20
5.	06	10
6.	06	10
7.	05	05
8.	06	10
9.	05	05
10.	06	10
Total	64	100

3.6 BASIC ELECTRICAL AND ELECTRONICS TECHNOLOGY

L	T	P
5	-	3

RATIONALE

The objective of the course is to impart basic knowledge and skills regarding electrical and electronics engineering, which diploma holders will come across in their professional life

DETAILED CONTENTS

1. **Overview of Electricity:** (04 Period)

General use and applications of electricity; Use and applications of electricity to agriculture, Mechanical & Automobile sector; Advantages of electrical energy over other forms of energy.

2. **DC Circuits:** (10 Period)

Introduction to basic terms: charge, current, voltage, power, and energy; Ohm's law; Power dissipation in resistors; Series and parallel combination of resistors; Kirchhoff's laws; Star-delta conversions; Thevenin's theorem, Norton's theorem, and Maximum-power-transfer theorem; Ideal and practical voltage source; Current source.

3. **AC Circuits:** (14 Period)

Concept of alternating voltage and current; Introduction to basic terms: cycle, frequency, time period, amplitude, instantaneous value, rms value, peak value, phase difference, form factor, and peak factor; Concept of phasor; Phasor diagrams; Concepts of reactance, impedance, admittance, susceptance, and conductance; Concepts of instantaneous power, real power, reactive power, apparent power, complex power, and power factor; Analysis of simple AC circuits; Overview of three-phase AC circuits.

4. **Batteries and Solar Cells:** (08 Period)

Primary and secondary cells; Construction, working, and applications of Lead-Acid,; Charging methods for Lead-Acid batteries; Maintenance of Lead-Acid batteries; Series and parallel connection of batteries; Maintenance free batteries; General idea of solar cells, solar panels and their applications.

5. **Electrical Machines:** (16 Period)

Electromagnetic induction; Introduction to magnetic circuits; Principles of electromechanical energy conversion; Construction and operation of single phase transformers; Tests of transformers; Efficiency and regulation; Operation of autotransformers & welding transformer;. Types of three-phase induction motors; principle of operation,; Methods of starting and speed-control of three-phase induction motors; Overview of single-phase induction motors.; Construction and operation of synchronous machines; Construction and operation of stepper motors. Applications of single and three phase induction motors.

6. **Semiconductors:** (10 Period)

Classification of materials as conductors, insulators, and semiconductors; Intrinsic and extrinsic semiconductors; p-type and n-type semiconductors; pn-junction diode; Half wave and full wave rectification using diodes; Basic construction and operation of BJT, UJT, JFET, MOSFET, and thyristor.

7. Measuring Instruments: (10 Period)

Construction and working principles of PMMC and MI type voltmeters and ammeters; Dynamometer wattmeter; Induction-type energy meters; Measurement of power and energy in three-phase circuits; Use of digital meters (voltmeter, ammeter, and multimeter).

8. Electrical Installation and Safety: (08 Period)

Various accessories and parts of electrical installation; Overview of industrial and domestic wiring systems; Common electrical safety measures; Protection and precaution against electrical shock; Treatment of electrical shock; Basic protective devices like fuse, MCB, thermal overload relay, ELCB, and RCCB; Concepts and types of earthing; Protection against lightning.

LIST OF PRACTICALS

1. Verification of Ohm's Law
2. Verification of KCL and KVL
3. Test of charging and discharging of lead-acid battery using hydrometer
4. Connection of a three-phase motor and starter with fuses and reversing of direction
5. Connection of analog and digital single phase energy meter
6. Study of a distribution board for domestic and industrial installation
7. Open-circuit and short-circuit test on a single-phase transformer
8. Star-delta starting of induction motors
9. To draw V-I characteristics of pn-junction diode
10. To draw input and output characteristics of a transistor in CB and CE configurations

RECOMMENDED BOOKS

1 Basic Electrical Engineering by PS Dhongal; Tata McGraw Hill Publishers, New Delhi
2 Basic Electricity by BR Sharma; Satya Prakashan, New Delhi
3 Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi
4 Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International Publishers Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	4	5
2	10	13
3	14	16
4	8	10
5	16	20
6	10	13
7	10	13
8	8	10
Total	**80**	**100**

4.1 Strength of Materials

L T P
4 - 2

RATIONALE

Diploma holders in this course are required to analyses reasons for failure of different components and select the material for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. Hence this subject has been introduced.

DETAILED CONTENTS

1. Introduction to Material Properties **03 Period**

Mechanical properties of materials such as elasticity, plasticity, ductility, brittleness, toughness, hardness, fatigue, malleability, stiffness. Elastic bodies, plastic bodies and rigid bodies, deformation.

2. Stresses and Strains **08 Period**

2.1 Force, its definition and types, units, different types of loads.
2.2 Definition of stress and strain, axial loading, different types of stresses and strains, tensile and compressive stress and strain, elastic limit, Hooke's law, stress-strain curve for ductile and brittle material, salient features of stress-strain curve. Young's modulus of elasticity
2.3 Factor of safety.
2.4 Stress and strain in straight, stepped bars and taper bar of circular cross section, determination of stress and elongation of a bolt in a bolted joint when subjected to direct external load only
2.5 Stress and strain on composite section under axial loading, stress and strain due to temperature variations in homogeneous and composite bars.
2.6 Shear load, shear stress and strain, modulus of rigidity, lateral strain, Poisson's ratio
2.7 Volumetric strain, bulk modulus. Relation between modulus of elasticity, modulus of rigidity and bulk modulus

3. Shear Force and Bending Moment **06 Period**

3.1 Types of beams.
3.2 Concept of shear force and bending momen.
3.3 Shear force and bending moment diagram for cantilever and simply supported beams subjected to point load and uniformly distributed loads only. Maximum bending moment and point of contraflexure.

4. Theory of Simple Bending **06 Period**

4.1 Concept of pure bending, neutral axis, moment of resistance, section Modulus, bending equation, bending of simple, beams of uniform strength.
4.2 Application of flexural formula for solid rectangular and circular section, Channel section, hollow rectangular and circular section.

5. Strain Energy **06 Period**

5.1 Concept of strain energy, proof resilience and modulus of resilience.
5.2 Stresses developed due to gradual, sudden and impact load.
5.3 Strain energy stored due to gradual, sudden and impact load.
5.4 Strain energy due to bending and torsion.

6. Slope and Deflection **06 Period**

6.1 Introduction, determination of slope and deflection by Macaulay's method, moment area of method
6.2 Simple cases of slope and deflection in simply supported beam with uniformly distributed load on whole of the length and a point load at the centre
6.3 Cantilever beam with uniformly distributed load on whole length and a point load at the end.

7. Torsion **05 Period**

7.1 Pure torsion, torsion equation (relation between twisting moment, shear stress and angle of twist), polar modulus of section
7.2 Assumptions in theory of pure torsion
7.3 Strength of circular solid shaft and hollow shaft in pure torsion
7.4 Power transmitted by shaft

8. Springs **05 Period**

8.1 Effect of falling load helical spring
8.2 Helical Springs closed coiled and open coiled helical springs subjected to axial load
8.3 Angle of twist, strain energy, shear stress and maximum deflection under axial load
8.4 Laminated spring (semi-elliptical and quarter-elliptical type), deterination of number of plates, maximum deflection under axial load

9. Thin Cylinder and spheres **07 Period**

9.1 Introduction
9.2 Thin cylinder Vessel Subjected to internal Pressure
9.3 Stresses in a Thin cylinder Vessel Subjected to internal Pressure
9.4 Expression for circumferential stresses
9.5 Expression for longitudinal stresses
9.6 Stresses in a Thin cylinder Vessel Subjected to internal Pressure and external pressure
9.7 Stresses in a thin sphere shells subjected to internal Pressure

10. Riveted Joints **06 Period**

10.1 Introduction
10.2 Types of rivets joints
10.3 Failure of riveted joints
10.4 Strength of the riveted joints
10.5Efficiency of riveted joints

11. Columns and struts **06 Period**

11.1 Definition, Types of column
11.2 Buckling load, crushing load
11.3 Slenderness ratio.
11.4 Factors affecting strength of column
11.5 Euler's formula for long columns
11.6 End restraints, effective length for different end conditions
11.7 Rankine Gourdan formula
11.8 Direct and eccentric loading with stress diagram
11.9 Direct and bending stresses and their combination

LIST OF PRACTICALS

1. Perform tensile test on bars of mild steel and aluminum.
2. Perform shear test on specimen of two different metals.
3. Carry out bending tests on a steel bar or wooden beam.
4. Perform following impact test:
   (a) Izod impact test
   (b) Charpy test
5. Perform torsion test on specimen of different metals for determination of angle of twist for a given torque.
6. Determine the stiffness of a helical spring and to plot a graph between load and extension.
7. Perform hardness test on metal and finding the Brinell hardness, Rockwell hardness and Vicker's hardness.

INSTRUCTIONAL STRATEGY

1 Use computer based learning aids for effective teaching-learning
2 Expose the students to real life problems.
3 Plan assignments so as to promote problem solving abilities and develop continued learning skills.

RECOMMENDED BOOKS

1. Strength of Materials by Srivatava & Gope, PHI Publication.
1. Strength of Materials by R.S. Khurmi; S. Chand and Company, Delhi.
2. Strength of Materials by S. Ramamurtham; Dhanpat Rai Publishing Co.(P) Limited, Delhi.
3. Mechanics of Materials by Kirpal Singh; Standard Publishers, New Delhi.
4. Elements of Strength of Materials by D.R. Malhotra and H.C, Gupta; Satya Parkashan, New Delhi.
5. Mechanics of Solids by VS Prasad; Galgotia Publications, New Delhi.
6. Strength of materials Dr. B.C Puniya & S.Rama Murthi; Laxmi Publication, New Delhi.
7. Mechanics of solids by J.K.Kapoor; Bharat Bharati Prakashan, Meerut

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1.	03	05
2.	08	10
3.	06	10
4.	06	10
5.	06	10
6.	06	10
7.	05	10
8.	05	05
9.	07	10
10.	06	10
11	06	10
Total	**64**	**100**

4.2 APPLIED THERMAL ENGINEERING

L	T	P
4	-	2

RATIONALE

Thermal energy is still a major means of power in the world. Knowledge of thermal contrivances and related principle is very essential for mechanical diploma holders. The subject presents an introduction to sources of heat, thermodymics principles and their applications to thermal contrivances.

DETAILED CONTENTS

1. IC Engines **14 Period**

1.1 Introduction and classification of IC engine
1.2 Working principle of two stroke and four stroke cycle, SI engines and CI engines, Otto cycle, Diesel cycle and dual cycle
1.3 Location and functions of various parts of IC engines and materials used for them
1.4 Concept of IC engine terms: bore, stroke, dead centre, crank throw, compression ratio, clearance volume, piston displacement and piston speed, working of carburettor, mixture requirements, carburetor types, simple numerical problems concerning the above.

2. Cooling and Lubrication **04 Period**

2.1 Function of cooling system in IC engine
2.2 Air cooling and water cooling system, use of thermostat, radiator and forced circulation in water cooling (description with line diagram)

3. Testing of IC Engines **10 Period**

3.1 Engine power - indicated and brake power
3.2 Efficiency - mechanical, thermal. relative and volumetric
3.3 Methods of finding indicated and brake power, Morse test.
3.4 Morse test for petro1 engine
3.5 Heat balance sheet
3.6 Concept of pollutants in SI and CI engines, pollution control, norms for two or four wheelers - EURO standards, methods of reducing pollution in IC engines, alternative fuels like CNG, LPG (Simple numerical problems)

4. Fundamentals of Refrigeration **04 Period**

Introduction to refrigeration and air conditioning, units of refrigeration, meaning of refrigerating effect, compressor work, condenser work and COP, difference between COP and efficiency, methods of refrigeration, natural system and artificial system of refrigeration (Simple numerical problems)

5. Vapour Compression System **06 Period**

Principle, function, parts and necessity of vapour compression system, T- ϕ and p– H charts, dry, wet and superheated compression. Sub cooling, super heating, mass flow rate, entropy, enthalpy, work done, refrigerating effect and COP. actual vapour compression system (Simple numerical problems)

6. Refrigerants **03 Period**

Functions, various classification of refrigerants, properties of R - 717, R – 22, R–134 (a), CO_2, R – 11, R – 12, R – 502, Properties of ideal refrigerant, selection of refrigerant

7. Vapour Absorption System **04 Period**

Introduction, principle, NH_3 absorption system, lithium bromide absorption system, domestic electrolux system, analysis of vapour absorption system, solar power refrigeration system, advantages and disadvantages of solar power refrigeration system over vapour compression refrigeration system (Simple numerical problems)

8. Refrigeration Equipment **08 Period**

8.1 Compressors

Function, various types of compressors, volumetric efficiency, power for single stage compressor, intermediate pressure for multistage compressor for maximum power, performance characteristics

8.2 Condensers

Function, various types of condensers, essential requirements of a condenser, water cooled and air cooled condensers, free and forced convection condensers, fouling factor, heat rejection factor, overall heat transfer coefficient

8.3 Evaporators

Function, DX and flooded evaporator, advantages and disadvantages, other types of evaporators

8.4 Expansion Valves

Function, various types such as capillary tube, thermostatic expansion valve, low side and high side float valves, application of various expansion valves

AIR CONDITIONING

9. Psychrometry **03 Period**

Definition, importance, specific humidity, relative humidity, degree of saturation, DBT, WBT, DPT, humid heat, latent heat, relationship amongst them.

10. Applied Psychrometry and Heat Load Estimation. **06 Period**

Psychrometric chart, various lines, psychrometric process, by pass factor, room sensible heat factor, effective room sensible heat factor, ADP, room DPT, supply air condition, different heat sources for calculation of heat load, factors which contribute towards load of an air conditioning room (Simple numerical problems)

LIST OF PRACTICALS

1. Study of working principle of two/ four stroke petrol engines.
2. Study of simple/ compound carburetor.
3. To determine brake horse power by dynamometer.
4. To determine indicated horse power of a multicylinder petrol/diesel engine.
5. To prepare that balance sheet of diesel/ petrol engines
6. To study a vapour compression/ absorption refrigeration system
7. Study a cold storage through a visit
8. Study a room air conditioner
9. Study of cooling system of I.C. engines
10. Study of lubrication system of four stroke I.C. engine

INSTRUCTIONAL STRATEGY

1. Models of various components/ parts should be demonstrated to develop comprehension amongst students
2. Industrial visit to thermal power plant and roadways/ private automobile workshop should be arranged

3. Video films for demonstration of working of IC engines, jet propulsion and gas turbine should be shown.

RECOMMENDED BOOKS

1. Elements of heat engines by Pandey and Shah; Charotar Publishing house, Anand
2. Thermal Engineering by PL.Ballaney; Khanna Publishers, New Delhi.
3. Engineering Thermodynamics by Francis F Huang; McMillan Publishing company, Delhi.
4. Engineering Thermodynamics by CP Arora; Tata Mc Graw Hill Publishers, New Delhi.
5. Thermal engineering by RK Purohit; Standard publishers Dustributors, New Delhi.
6. Refrigeration and air conditioning by Domkundwar; Dhanpat Rai & sons, Delhi.
7. Refrigeration and air conditioning by CP Arora , Tata McGraw Hill , New Delhi.
8. Refrigeration and air conditioning by R.S Khurmi and J.K Gupta; S Chand and Company Limited, New Delhi

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SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1.	**14**	**20**
2.	**04**	**05**
3.	**10**	**15**
4.	**04**	**05**
5.	**06**	**10**
6.	**03**	**05**
7.	**04**	**05**
8.	**10**	**20**
9.	**03**	**05**
10.	**06**	**10**
Total	**64**	**100**

4.3 BASIC CIVIL ENGINEERING

L	P
3	4

THEORY

1- Construction material

Basics of various construction materials such as stones,bricks,lime,cement,steel and timber along with their properties, physical/field testing and uses, elements of brick and stone masonry. **(08 Period)**

2- Foundations Engineering

I) Various types of soil

II) Bearing capacity of soil and its importance

III) Types of various foundations for heavy, light and vibrating machines **(08 Period)**

3- Basic concept of concrete

Various ingredients of concrete, physical properties of aggregate as constituent material of concrete, different grade of concrete, water cement ratio, workability, physical/field testing of concrete, mixing of concrete , Introduction to IS: 456-2000, IS: 800-2007 and NBC 2005 (SP-7: 2005) **(08 Period)**

4- RCC

Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building, design of plain concrete strap footing. **(06 Period)**

5- Steel structure

Various types of steel, various rolled steel sections and their properties, use of steel table, introduction to riveted and welded connections. **(06 Period)**

6- Environmental engineering

Various sources of water, parameters related to qualities of portable water, impurities in water, introduction to various methods of water treatment. **(04 Period)**

7- Surveying

Introduction to surveying, representation to scale, introduction to chain surveying, traversing and plain table surveying , introduction to leveling , introduction to contouring and its properties. **(08 Period)**

PRACTICAL EXERCISES IN CIVIL ENGINEERING

1- Testing of bricks:

(a) Shape & Size

(b) Soundness Test

(c) Water Absorption

(d) Crushing Strength

2- Testing of Concrete:

(a) Slump Test

(b) Compressive Strength of concrete cube.

3- Testing of Aggregates:

(a) Impact Test
(b) Abrasion Test

4- Testing of Sand:

(a) Field test of physical impurities of sand

5- Testing on Steel:

(a) Tensile Strength Test of steel bars

6- Surveying Test:

(a) Ranging with rod
(b) Determination of reduced level (R.L.) of a point using Dumpy Level.
(c) Measurement of bearings & internal angles of a traverse using Prismatic Compass.

7- The students should be taken to different construction sites to show them various construction materials, concreting process & construction of RCC structural elements, foundations & other civil works.

REFERENCES

1- Building Materials

(a) S.K. Duggal: Building Materials, New Age International Publishers
(b) P.C. Varghese: Building Materials, PHI

2- Foundation Engineering

(a) Gopal Ranjan & Rao, A.S.R., "Basics of Applied Soil Mechanics", New Age International Publishers.
(b) B. C. Punmia, "Soil Mechanics & Foundations", Laxmi Publications

3- Basics concept of Concrete

(a) M. S. Shetty " Concrete Technology": S Chand Publication
(b) Neville A.M.,: "Properties of Concrete", Pitman Publishing Company

4- Reinforced Cement Concrete

(a) A.K. Jain, " Reinfored Concrete", Nem Chand & Bros
(b) O.P. Jain & J. Krishna, " Plain & Reinforcement Concrete", Nem Chand & Bros

5- Steel Structures

(a) S.K. Duggal, "Steel Structures", TMH
(b) S.S. Bhavikatti, "Steel Structures", I.K. International Publishing House Pvt. Ltd.

6- Environmental Engineering

(a) S.K. Garg, " Water Supply Engineering",Khanna Publishers

7- Surveying

(a) S.K. Duggal, " Surveying Vol. I", TMH
(b) B.C Punmia," Surveying &Levelling", Laxmi Publication
(c) K.R Arora," Surveying Vol. I", Standard Book House, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1.	08	20
2.	08	20
3.	08	20
4.	06	10
5.	06	10
6.	04	05
7.	08	15
Total	48	100

4.4 PRODUCTION TECHNOLOGY

L T P
4 -0- 6

RATIONALE

This subject provides knowledge and develops skills on various machine operations viz capstan and turret Lathe, milling, grinding, gear manufacturing, broaching and automatic machines which is very essential for Mechanical diploma holders to work in manufacturing industries.

DETAILED CONTENTS

UNIT-1: **08Period**

1. Introduction ,study and uses of Capstan and Turret Lathe , Turret indexing mechanism, Bar feeding mechanism, Work holding devices and Tool holding devices –Jaw and collet chucks –Slide tool holder, Knee tool holder, knurling tool,holder, recessing tool holder, form tool holder, tap and die holder, V - steady box tool holder, roller steady, box tool holder, bar stops.

UNIT-2: **12Preiod**

Introduction tooling layout,Comparison of capstan, turret and conventional lathe. Specification, Classification and working principle of milling machine applications of milling machines, up milling and down milling, Milling operations –face milling, angular milling, form milling, straddle milling and gang milling.

UNIT-3: **12Period**

Grinding , Various elements of grinding wheel –Abrasive, Grade, structure, Bond, Grinding methods – Surface grinding, cylindrical grinding and centre less grinding. Gear Manufacturing Processes , Gear hobbing, Gear shaping, Broaching , Introduction Types of broaching machines –Single ram and duplex ram horizontal type, vertical type pull up, pull down, push down. Elements of broach tool, broach teeth details –nomenclature, types, tool material.

UNIT-4: 12 Period

Metal Forming Processes, Press Working, Press working –Types of presses, type of dies, selection of press die, die material,Press Operations-Shearing, piercing, trimming, punching, notching, shaving, gearing, embossing, stamping, Forging, Open die forging, closed die forging,Press forging,

Extrusion and Drawing, Type of extrusion- Hot and Cold, Direct and indirect, Pipe drawing, tube drawing

UNIT-5: 10 Period

UNCONVENTIONAL MACHINING PROCESSES-Introduction, principle, process and application of Ultrasonic machining (USM) ,Electro chemical machining (ECM) ,Electro chemical Grinding (ECG), Electrical Discharge Machining (EDM), Laser beam machining (LBM), Electro beam machining (EBM), Plasma arc machining (PAM)

Importance and use of jigs and fixture Principle of location, Types of Jigs –Drilling jigs, bushes, template jigs, plate jig, channel jig,

UNIT-6: 10 Period

Fixture for milling Advantages of jigs and fixtures, Plastic Processes Injection Blow moulding –working principle, advantages and limitations, Compression moulding ,Metallic and Non Metallic Coating Processes, powder process, Metal Finishing Processes, Lapping process, lapping compounds and tools, Brief idea of lapping machines, Super finishing process, its applications. Production of metal powders, sintering and finishing operations and extrusion Advantages, limitations and applications of powder metallurgy.

PRACTICAL EXERCISES

1. Preparation of a drilling jig.

2. Preparation of a milling fixture.

3. Exercise on milling- slab milling, Gang milling and straddle milling

4. To produce a gearby indexing device on a millingmachine

5. Preparing job on following machines:-a) Surface grinder ,b) Cylindricalgrinder

6. Exercise on tool and cutter Grinder

a) To grind Lathe tools

b) To grind a drill bit

c) To grind a milling cutter

INSTRUCTIONAL STRATEGY

1. Teaches should lay special emphasis in making the students conversant with concept, principle, procedure and practices related to various manufacturing processes

2. Focus should be laid on preparing jobs using various machines/ equipment in the workshop

3. Aids/ Video films should be used to show operations

RECOMMENDED BOOKS

1. Manufacturing technology by Rao; Tata McGraw hill Publishers, New Delhi
2. Manufacturing technology by M. Adithan and AB. Gupta; New Age International (P) Ltd, New Delhi
3. Workshop Technology vol I, II, III by Champman; Standard publishers Distributors
4. Practical hand book for Mechanical Engineers by AB Gupta; Galgotia publications, New Delhi
5. Fundamentals of metal cutting and machine tools by Juneja and Sekhon; Wiley Eastern Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1.	08	15
2.	12	20
3.	12	20
4.	12	15
5.	10	15
6.	10	15
Total	64	100

4.5 HYDRAULICS AND HYDRAULIC MACHINES

L T P

3 - 4

RATIONALE

Diploma holders in Mechanical Engineering are required to deal with problems of fluid flow and use of hydraulics in power generation. For this purpose, knowledge and skill about fluid mechanics, fluid flow and hydraulic machines are required to be imparted for enabling them to perform above functions. This subject aims at development of knowledge and skills about various properties of fluids, measurement of various flow parameters and about various hydraulic machines.

DETAILED CONTENTS

1. Introduction 04 Period

Fluid, types of fluid; properties of fluid viz mass density, weight density (specific weight), specific volume, capillarity, specific gravity, viscosity, compressibility.

2. Pressure and its Measurement 06 Period

2.1 Concept of Pressure (Atmospheric Pressure, gauge pressure, absolute pressure)

2.2 Pressure measuring devices: peizometer tube, manometers - simple U-tube, differential single column, inverted U- tube, micromanometer

2.3 Bourdon tube pressure gauge

2.4 Simple problems

3. Flow of Fluids 06 Period

Types of fluid flow- steady and unsteady, uniform and non- uniform, laminar and turbulent; rate of flow and their units; continuity equation of flow; Bernoulli's theorem (without proof) and its applications, Discharge measurement with the help of venturimeter, orifice meter and pitot tube, simple problems

4. Notches and Weirs 06 Period

Different type of notches, Measurment of discharge over rectangular notch. Francis and Brazin's fomula for rectangular weirs, submerged weirs, broad crested weirs.

5. Flow through orifices 06 Period

Cc, Cv, Cd, flow through drowned, partially drowned orifices, time for emptying a tank through a circular orifice. Simple problems

6. Flow through pipes 06 Period

§ Definition of pipe flow, wetted perimeter, hydraulic mean depth, hydraulic gradient; loss of head due to friction; Chezy's equation and Darcy's equation of head loss.§ Loss of head in pipes due to sudden enlargement, sudden contraction, obstruction on flow path, change of direction and pipe fittings, Simple problems

7. Hydraulic Devices **06 Period**

Description, operation and application of hydraulic machines –hydraulic ram, hydraulic jack, hydraulic brake, hydraulic accumulator, hydraulic door closer,

hydraulic press,

8. Water Turbines and Pumps **(08 Period)**

Concept of a turbine, types of turbines – impulse and reaction. Construction and working of pelton wheel, Francis turbine and Kaplan turbine. Concept of hydraulic pump. Construction, working and operation of reciprocating pump and centrifugal pump.

LIST OF PRACTICALS

1. Measurement of pressure head by employing

i) Piezometer tube

ii) Single and double column manometer

iii) Pressure gauge

2. To find out the value of coefficient of discharge for a venturimeter

3. Measurement of flow by using venturimeter

4. Verification of Bernoulli's theorem

5. To determine the coefficient of friction of pipe using Darcy's equation.

6. Study the working of a pelton wheel and Francis turbine

7. Dismantling and assembly of a single stage centrifugal pump to study its

constructional details, operation including fault diagnosis.

8. To demonstrate the working of a Kalpan Turbine.

9. To demonstrate the working of a single acting and double acting Reciprocating

pump.

10. To determine Cd, Cv and Cc for a orifice.

RECOMMENDED BOOKS

1. Hydraulics and Hydraulic Machines by RS Khurmi ; S.Chand & Co. Ltd., New

Delhi.

2. Hydraulics and Fluid Mechanics by Jagdish Lal; Metropolitan Book Company

Ltd., Delhi.

3. Fluid Mechanic, Hydraulics and Hydraulic Machines by K.K. Arora; Standard

Publishers Distributors, Delhi.

4. Fluid Mechanics, Hydraulics and Fluid Machines by S. Ramamruthan; Dhanpat Rai and Sons, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Period)	Marks Allotted (%)
1.	04	05
2.	06	14
3.	06	14
4.	06	10
5.	06	14
6.	06	14
7.	06	14
8.	08	15
Total	48	100

4.6 METROLOGY

L T P
4 - 4

RATIONALE

Diploma holders in these courses are required to measure and inspect for ensuring quality of product. For this purpose, knowledge and skills about standards of measurement, limit, fits and tolerances, types of inspection and various measuring instruments are required. Hence this subject is offered

DETAILED CONTENTS

1. Introduction **06 Period**

1.1 Definition of metrology
1.2 Standard of measurement - Primary, secondary, Tertiary and working standards.
1.3 Types of errors- Controllable and random errors
1.4 Precision, accuracy, sensitivity, hysterisis, response time, repeatability, calibration, uncertainty of measurement

2. Linear Measurement **10 Period**

2.1 Construction features and use of instruments for non precision linear measurement: steel rule, callipers, surface plate, angle plate, V-block.
2.2 Construction features and use of instruments for precision measurements : vernier calipers, vernier height and depth gauges, micrometers.
2.3 Slip gauges, Indian standards of slip gauges, sets of slip gauges, use of slip gauges.
2.4 Cylinder bore gauges, feeler and wire gauges.
2.5 Comparators – Characteristics, uses, working principles of different types of comparators: mechanical, electrical, electronics and pneumatic comparator.

3. Angular Measurement **09 Period**

3.1 Construction and use of instruments for angular measurements: bevel Protector, sine bar, angle gauges, clinometers.
3.2 Optical instruments for angular measurement, autocollimator. Angle dekkors
3.3 Circular divisions - optical dividing heads, circular dividing engine, rotary tables, other instruments

4. Measurement of Surface Finish **08 Period**

4.1 Terminology of surface roughness.
4.2 Concept of primary texture and secondary texture.
4.3 Factors affecting surface finish.
4.4 CLA, RMS and RA value.
4.5 Principle and operation of stylus probe instruments for measuring surface Roughness

5. Measurements of Screw threads and Gears **08 Period**

5.1 Measurement of screw threads- Introduction, measurements of external and core diameters, checking of pitch and angle of threads with gauges.
5.2 Effective diameter measurement by three wire method.
5.3 Measurements of gears (spur) – Measurement of tooth thickness, pitch, testing of alignment of teeth.
5.4 Profile projector, Coordinate Measuring Machine (CMM), Tool maker's microscope.

6. Machine Tool Testing **08 Period**

6.1 Alignment test on lathe, drilling machine and milling machine.

7. Limits, Fits and Tolerances **07 Period**

7.1 Definition and terminology of limits, fits and tolerances.
7.2 Interchangeability
7.3 Hole basis and shaft basis systems.
7.4 Type of fits.
7.5 Standard and Limit gauges.

8. Instrumentation **08 Period**

8.1 Brief description about the measurement of displacement, vibration, frequency, pressure, temperature and humidity by electromechanical transducers

LIST OF PRACTICALS

1. Internal and external measurement with vernier - caliper and micrometer.
2. Measurement with height gauge and depth gauge.
3. Measurement of flatness with dial indicator.
4. Measurement with combination set and bevel protector.
5. Study and use of slip gauges.
6. Measurement of gear characteristics
7. Measurement of angle with sine bar and slip gauges
8. Measurement of worn out IC engine piston clearance between cylinder and piston.
9. Measurement of flatness using comparator.
10. Determination of temperature by (i) pyrometer (ii) thermocouple.
11. Use of feeler gauge, wire gauge, radius gauge and fillet gauges for checking of standard parameters.
12. Measurement of surface roughness of a surface

INSTRUCTIONAL STRATEGY

1. Demonstrate use of various measuring instruments while imparting theoretical instructions.
2. Stress should be laid on correct use of various instruments.

RECOMMENDED BOOKS

1. Engineering Metrology by RK Jain; Khanna Publishers, New Delhi.
2. A Text Book of Production Engineering by PC Sharma; S Chand and Company, New Delhi.

3. Metrology Laboratory Manual by M Adithan and R Bahl; NITTTR, Chandigarh.
4. Engineering Metrology by RK Rajput; SK Kataria and Sons, Ludhiana.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	6	10
2	10	18
3	9	14
4	8	12
5	8	12
6	8	12
7	7	10
8	8	12
Total	**64**	**100**

4.8 INDUSTRIAL TRAINING

Industrial training 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.

For this purpose, students at the end of fourth semester need to be sent for industrial training for a minimum of 4 weeks duration to be organised during the semester break starting 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 teacher may guide a group of 4-5 students. A minimum of one visit 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.

Internal assessment and external assessment 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, if any. The components of evaluation will include the following.

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with workers	15%
d)	Industrial training report	55%

5.1. COMPUTER APPLICATIONS IN Mechanical DRAFTING, DESIGN AND ANALYSIS

L - T - P
3 - 0 - 6

RATIONALE

Today age is computer age. Most of our daily activities are being influenced by the use of computers. It has become necessary for diploma students to have a basic knowledge of computer applications related to their branch. This subject is being offered to provide further practice to students on MS Power Point and MS Access and acquaint them to Computer Aided Design software for modelling, assembling and drafting.

DETAILED CONTENTS

1. MS Word:

Introduction to MS word for preparing technical report. Use of different fonts, size, tables, and equations should be considered.

2. MS Excel

Creation of graphs such as bar chart, PI chart, line diagram using technical data, Examples: Load deformation data of any material may be given to the students and ask to convert these data to stress strain form and plot of stress strain curve. Determination of modulus of elasticity, yield strength, percentage elongation, ultimate strength, etc from the above curve. With given x-y data, plotting of the data and fitting various regression equations using Excel program.

3. MS Power Point:

Templates, wizard, views, color schemes, Introduction to various Power Point toolbars, Presentations using Power Point:-

- Slide Views
- Slide Formatting
- Animation
- Graphs

4. Computer Aided Design using any sotware such as AUTO CAD/ IDEAS/ etc

4.1 Concept of AutoCAD, Tool bars in Auto CAD, coordinate system, snap,grid, and ortho mode
4.2 Drawing commands – point, line, arc, circle, ellipse,
4.3 Editing commands – scale, erase, copy, stretch, lengthen and explode.
4.4 Dimensioning and placing text in drawing area
4.5 Sectioning and hatching
4.6 Inquiry for different parameters of drawing entity

5. Assembly and detail drawings of the following using AUTOCAD

5.1 Tool post
5.2 Tail stock
5.3 Screw jack
5.4 Safety valve
5.5 Stuffing Box
5.6 Bench vice

6. Isometric Drawings by CAD

Drawings of following on computer:

- Cone
- Cylinder
- Isometric view of objects

7. 3D Modelling

3D modelling, Transformations, scaling, rotation, translation

8. Project work

Technical report writing where all such chapters are to be used.

NOTE :- Practical work must be performed on the related contents as described above. Strategy should be made in such a way that at first student should be taught the contents theoretically than related practical works must be performed.

INSTRUCTIONAL STRATEGY

1. Teachers should show model of the component/part whose drawing is to be made.

RECOMMENDED BOOKS

1. AutoCAD 2000 for you by Umesh Shettigar and Abdul Khader; Janatha Publishers, Udupi.
2. Machine Drawing by P.S. Gill; Kataria and Sons, Ludhiana.
3. A Text book of Machine Drawing by R.K. Dhawan , S.Chand and Company Ltd.,New Delhi.
4. Engineering Drawing with AutoCAD 2000 by T. Jeyapooran; Vikas PublishingHouse, Delhi.
5. AutoCAD for Engineering Drawing Made Easy by P. Nageswara Rao; Tata McGraw Hill, New Delhi.

5.2 DYNAMICS OF MACHINES

L T P
6 - -

RATIONALE

Diploma holder in Mechanical Engineering comes across many machines. He must have the knowledge of various mechanisms, power transmission devices, balancing of masses, vibrations etc. Hence this subject is offered.

DETAILED CONTENTS

1. Basic Concepts (09Periods)

1.1 Definition of statics, dynamics, kinetics, and. kinematics
1.2 Rigid body and resistant body.
1.3 Links, its classification, Kinematics chain and their types
1.4 Kinematics pairs and it's classification.
1.5 Mechanism. Machine, Structure & Inversion
1.6 Degree of freedom, Types of joints, Problems on determination of degree of freedom of mechanism
1.7 Constrained motion, and it's classification .
1.8 Classification of mechanisms.
1.9 Equivalent mechanism.
1.10 Laws of inversion of mechanisms.
1.11 Four bar chain and it's inversion
1.12 Single slider crank chain and its inversions.
1.13 Double slider crank mechanism and it's inversion .
1.14 Applications of mechanisms and their selection from manufacture catalogue.
1.15 Indicator mechanism, pantograph.
1.16 Straight line mechanism such as Peaucellier and Harts mechanism
1,17 Steering gear mechanism such as Davis and Ackerman mechanism

2. Fly Wheel (12Periods)

2.1 Turning moment diagram plotting and its purpose
2.2 Turning moment diagram for single cylinder double acting steam engine
2.3 Turning moment diagram for multi- cylinder engines
2.4 Fluctuation of energy of Flywheel
2.5 Functions of fly wheel.
2.6 Types of fly wheels.
2.7 Mass and size calculations in different cases

3. Governors (12Periods)

3.1 Functions of governor
3.2 Classification of governor - elementary knowledge of porter governor, Watt governor, Proell governor, Porter governor, Hartnell governor and Wilson-Hartne governor
3.3 Terminology used in governors
3.4 Gonernor effort and power
3.5 Hunting, isochronism, stability, sensitiveness of a governor
3.6 Controlling force diagram plotting and interpretation.
3.7 Simple problems related to watt, porter and proell governor.

4. Cams (12Periods)

4.1 Definition of cam
4.2 Classification of cams
4.3 Followers and their classification
4.4 Basic definition related to cams
4.5 Construction of displacement diagram of follower performing uniform velocity.

4.6 Construction of displacement diagram of follower performing SHM
4.7 Construction of displacement diagram of follower performing uniform acceleration and deceleration
4.8 Simple cam profile for uniform velocity, SHM and uniform acceleration and deceleration

5. Power Transmission Devices (Belt, Rope and Chain Drive) (12Periods)

5.1 Introduction.
5.2 Belt, Rope and Chain drives
5.3 Material for Belt, and Rope
5.4 Open and crossed belt drives, action of belt on pulleys, velocity ratio.
5. 5 Slip and Creep in belts,
5.6 Types of V Belt and Flat belt, joint preparation for flat belt.
5.7 Types of pulleys - step pulley, flat pulley, jockey pulley.
5.8 Crowning in pulley.
5.9 Laws of belting and length of belt in case of open and cross belt
5.10 Ratio of tensions in case of flat and V belt
5.11 Power transmitted and maximum power transmitted by belt
5.12 Centrifugal force and its effect on belt tension
5.13 Initial tension and its effect on the transmission of maximum power
5.14 Chain drive, chain length, classification of chains
5.15 Selection of belt, chain and pulley for different applications on the basis of centre distance between the shaft, power to be transmitted, availability of space, velocity ratio
5.16 Selection of rope based on the load to be lifted
5.17 Simple problems on power transmitted by belts and ropes

6. Gear Drive (12Periods)

6.1 Functions of gear
6.2 Classification of gears and Gear material
6.3 Gear nomenclature
6.4 Law of gearing
6.5 Forms of teeth: Involute and Cycloidal
6.6 Comparison between Involute and Cycloidal gears
6.7 Simple, compound, reverted and epicyclic gear train
6.8 Horsepower transmitted by a gear train
6.9 Selection of gear trains- simple and epicyclic

7. Brakes and Dynamometers (06Periods)

7.1 Introduction and Classification of brakes
7.2 Brief description of different types of Mechanical Brake such as block or shoe brake Simple and Differential band brake, band and block, internal expanding, power brake and disc brake
7.3 Simple problems related to determination of braking torque in case of shoe brake, Simple and Differential band brake
7.4 Definition and types of dynamometers, pony brake dynamometer, rope brake dynamometers, hydraulic dynamometer, belt transmission dynamometer and Bevis Gibson torsion dynamometer

8. Clutches (06Periods)

8.1 Function of clutch
8.2 Classification of clutches
8.3 Principle of working of Disc clutch and Cone clutch with simple line diagram
8.4 Principle of working of Multi plate clutch and Centrifugal clutch
8.5 Calculation of frictional torque by uniform pressure and uniform wear theory in case of Single/multi plate clutch and Cone Clutch
8.6 Horse power transmitted
8.7 Selection of clutches for different applications from hand book/catalogue

9. Balancing **(12Periods)**

9.1 Need of balancing
9.2 Concept of static and dynamic balancing
9.3 Forces due to revolving masses
9.4 Balancing of single rotating mass by single mass in the same plane
9.5 Balancing of single rotating mass by two masses in the different plane
9.6 Concept of reference plane
9.7 Balancing of several masses rotating in same plane
9.8 Balancing of several masses rotating in different planes
9.9 Balancing of unbalance due to reciprocating mass
9.10 Partial balancing of unbalance due to reciprocating mass

10. Vibrations **(03Periods)**

10.1 Introduction and definitions
10.2 Types of vibration - longitudinal, transverse and torsional vibration
10.3 Basic features of vibrating systems.
10.3 Damping of vibrations
10.4 Vibration isolation and Transmissibility

INSTRUCTIONAL STRATEGY

1. Use teaching aids for classroom teaching.
2. Give assignments for solving numerical problems.
3. Arrange industry visits to augment explaining use of various machine components like belt, rope, chain, gear drives, action due to unbalanced masses, brake clutch, governors, fly wheels, cams and gear drives.
4. Video films may be used to explain the working of mechanisms and machine components like clutch, governors, brake etc.

RECOMMENDED BOOKS

1. Mechanism and Machine Theory; JS Rao and Dukkipati; Wiley Eastern, NewDelhi.
2. Theory of Mechanism and Machine; A Ghosh and AK Malik, East West Press(Pvt.) Ltd., New Delhi.
3. Theory of Machines; SS Rattan: Tata McGraw Hill, New Delhi.
4. Theory of Machines by RS Khurmi and JK Gupta; S.Chand and Company Ltd.,New Delhi.
5. Theory of Machines and Mechanisms by PL Ballaney; Khanna Publishers, NewDelhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Alloted(Periods)	Marks Alloted (%)
1	09	10
2	12	12
3	12	12
4	12	12
5	12	12
6	12	12
7	06	07
8	06	06
9	12	12
10	03	05
Total	**96**	**100**

5.3 Machine Element Design

L	T	P
4	2	0

RATIONALE

This course is designed for the diploma level students for Mechanical and Automobile engineering as first course in Machine Design. The contents of this subject are organised to understand the intricacies of different engineering design aspects. This will also help the students to enhance their imagination, innovative skill, adaptability to new situation and continued learning skills for problem solving.

DETAILED CONTENTS

1. Introduction (08 Periods)

1.1 Design – Definition, Type of design, necessity of design
- 1.1.1 Comparison of designed and undesigned work
- 1.1.2 Design procedure
- 1.1.3 Practical examples related with design procedure
- 1.1.4 Characteristics of a good designer
- 1.1.5 Characteristics of environment required for a designer

1.2 Design terminology: stress, strain, factor of safety, factors affecting factor of safety, stress concentration, methods to reduce stress concentration, fatigue, endurance limit. General design considerations

1.3 Engineering materials and their mechanical properties :
- 1.3.1 Properties of engineering materials: elasticity, plasticity, malleability, ductility, toughness, hardness and resilience. Fatigue, creep, tenacity, strength
- 1.3.2 Selection of materials, criterion of material selection, numbering systems for Cast Iron, steel, Aluminium alloys, IS/BS/ASTM standards for material specification

2. Design Failure for static loading (10 Periods)

2.1 Brittle and ductile behaviour of the materials, Various design failures under static loading, causes of failure
- Maximum principal stress theory.
- Maximum shear stress theory
- Distortion Energy theory
- Mohr's theory
- Road maps for the selection of static failure theory for ductile and brittle materials

2.2 Design for tensile, compressive and torsional loading

2.3 Design for combined torsion and bending

3. Design Equation for Impact loading (06 Periods)

Examples of impact loading, stress and deflection due to impact load, selection of impact factor for minor, medium and heavy shock load

4. Design for Cyclic loading (06Periods)

Types of cyclic loading, failure of parts due to cyclic loading, design strength for cyclic loading, design equation for simple cyclic loading

5. Design of Shaft **(10 Periods)**

5.1 Type of shaft, shaft materials, Type of loading on shaft, standard sizes of shaft available

5.2 Design of shaft subjected to torsion on the basis of :

- Strength criterion
- Rigidity criterion

5.3 Design of shaft subjected to bending

5.4 Design of shaft subjected to combined torsion and bending

5.5 Introduction to stepped shaft

6. Design of Key **(06 Periods)**

6.1 Types of key, materials of key, functions of key

6.2 Failure of key (by Shearing and Crushing).

6.3 Design of key (Determination of key dimension)

6.4 Effect of keyway on shaft strength. (Figures and problems).

7. Design of Joints **(12 Periods)**

Types of joints - Temporary and Permanent, utility of joints

71 Temporary Joint:

7.1.1 Knuckle Joints – Different parts of the joint, material used for the joint, type of knuckle Joint, design of the knuckle joint. (Figures and problems).

7.1.2 Cotter Joint – Different parts of the joint, type of cotter joint – spigot and socket joint, gib and cotter joint, sleeve and cotter joint, Design of cotter joint (Figures and problems).

7.2 Permanent Joint: Welding symbols, standards and materials having high weldability.

7.2.1 Welded Joint - Type of welded joint, strength of parallel and transverse fillet welds.

7.2.2 Strength of combined parallel and transverse weld.

7.2.3 Axially loaded welded joints.

7.2.4 Riveted Joints. : Rivet materials, Rivet heads, leak proofing of riveted joint – caulking and fullering.

7.2.5 Different modes of rivet joint failure.

7.2.6 Design of riveted joint – Lap and butt, single and multi rivetedjoint

8. Design of Flange Coupling **(06 Periods)**

Necessity of a coupling, advantages of a coupling, types of couplings, design of flange coupling. (both protected type and unprotected type).

9. Design of Screw, Nut, Bolt and Thread **(08 Periods)**

9.1 Form of thread (ISO), Type of nut heads, type of threads and their nomenclature.

9.2 Nature of loads on nut and bolts, types of failure of nut and bolts.

9.3. Initial stresses due to screwing up, stresses due to combination of different loads.

INSTRUCTIONAL STREATEGY

1. Use models of machine parts/components.
2. Presentation should be arranged for various topics.

REFERENCE BOOKS

1. Machine Design- Fundamentals and Practices, by P C Gope, PHI Learning Pvt Limited, New Delhi. 2012
2. Machine Design by R.S. Khurmi and JK Gupta; Eurasia Publishing House (Pvt.) Limited, New Delhi.
3. Machine Design by Sharma and Agrawal; Katson Publishing House, Ludhiana.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	8	10
2	10	20
3	6	05
4	6	05
5	10	20
6	6	10
7	12	10
8	6	10
9	8	10
Total	**72**	**100**

5.4 Operations Management

L	T	P
6	0	0

Rationale: After studying the subject of production management, the students will be able to know the basics of production planning and control, industrial engineering, and estimation and costing. This will enable them to understand and handle production environment effectively.

1. Introduction (12 Periods)

Operations management defined, history of development, functions of OM, scope & applications of OM, advantages- disadvantages.

2. Production and Productivity (13 Periods)

Production, production functions, productivity, factors affecting productivity, measurement of productivity, causes of decrease in productivity, difference between production and productivity.

3. **Plant Location, Layout and Material Handling (16 Periods)**

Plant location, factors affecting plant location, concept of plant layout, types of layout, their characteristics, factors affecting plant layout, work station design, factors considered while designing a work station, introduction, need and objective of material handling, factors considered while selecting a material handling device, safety concept of material handling equipment.

4. **Work Study (13 Periods)**

Definition and scope of work study; areas of application of work study in industry, Role of work study in improving productivity, Objectives, needs and methods of method study, information collection, recording techniques, process symbols, c h a r t s a n d diagrams, critical examination, development, installation and maintenance of improved methods, work measurement objectives, needs and methods of work measurement, time study, various allowances, calculation of time, work sampling, standard data and its use. Application of engineered time standards and work sampling, Ergonomics, concept and advantages.

5. **Production Planning and Control (16 Periods)**

Introduction, objectives and components (functions) of P.P.C, Advantages of production planning and Production Control, stages of P.P.C, process planning, routing, scheduling, dispatching and follow up, routing purpose, route sheets, scheduling – purpose, machine loading chart, Gantt chart, dispatching – purpose, and procedure, follow up – purpose and procedure. Production Control in job order, batch type and continuous type of productions. Difference between these controls.

6. **Inspection and Quality Control (13 Periods)**

Definitions, types of inspection and procedure, Quality, Quality control, Statistical quality control, Process capability, Control charts for variables - X and R chart, control chart, for fraction defectives (P chart), control chart for number of defects (C chart), Concept of ISO 9000, ISO 14000 and TQM, Quality Circles.

7. **Estimation and Costing (13 Periods)**

Introduction, purpose/functions of estimating, costing concept, ladder and elements of cost, difference between estimation and costing. Overheads and their types, estimation of material cost, estimation of cost for machining processes, numerical problems.

INSTRUCTIONAL STRATEGY

Teacher should put emphasis on giving practical problems related to plant location and plant layout. Students should be taken to industrial units to give an exposure of production environment, plant layout and material handling. Live problems may be given to students to carry out case studies in teams under the guidance of teacher.

RECOMMENDED BOOKS

1. Industrial Engineering by O.P. Khanna; Dhanpat Rai and Sons, New Delhi.
2. Industrial Engineering by S.C. Sharma; Khanna Publisher.
3. Industrial Engineering and Management by T.R. Banga.
4. Elements of work study by Suresh Dalela.
5. Production Management by Jain and Aggarwal.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	12	10
2.	13	15
3.	16	15
4.	13	15
5.	16	15
6.	13	15
7.	13	15
Total	**96**	**100**

5.5 CNC MACHINES AND AUTOMATION

L	T	P
3	0	6

Rationale: Computer-aided manufacturing is the use of computer software to control machine tools and related machinery in the manufacturing of work pieces. NC and CAM may also refer to the use of a computer to assist in all operations of a manufacturing plant, including planning, management, transportation and storage.

Course objective : Its primary purpose is to create a faster production process and components and tooling with more precise dimensions and material consistency, which in some cases, uses only the required amount of raw material (thus minimizing waste), while simultaneously reducing energy consumption.

Syllabus:

UNIT-1: (08Periods)

Automation

Introduction to CAM, Automated Manufacturing system, Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends.

Features of NC Machines-

Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter and Productivity.

UNIT-2: (12 Periods)

NC Part Programming & Common Problems in CNC Machines

Part programming and basic concepts of part programming, NC words, part programming formats, simple programming for rotational components, part programming using canned cycles, subroutines and do loops, tool off sets, cutter radius compensation and wear compensation Manual (word address format) programming, Examples: Drilling, Turning and Milling, Canned cycles, Subroutine and Macro. APT programming, Geometry, Motion and Additional statements, Macro- statement. Common problems in mechanical, electrical, pneumatic, electronic and PC components of CNC machines, diagnostic study of common problems and Remedies , use of on-time fault finding diagnosis tools in CNC machines.

UNIT-3: (12 Periods)

System Devices

Introduction to DC motors, stepping motors, feedback devices such as encoder, counting devices, digital to analog converter and vice versa.

Interpolators

Digital differential Integrator-Principle of operation, exponential declaration, DDA Hardware Interpolator- Linear, Circular, DDA Software Interpolator.

Control of NC Systems

Open and closed loops, Control of point to point systems, Incremental open loop control, Incremental close loop, Absolute close loop, Control loop in contouring systems, Adaptive control.

UNIT-4: **(08 Periods)**

Computer Integrated Manufacturing system

Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process planning-Retrieval and Generative, Concept of Mechatronics, Computer aided Inspection.

UNIT-5: **(08Periods)**

Robotics and Intelligent Manufacturing

Types and generations of Robots, Structure and operation of Robot, Robot applications, Economics, Robot programming methods.

Introduction to Artificial Intelligence for Intelligent manufacturing.

List of Practical

1 To study the basic feature and operation of NC, CNC machine & Study the constructional details of CNC lathe , working of following ,tool changer and tool setter ,Multiple pallets , Safety devices.

2 To demonstrate how to program (using the computer-assisted method) and machine a simple part on the CNC lathe and Develop part programms for following lathe operations:
- Plain turning and facing operations
- Taper turning operations (internal and external)
- Thread cutting operations (internal and external)

3 To operate a CNC milling machine and become familiar with set-up, procedures and data flow.

4 To use AutoCAD to define a series of closed 2-D polygons that form initials, or other artistic creations, within a 150 x 100 mm border. To run the output data file through the AutoLISP program called “digitize.lsp”.

Text Books:

1. Numerical Control and Computer aided Manufacturing, By Kundra, Rao and Tewari.
2. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P.Groover.
3. Computer Aided Manufacturing by Kundra and Rao.
4. Computer control of Manufacturing systems by Koren.
5. NC Machine Tools by S.J. Martin.
6. NC Machines by Koren.
7. CAD/CAM by Groover.

Reference Books:

1. Numerical Control Machine Tool by Y. Koren and Joseph Ben Uri.
2. Computer Aided Design and Manufacture by Groover and Zimmer, PHI.
3. Technology of Computer aided Design and Manufacturing by Kumar and Jha, Dhanpat Rai and Sons
4. CNC Machines –Programming and Applications by M Adithan and BS Pabla, New Age International (P) Ltd., Delhi.
5. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata McGraw Hill,New Delhi.
6. Numerical Control of Machines Tools by Yorem Korem and IB Uri, KhannaPublishers, New Delhi.

INSTRUCTIONAL STRATEGY

This is a highly practice-based course. Efforts should be made to develop programming skills amongst the students. During practice work, it should be ensured that students get opportunity to individually perform practical tasks.

SUGGESTED DISTRIBUTION OF MARKS

Unit No.	Time allotted (Periods)	Marks Allotted (%)
1	08	10
2	12	35
3	12	35
4	08	10
5	08	10
Total	**48**	**100**

5.6 MAINTENANCE ENGINEERING

L	T	P
3	-	4

RATIONALE

A diploma engineer comes across installation, maintenance, testing of various machines and equipment in industries. The layout of different machines, their foundation is in an important phenomenon of an industry. He should know the various methods of testing and maintenance. This subject will enable diploma holders to deal with such aspects.

DETAILED CONTENTS

1. Introduction (05 Periods)

- 1.1 Necessity and advantages of testing, repair and maintenance
- 1.2 Economic aspects, manpower planning and materials management
- 1.3 Fits and tolerances – common fits and tolerances used for various machine Parts

2. Erection and Commissioning of Machines (Installation) (08 Periods)

- 2.1 Location, layout and positioning of machines
- 2.2 Foundation – types of foundation, foundation plan, erection and leveling, grouting, vibration damping, vibration isolation – methods of isolation, anti vibration mounts.

3. Testing of Machines (09 Periods)

- 3.1 Testing equipment – dial gauge, mandrel, spirit level, straight edge, autocollimator
- 3.2 Testing methods – geometrical/alignment test, performance test, testing under load, run test, vibrations, noise

4. Lubrication Systems (10 Periods)

- 4.1 Lubrication methods and periodical lubrication chart for various machines (daily, weekly, monthly)
- 4.2 Handling and storage of lubricants
- 4.3 Lubricants conditioning and disposal
- 4.4 Lubricant needed for specific components such as gears, bearings, and chains
- 4.5 Purpose and procedure of changing oil periodically (like gear box oil)

5. Repairing (06 Periods)

- 5.1 Common parts which are prone to failure, reasons of failure
- 5.2 Repair schedule
- 5.3 Parts that commonly need repair such as belts, couplings, nuts, and bolts

6. Maintenance (10 Periods)

- 6.1 Definition, advantages, limitations and types of maintenance viz. preventive, breakdown, predictive
- 6.2 Organization of maintenance
- 6.3 Introduction to computerized maintenance record
- 6.4 ISO standards for maintenance documentation
- 6.5 Introduction to machine history card – purpose and advantages
- 6.6 Preparation of yearly plan for preventive maintenance
- 6.7 Need of frequently needed spare parts inventory

LIST OF PRACTICALS

1. Preparation of prevention maintenance check.
2. Condition monitoring by non destructive testing.
3. Case study on trouble free maintenance.
4. Project on maintenance of utility equipment like compressors, pumps, driers,valves (actuator type valves).
5. Equipment/machine leveling and alignment.
6. Maintenance of material handling equipment – pulley blocks, hand operated cranes, fork lifts, hydraulic jacks, mobile cranes, winches.
7. Use of lubrication equipment like oil gun, grease gun.
8. Removing old lubricant, cleaning and replenishing the machine with freshlubricant.
9. Case study on computerized maintenance schedule.
10. Reconditioning of machine parts.
11. Replacing gear.
12. Replacing bearings (all types).
13. Practically making different types of fits.

INSTRUCTIONAL STRATEGY

1. Lay greater emphasis on practical aspects of maintenance.
2. Make use of transparencies, video films and CD's.
3. Expose the students to real life situation.
4. Promote continued learning through properly planned assignments.
5. Demonstrate sample of all types of gear and bearings.

RECOMMENDED BOOKS

1. Industrial Maintenance by HP Garg; S. Chand and Company, Delhi.
2. Plant Maintenance Engineering by RK Jain; Khanna Publishers, Delhi.
3. Installation, Servicing and Maintenance by SN Bhattacharya; S Chand and Company,Delhi.
4. Maintenance Engineering and Management by RC Mishra and K Pathak; Prentice Hall of India Pvt. Ltd., New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

S.No.	Time Allotted (Periods)	Marks Allotted (%)
1	5	12
2	8	15
3	9	20
4	10	20
5	6	15
6	10	18
Total	**48**	**100**

6.1 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

	L	T	P
Periods per week	**5**	**-**	**-**

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

DETAILED CONTENTS

SECTION – A ENTREPRENEURSHIP

1. Introduction (23 periods)
   - Concept /Meaning and its need
   - Qualities and functions of entrepreneur and barriers in entrepreneurship
   - Sole proprietorship and partnership forms of business organisations
   - Schemes of assistance by entrepreneurial support agencies at National, State, District level: NSIC, NRDC, DC:MSME, SIDBI, NABARD, Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP)

2. Market Survey and Opportunity Identification (17 periods)
   - Scanning of business environment
   - Salient features of National and State industrial policies and resultant business opportunities
   - Types and conduct of market survey
   - Assessment of demand and supply in potential areas of growth
   - Identifying business opportunity
   - Considerations in product selection

3. Project report Preparation (14 periods)
   - Preliminary project report
   - Detailed project report including technical, economic and market feasibility
   - Common errors in project report preparations
   - Exercises on preparation of project report

SECTION –B MANAGEMENT

4. Introduction to Management (06 periods)
   - Definitions and importance of management
   - Functions of management: Importance and Process of planning, organising, staffing, directing and controlling
   - Principles of management (Henri Fayol, F.W. Taylor)
   - Concept and structure of an organisation
   - Types of industrial organisations
     a) Line organisation
     b) Line and staff organisation
     c) Functional Organisation

5. Leadership and Motivation (05 periods)

a) Leadership

- Definition and Need
- Qualities and functions of a leader
- Manager Vs leader
- Types of leadership

b) Motivation

- Definitions and characteristics
- Factors affecting motivation
- Theories of motivation (Maslow, Herzberg, McGregor)

6. Management Scope in Different Areas (10 periods)

a) Human Resource Management

- Introduction and objective
- Introduction to Man power planning, recruitment and selection
- Introduction to performance appraisal methods

b) Material and Store Management

- Introduction functions, and objectives
- ABC Analysis and EOQ

c) Marketing and sales

- Introduction, importance, and its functions
- Physical distribution
- Introduction to promotion mix
- Sales promotion

d) Financial Management

- Introductions, importance and its functions
- Elementary knowledge of income tax, sales tax, excise duty, custom duty and VAT

7. Miscellaneous Topics (05 periods)

a) Customer Relation Management (CRM)

- Definition and need
- Types of CRM

b) Total Quality Management (TQM)

- Statistical process control
- Total employees Involvement
- Just in time (JIT)

c) Intellectual Property Right (IPR)

- Introductions, definition and its importance
- Infringement related to patents, copy right, trade mark

Note: In addition, different activities like conduct of entrepreneurship awareness camp extension lecturers by outside experts, interactions sessions with entrepreneurs and industrial visits may also be organised.

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment or seminar method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided.

RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development published by Tata McGraw Hill Publishing Company Ltd., New Delhi
3. Entrepreneurship Development in India by CB Gupta and P Srinivasan; Sultan Chand and Sons, New Delhi
4. Entrepreneurship Development - Small Business Enterprises by Poornima M Charantimath; Pearson Education, New Delhi
5. Entrepreneurship : New Venture Creation by David H Holt; Prentice Hall of India Pvt. Ltd., New Delhi
6. Handbook of Small Scale Industry by PM Bhandari
7. Principles and Practice of Management by L M Prasad; Sultan Chand & Sons, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	23	30
2	17	20
3	14	15
4	6	10
5	5	05
6	10	15
7	5	05
Total	**80**	**100**

6.2 ADVANCED MACHINE DESIGN

L T P
4 - 2 - 0

RATIONALE

This is the second course for the students of Mechanical Engineering. Application of the basic design principles for the component design of different machine parts should be emphasized.

DETAILED CONTENTS

1. Introduction (02 period)

   - Review of the design principle under static, impact and cyclic loading

2. Design of power transmission systems (20 period)

   (i) Design of flat belts, V belts selection procedure

   Design of pulleys

   Design of chain drives

   Design of rope drives

   (ii) Manufacturing methods of gear

   Gear tooth profiles

   Types of gear drives, selection of gear drives

   Design of spur gears, helical, bevel and worm gears

3. Selection of rolling contact bearing (10 period)

   Types of rolling contact bearing, their nomenclature Selection of bearing from SKF or TATA bearing of simple kind like ball, roller under axial and or thrust loading

4. Journal bearing (05 period)

   Sliding contact bearing, terms used in journal bearing, Explain the use of Design chats

5. Design of brakes (10 period)

   Different types of braking systems Braking materials Design of simple shoe and band brake

6. Design of flywheels (10 period)

   Function of flywheel, Stresses in flywheel, Design of flywheel

7. Designing clutches

   Design procedure for positive clutches, Design of friction clutches, Design of cone clutch

INSTRUCTIONAL STRATEGY

Teacher should lay emphasis on conceptual understanding and design aspects of various parts/components. Various models should be demonstrated in the class to explain mechanism

RECOMMENDED BOOKS

1. Machine Design- Fundamentals and Practices, by P C Gope, PHI Learning Pvt Limited, New Delhi. 2012
2. A Text Book of Machine Design by RS Khurmi & JKGupta, Eurasia Publishing House, Pvt. Ltd.., New Delhi
3. Introduction to Machine Design by VB Bhandari, TMH, Delhi
4. Theory of Machines by PL Ballaney, Khanna Publishers, New Delhi
5. Theory of Machines by DR Malhotra & HC Gupta, Satya Prakashan, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time allotted (**period**)**	**Marks Allotted (%)**
1	2	05
2	20	25
3	10	20
4	05	10
5	10	10
6	10	10
7	15	20
Total	**72**	**100**

6.3 AUTOMOBILE ENGINEERING

L T P
5 – 2

RATIONALE

The development of automobile industry direct and indirect dependence of the present day society on the services of its products has made the knowledge of the technology imperative, this subject deals with automotive needs.

DETAILED CONTENTS

1. INTRODUCTION (06 Periods)

1.1 Definitions and specifying an automobile
1.2 Automobile development and scope
1.3 Components of an automobile
1.4 Classification of automobiles
1.5 Layout of chassis
1.6 Types of drives-front wheel, rear wheel, four wheel left hand, right hand
1.7 Body or super structure

2. TRANSMISSION SYSTEM (20 Periods)

2.1 CLUTCH
- 2.1.1 Function
- 2.1.2 Constructional details of single plate and multi plate friction clutch
- 2.1.3 Centrifugal and semi centrifugal clutch
- 2.1.4 Hydraulic operation of single plate clutch
- 2.1.5 Clutch troubles

2.2 GEAR BOX
- 2.2.1 4-speed gear box
- 2.2.2 Gear ratios
- 2.2.3 Working of sliding mesh, constant mesh and synchromesh 4-speed gear box
- 2.2.4 Torque converter and overdrive
- 2.2.5 Transfer box

2.3 Propeller shaft and rear axle
- 2.3.1 Function
- 2.3.2 Universal joint
- 2.3.3 Final drive and differential assembly
- 2.3.4 Front driving axles
- 2.3.5 Real axle drives and different types of rear axles

2.4 WHEELS AND TYRES
- 2.4.1 Types of wheels- disc wheel, wire wheel and alloy cast wheel
- 2.4.2 Types of tyres used in Indian vehicles
- 2.4.3 Toe in, Toe out, camber, caster, kingpin inclination
- 2.4.4 Tubeless tyres

3. STEERING SYSTEM (11 Periods)

3.1 Function and principle
3.2 Ackerman and Davis steering gears
3.3 Types of steering gears – worm and ball nut, worm and wheel, worm and roller, rack and pinion type
3.4 Power steering
3.5 Wheel balancing
3.6 Wheel alignment

4. BRAKING SYSTEM (11 Periods)

4.1 Constructional details and working of mechanical, hydraulic and vacuum brake
4.2 Details of master cylinder, wheel cylinder
4.3 Concept of brake drum, brake lining and brake adjustment
4.4 Air brake, Emergency and Parking brake
4.5 Anti-lock braking system

5. SUSPENSION SYSTEM (07 Periods)

5.1 Function
5.2 Types
5.3 Working of coil spring, leaf spring, rubber springs
5.4 Shock absorber- telescopic type
5.5 Air suspension
5.6 Strut suspension

6. BATTERY (09 Periods)

6.1 Principles of battery operation
6.2 Constructional details of lead acid cell battery
6.3 Specific gravity of electrolyte – effect of temperature on specific gravity
6.4 Capacity and efficiency of battery
6.5 Battery charging, chemical reactions during charge and discharge
6.6 Maintenance of Batteries
6.7 Checking of batteries for voltage and specific gravity
6.8 Battery leakage test

7. DYNAMO and ALTERNATOR (08 Periods)

7.1 DYNAMO
  7.1.1 Function and details
  7.1.2 Regulator – voltage current and compensated type
  7.1.3 Cutout – construction, working and their adjustment
7.2 ALTERNATOR
  7.2.1 Construction and working
  7.2.2 Charging of battery from alternator

8. LIGHTING SYSTEM and ACCESSORIES (08 Periods)

8.1 Lighting system
8.2 Wiring circuit
8.3 Headlight, aiming of headlights
8.4 Lighting switches
8.5 Direction indicators
8.6 Windscreen wiper
8.7 Horn
8.8 Speedometer
8.9 Heater
8.10 Air conditioning
8.11 Temperature indicator

LIST OF PRACTICALS

1. WHEEL BALANCING
2. WHEEL ALIGNMENT
3. SUSPENSION SYSTEM SERVICING
4. RETREADING AND RECAPPING OF TYRES
5. AUTOMOTIVE BRAKE SERVICE
6. A/C SYSTEM SERVICE
7. CLUTCH TROUBLES AND CLUTCH SERVICE
8. SERVICING OF FUEL INJECTION PUMP
9. STUDY OF MPFI SYSTEM

RECOMMENDED BOOKS

1. Automobile Engineering vol. 1 by Dr. Kirpal Singh; Standard Publishers and Distributors, Delhi
2. Automobile Engineering by Dr. PS Gill
3. Automobile Engineering Vol. 1 by GBS Narang; khanna Publishers, Delhi

SUGGESTED DISTRIBUTION OF MARKS

TOPIC NO.	TIME ALLOTED (Periods)	MARKS ALLOTED (%)
1	6	6
2	20	25
3	11	12
4	11	12
5	7	8
6	9	14
7	8	14
8	8	9
TOTAL	**80**	**100**

6.4 POWER PLANT ENGINEERING

L	T	P
5	-	2

RATIONALE

A diploma holder in mechanical engineering is supposed to manage the power generating plant. In Uttranchal state, hydropower potential in supossed to be very large. Therefore, he must have relevant knowledge and skills about various power plants e.g. steam power plant, nuclear power plant, hydro power plant, diesel engine power plant and gas turbine power plant. Hence this subject is offered.

DETAILED CONTENTS

1. Introduction (08 Periods)

Sources of energy fuels, flowing stream of water, solar rays, wind, terrestial heat, ocean tides and waves Concept of power station, central and industrial power station, captive power station, classification of power station with respect to prime mover steam, IC engine, gas turbine and hydro power station, scope in Uttaranchal state

2. Steam Power Plant (20 Periods)

2.1 Parameters of power cycle- thermal efficiency, work ratio, specific steam Consumption Rankine cycle flow diagram, representation on thermodynamic planes, thermal efficiency, effect on change of condenser pressure, boiler pressure, degree of super heat on thermal efficiency Reheat cycle, simple regenerative cycle, (No numerical)

2.2 Steam prime movers

Concept of a prime mover, steam turbine- advantages as a prime mover, principle elements of a steam turbine and functions –nozzles, blades, rotor, shaft, casing, shaft seals, diaphragm, bearings, steam control, oil system Governing of steam turbines- classification of steam turbines Starting and stopping procedures for turbines, precautions during running Performance of steam turbine, Thermal efficiency, efficiency ratio, mechanical efficiency, steam rate

2.3 Steam Condensing Equipment

Functions of condensers, classification, surface condenser components and their functions Condenser auxiliaries- hot well, condensate pump, vaccum pump, air ejector, circulating pump, atmospheric relief valve Requirement of a good condensing system Cooling towers- purpose and types

2.4 Steam power station control

Effect of load variation of various parameters, types of control systems-area and centralized, basic components of a control system, compressed air and electrical control systems, controls and instruments in a modern central station control room Working of feed water control system and steam temperature control system Records maintained in a steam power station and their purpose

3. Nuclear Power Plant **(18 Periods)**

Equivalence between mass and energy- Atomic structure of matter, atomic nomenclature, nuclear reactions- fission, fusion, mass defect, binding energy, chain reaction, methods of control of rate of fusion reaction, types of nuclear materials, fissile and fertile materials Nuclear reactors- elements and functions of different elements, classification on the basis of different criteria Nuclear power stations employing boiling water rent reactor, candu type reactor-system components, advantages and dis advantages Comparison of nuclear power station with a steam power station Health hazards, safety precautions

4. Diesel Engine Power Plant **(08 Periods)**

Advantages and disadvantages of diesel engine. Essential elements of diesel power plant. Fuel injection system performance, testing of diesel engine power plant

5. Gas Turbine Power Plant **(08 Periods)**

Brayton cycle- schematic diagram, thermal efficiency. Advantages of gas turbines over diesel engines. Classification of gas turbines, advantages and disadvantages methods of improving thermal efficiency, Important parts and their functions, Essential auxiliaries and controls for gas turbine power point. Fuel for gas turbines

6. Hydro Power **(18 Periods)**

Advantages, basic elements, dams, head works, water turbines, classification of water turbines, speed and pressure control, plant auxiliaries, plant operation, potential in Uttranchal state, detailed working

INSTRUCTIONAL STRATEGY

Treatment of the subject will be subjected to analysis and examples. One visit to Power plant station is compulsory.

List of Practicals:-

The student will visit to different power plant station and prepare a report. The Evaluation of internal and external marks will be based on report as well as viva-voice.

RECOMMENDED BOOKS

1. A course in Power Plant Engineering by S. Domkundwar & Arora; Dhanpat Rai and sons
2. Power Plant Engineering by G.B.S Narang
3. Power plant engineering by G.R. Nagpal; S.K. Khanna Publishers, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Period)	Marks Allotted (%)
1	08	10
2	20	30
3	18	20
4	08	10
5	08	10
6	18	20
Total	**80**	**100**

6.5 MECHATRONICS

L	T	P
5	-	2

RATIONALE

The mechatronics, the integration of electronic, of electrical engineering, computer technology and control engineering with mechanical engineering is increasingly forming a crucial part in design, manufacture and maintenance of wide range of engineering products and processes. The diploma holders need skills and knowledge that are not confined to a single subject area. They need to be capable of operating and communicating across a range of engineering disciplines and linking those having more specialized skills. So it is important to introduce this subject.

DETAILED CONTENTS

1- Introduction (05 Periods)

Introduction to Mechatronics General Behaviour of Mechatronic system & Measurement systems . Idea of different types of Control system as open Loop & Close loop. The Mechatronics approach

2- Sensing Elements and transducers (20 Periods)

- Resistive sensing elements: potentiometers, strain gauges,
- Pressure Sensing Elements : Diaphragm, Borden and bellows tube, Load cell/Pressure cell
- Capacitive sensing elements: variable separation, area and dielectric
- Inductive sensing elements: variable reluctance and LVDT displacement sensors
- Electromagnetic sensing elements: velocity sensors
- Thermoelectric sensing elements: laws, thermocouple characteristics, installation problems
- Liquid level and flow sensing elements
- Elastic sensing elements : sensing elements for force, torque, acceleration,
- Piezoelectric sensing elements: static and dynamic characteristics
- Electrochemical sensing elements: PH meter, solid state gas sensors
- Photo sensing elements : Basic principle and characteristics of photo sources and photo detector,
- Digital Transducer element, Micro sensor, smart sensors

3- Signal Recording and Display (15Periods)

- Recording Requirements
- Analog Recorders
- Graphics Recorders
- Strip Chart Recorders
- Types of Strip Chart Recorders
- Galvanometer Type Recorders
- Null Type Recorders
- Potentiometric Recorders
- Segmental Displays
- Dot Matrices

4- Mechanical Actuation Systems (05Periods)

Mechanical systems Types of motion Kinematic chains Cams Gear trains Ratchet and pawlBelt and chain drives Bearing Mechanical aspects of motor selection Simple problems

5- Electrical Actuation System (05Periods)

Electrical systems Mechanical switches Solid- state switches Solenoids D.C. motors A.C. motors Stepper motors simple Problems

6- Basic System Models (05Periods)

Mathematical models Mechanical systems building blocks Electrical system building blocks Fluid system building blocks Thermal system building blocks Simple Problems

7- Pneumatic & Hydraulic control system (15 Periods)

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

Controller

- Block Diagram & Circuits of pneumatic & hydraulic PI,PD & PID controller, Controller
- Electronic Controller/Automatic Controller

8- Programmable Logic Controller (PLC) (05Periods)

Introduction of PLC, Block Diagram of PLC, Characteristics function of PLC **,**Use of PLC in Mechanical Industry

9- Robotix (05Periods)

General Idea of robot, Brief Description and applications of Hexa Pod, Line follower, Automatic Management and blue boltz robots, Application of robot in Mechanical system, control Mechanism.

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching learning.
2. Students should be taken to various industrial units for clear conception of various topics.
3. Efforts should be made to relate the process of teaching with direct experiences in the industry.

RECOMMENDED BOOKS

1- Mechatronics by HMT, Tata McGraw Hill, New Delhi
2- Mechatronics: Electronic Control System in Mechanical Engineering by W. Bolton; Pearson Education, Singapore.
3- Electronic Instrumentation; by H.S.Kalsi; McGraw-Hill Education India Pvt.Ltd.
4- Principles of Measurement Systems by John P.Bently (Pearson)
5- Electrical and Electronic Measurements and Instrumentation by A.K.Sawhney; DhanpatRai& Co.
6- Instrumentation measurement and Analysis by B.C. Nakra, K.K.Chaudhary
7- Optoelectronics An Introduction to Materials and Devices by Singh Jasprit;McGraw Hill

8- Instrumentation Devices and Systems by C.S.Ranjan; Tata McGraw Hill
9- Instrumentation Devices & Systems by S Ranjan (Tata McGraw-Hill Publishing)
10- Process Control by Donald P. Echman

LIST OF PRACTICALS

1. Measurement of Displacement using LVDT
2. Measurement of Temperature using Thermocouple
3. Application of Load Cell/Pressure Cell
4. Application of capacitive transducer
5. Application of Potentiometer
6. Application and use of Photocell
7. Application and use of graphic and strip chart recorder
8. Experiment of ON-OFF Controller
9. Experiment of Pneumatic PID Controller
10. Experiment of Hydraulic PID Controller
11. Application of PLC
12. Study and sketch of a general Robot
13. Study of feedback control in a Robot.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Period)	Marks Allotted (%)
1	05	08
2	20	20
3	15	16
4	05	08
5	05	08
6	05	08
7	15	16
8	05	08
9	05	08
Total	**80**	**100**

6.6 PROJECT WORK

L T P
Periods per week - - 10

Project work aims at developing skills in the students whereby they apply the totality of knowledge and skills gained through the course in the solution of particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given for a group. The students should identify or given project assignment at least two to three months in advance. The project work identified in collaboration with industry may be preferred.

Each teacher is expected to guide the project work of 5-6 students.

- Projects related to repair and maintenance of automobiles
- Projects related to increasing productivity
- Projects related to quality assurance
- Projects related to estimation and economics of production
- Projects connected with repair and maintenance of plant and equipment
- Projects related to identification of raw material thereby reducing the wastage
- Any other related problems of interest of host industry

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

Sr. No.	Performance criteria	Max. marks	Rating Scale				
			Excellent	Very good	Good	Satis-factory	Poor
1.	Selection of project assignment	10	10	8	6	4	2
2.	Planning and execution of considerations	10	10	8	6	4	2
3.	Quality of performance	20	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20	20	16	12	8	4
5.	Sense of responsibility	10	10	8	6	4	2
6.	Self expression/ communication skills	5	5	4	3	2	1
7.	Interpersonal skills/human relations	5	5	4	3	2	1
8.	Report writing skills	10	10	8	6	4	2
9.	Viva voce	10	10	8	6	4	2
Total marks		**100**	**100**	**80**	**60**	**40**	**20**

The overall grading of the practical training shall be made as per following table

	Range of maximum marks	**Overall grade**
i)	More than 80	*Excellent*
ii)	65-80	Very good
iii)	50-64	Good
iv)	41-49	Fair
v)	Less than 40	Poor

In order to qualify for the diploma, students must get "Overall Good grade" failing which the students may be given one more chance of undergoing 8 -10 weeks of project oriented/project work professional training in the same industry and re-evaluated before being disqualified and declared "not eligible to receive diploma ". It is also important to note that the students must get more than six "goods" or above "good" grade in different performance criteria items in order to get "Overall Good" grade.

Important Notes

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.

2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.

4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve another criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organizations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.

6.7 EMPLOYABLE SKILLS

	L	T	P
Periods per week	-	-	4

RATIONALE

Diploma holders are required to not only possess subject related knowledge but also soft skills to get good jobs and to rise steadily at their workshop. This subject is included to develop employability skills amongst the students

DETAILED CONTENTS

1. Industrial Scenario Engineering Education and expectations of competences from an engineer by employer (04 period)

2. Personality types, characteristic and features for a successful engineer (04 period)

3. Professional Engineer desirable values and ethics and their development. Relation between engineering profession, society and environment (04 period)

4. Managing project (16 period)
   - Leadership
   - Motivation
   - Time management
   - Resource management
   - Computer Software
   - Interpersonal relationship
   - Engineer economics and fundamentals

5. Effective Communication (08 period)
   - Listening
   - Speaking
   - Writing
   - Presentation Technique/Seminar
   - Group discussion

6. Preparing for Employment (08 period)
   - Searching for job/job hunting
   - Resume Writing
   - Interview technique in personal interview telephonic interview, panel interview, group interview, video conference

7. Managing Self (06 period)
   - Managers body, mind, emotion and spirit

- Stress Management
- Conflict resolution

8. Continuing professional development (04 period)
   - Organising learning and knowledge
   - Use of computer for organising knowledge resource

9. Creativity, Innovation and Intellectual property right (06 period)
   - Concept and need in present time for an engineer

10. Basic rules, laws and norms to be adhered by engineers during their working (04 period)

3.1 FLUID MECHANICS

	L	T	P
Periods/Week	4	-	2

RATIONALE

Subject of Fluid Mechanics is a basic engineering subject and helps in solving fluid flow problems in the field of Civil Engineering. The subject deals with basic concepts and principles in hydrostatics, hydro kinematics and hydrodynamics and their application in solving fluid - mechanics problems.

DETAILED CONTENTS

1. Introduction: (2 periods)

   1.1 Fluids: Real and ideal fluids

   1.2 Fluid Mechanics, Hydrostatics, Hydrodynamics, Hydraulics

2. Properties of Fluids (definition only) (5 periods)

   2.1 Mass density, specific weight, specific gravity, viscosity, surface tension - cohesion, adhesion and, capillarity, vapour pressure and compressibility.

   2.2 Units of measurement and their conversion

3. Hydrostatic Pressure: (10 periods)

   3.1 Pressure, intensity of pressure, pressure head, Pascal's law and its applications.

   3.2 Total pressure, resultant pressure, and centre of pressure.

   3.3 Total pressure and centre of pressure on horizontal, vertical and inclined plane surfaces of rectangular, triangular, trapezoidal shapes and circular. (No derivation)

4. Measurement of Pressure: (7 periods)

   4.1 Atmospheric pressure, gauge pressure, vacuum pressure and absolute pressure.

   4.2 Piezometer, simple manometer and differential manometer, Bourdon gauge and dead weight pressure gauge.

5. Fundamentals of Fluid Flow: (8 periods)

   5.1 Types of Flow: Steady and unsteady flow, laminar and turbulent flow, uniform and non-uniform flow

5.2 Discharge and continuity equation (flow equation) {No derivation}

5.3 Types of hydraulic energy: Potential energy, kinetic energy, pressure energy. Hydraulic gradient line and total energy line.

5.4 Bernoulli's theorem; statement and description (without proof of theorem) and simple numerical problems.

6. Flow Measurements (brief description with simple numerical problems) (8 periods)

6.1 Venturimeter and mouthpiece

6.2 Pitot tube

6.3 Orifice and Orificemeter

6.4 Current meters

6.5 Notches and weirs (simple numerical problems)

7. Flow through Pipes: (10 periods)

7.1 Definition of pipe flow; Reynolds number, laminar and turbulent flow - explained through Reynold's experiment

7.2 Critical velocity and velocity distributions in a pipe for laminar flow

7.3 Head loss in pipe lines due to friction, sudden expansion and sudden contraction, entrance, exit, obstruction and change of direction (No derivation of formula)

7.4 Flow from one reservoir to another through a long pipe of uniform cross section (simple problems)

7.5 Pipes in series and parallel

7.6 Water hammer phenomenon and its effects (only definition and description)

8. Flow through open channels: (11 periods)

8.1 Definition of an open channel, uniform flow and non-uniform flow

8.2 Discharge through channels using
- i) Chezy's formula (no derivation)
- ii) Manning's formula (no derivation)
- iii) Simple Numerical Problems

8.3 Most economical channel sections (no derivation)
- i) Rectangular

ii) Trapezoidal
iii) Simple Numerical Problems

8.4 Head loss in open channel due to friction

9. Hydraulic Pumps: (3 periods)
Hydraulic pump, reciprocating pump, centrifugal pumps (No numericals and derivations) (may be demonstrated with the help of working models)

Note: Visit to Hydraulic research station is must to explain the various concepts.

PRACTICAL EXERCISES

i) To verify Bernoullis Theorem

ii) To find out venturimeter coefficient

iii) To determine coefficient of velocity (C_v), Coefficient of discharge (C_d) Coefficient of contraction (C_c) of an orifice and verify the relation between them

iv) To perform Reynold's experiment

v) To verify loss of head in pipe flow due to
a) Sudden enlargement
b) Sudden contraction
c) Sudden bend

vi) Demonstration of use of current meter and pitot tube

vii) To determine coefficient of discharge of a rectangular notch/triangular notch.

INSTRUCTIONAL STRATEGY

Hydraulics being a fundamental subject, teachers are expected to lay considerable stress on understanding the basic concepts, principles and their applications. For this purpose, teachers are expected to give simple problems in the class room and provide tutorial exercises so as to develop necessary knowledge for comprehending the basic concepts and principles. As far as possible, the teaching of the subject be supplemented by demonstrations and practical work in the laboratory. Visit to hydraulic research stations must be carried out.

RECOMMENDED BOOKS

1. Jagdish Lal, "Fluid Mechanics and Hyraulics" Delhi Metropolitan Book Co. Pvt Ltd.

2. Modi, PN, and Seth, SM; "Hydraulics and Fluid Mechanics", Standard Publishers Distributors, Delhi

3. Khurmi RS, "Hydraulics and Hydraulics Machines", S Chand and Co., Delhi

4. Likhi SK., Laboratory Manual in Hydraulics, Delhi Wiley Eastern.

5. Birinder Singh , "Fluid Mechanics", Kaptian Publishing, New Delhi.

6. Sarao A.S., "Fluid Mechanics", Tech. India Publication, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	2	2
2	5	7
3	10	17
4	7	11
5	8	12
6	8	12
7	10	17
8	11	18
9	3	4
Total	**64**	**100**

3.2 APPLIED MECHANICS

	L	T	P
Periods/week	4	-	2

RATIONALE

The subject Applied Mechanics deals with basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion and simple machines which are required by the students for further understanding of other allied subjects. The subject enhances the analytical ability of the students.

DETAILED CONTENTS

1. Introduction (08 period)

   1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics.

   1.2 Definition, basic quantities and derived quantities of basic units and derived units

   1.3 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another density, force, pressure, work, power, velocity, acceleration

   1.4 Concept of rigid body, scalar and vector quantities

2. Laws of forces (12 period)

   2.1 Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force

   2.2 Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position

   2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components

   2.4 Free body diagram

   2.5 Equilibrant force and its determination

   2.6 Lami's theorem (concept only)

   [Simple problems on above topics]

3. Moment (10 period)

3.1 Concept of moment

3.2 Moment of a force and units of moment

3.3 Varignon's theorem (definition only)

3.4 Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support)

3.5 Parallel forces (like and unlike parallel force), calculating their resultant

3.6 Concept of couple, its properties and effects

3.7 General conditions of equilibrium of bodies under coplanar forces and beams, fixed support, roller, support, over hanging, Uniformly distributed load, point load, varying load

3.8 Position of resultant force by moment

[Simple problems on the above topics]

4. Friction (10 period)

4.1 Definition and concept of friction, types of friction, force of friction

4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction

4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane, friction in simple screw jack

4.4 Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force:

a) Acting along the inclined plane Horizontally

b) At some angle with the inclined plane

[Simple problems on the above topics]

5. Centre of Gravity (08 period)

5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies

5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion

5.3 Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed

[Simple problems on the above topics]

6. Moment of Inertia (06 period)

Concept of moment of inertia and second moment of area and radius of gyration, theorems of parallel and perpendicular axis, second moment of area of common geometrical sections: rectangle, triangle, circle *(without derivations).* Second moment of area for L, T and I sections, section modulus.

7. Simple Machines (10 period)

7.1 Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines

7.2 Simple and compound machine (Examples)

7.3 Definition of ideal machine, reversible and self locking machine

7.4 Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency

7.5 System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency

7.6 Working principle and application of wheel and axle, different pulley blocks, simple screw jack, worm and worm wheel, single and double winch crab. Expression for their velocity ratio and field of their application

[Simple problems on the above topics]

LIST OF PRACTICALS

1. Verification of the following laws:
   a) Parallelogram law of forces
   b) Triangle law of forces
   c) Polygon law of forces
2. To verify the forces in different members of jib crane.
3. To verify the reaction at the supports of a simply supported beam.
4. To find the Mechanical Advantage, Velocity Ratio and efficiency in case of an inclined plane.
5. To find the Mechanical Advantage, Velocity Ratio and efficiency of a screw jack.
6. To find the Mechanical Advantage, Velocity Ratio and efficiency of worm and worm wheel.
7. To find Mechanical Advantage, Velocity Ratio and efficiency of single purchase crab.
8. To find out center of gravity of regular lamina.

9. To find out center of gravity of irregular lamina.
10. To determine coefficient of friction between three pairs of given surface.

RECOMMENDED BOOKS

1. A Text Book of Applied Mechanics by S Ramamurtham, Dhanpat Rai Publishing Co. Ltd.
2. A Text Book of Engineering Mechanics (Applied Mechanics) by RK Khurmi; S Chand and Co. Ltd., New Delhi.
3. A Text Book of Applied Mechanics by RK Rajput; Laxmi Publications, New Delhi.
4. Text Book of Applied Mechanics by Birinder Singh, Kaption Publishing House, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	14
2	12	16
3	10	18
4	10	18
5	08	10
6	06	08
7	10	16
Total	**64**	**100**

3.3 SURVEYING - I

	L	T	P
Periods/week	**3**	**-**	**6**

RATIONALE

The important functions of a diploma civil engineer includes the jobs of detailed surveying, plotting of survey data, preparation of survey maps and setting out works

While framing the curriculum for the subject of surveying, stress has been given to the development of the skill in each type of survey like chain surveying, compass surveying leveling, that the Civil Engineering diploma holder will normally be called upon to perform and plane table surveying,

Field work should be a selected one so that student can check his work and have an idea of the results the extent of error in the work done by him. As far as possible, the surveys done should be got plotted, as this will also reveal errors in the work and develop skill in plotting.

DETAILED CONTENTS

1. Introduction: (05 periods)

    1.1 Basic principles of surveying
    1.2 Concept and purpose of surveying, measurements-linear and angular, units of measurements
    1.3 Instruments used for taking these measurements, classification based on surveying instruments

2. Chain surveying: (06 periods)

    2.1 Purpose of chain surveying, principles of chain surveying and its advantages and disadvantages
    2.2 Obstacles in chain surveying
    2.3 Direct and indirect ranging offsets and recording of field notes
    2.4 Errors in chain surveying and their corrections

3. Compass surveying: (10 periods)

    3.1 Purpose of compass surveying. Use of prismatic compass: Setting and taking observations

    3.2 Concept of following with simple numerical problems:
        a) Meridian - Magnetic and true
        b) Bearing - Magnetic, True and Arbitrary
        c) Whole circle bearing and reduced bearing
        d) Fore and back bearing
        e) Magnetic dip and declination
    3.3 Local attraction - causes, detection, errors and corrections, problems on local attraction, magnetic declination and calculation of included angles in a compass traverse

4. Levelling: (14 periods)

4.1 Purpose of levelling, concept of a level surface, horizontal surface, vertical surface, datum, reduced level and bench marks

4.2 Identification of various parts of Dumpy level and use of Dumpy level, Engineer' level, Auto level: advantages and disadvantages, use of auto level.

4.3 Concepts of line of collimation, axis of the bubble tube, axis of the telescope and vertical axis

4.4 Levelling staff: single piece, folding, invar precision staff, telescopic

4.5 Temporary adjustment and permanent adjustment of dumpy level by two peg method.

4.6 Concept of back sight, foresight, intermediate sight, change point, to determine reduce levels

4.7 Level book and reduction of levels by

4.7.1 Height of collimation method and
4.7.2 Rise and fall method

4.8 Arithmetic checks, problem on reduction of levels, fly levelling, check leveling and profile levelling (L-section and X-section), errors in levelling, permissible limits, reciprocal leveling. Numerical problems.

4.9 Computations of Areas of regular figures and irregular figures. Simpson's rule: prismatic formula and graphical method use of planimeter for computation of areas, numerical problems

5. Plane Table Surveying (13 periods)

5.1 Purpose of plane table surveying, equipment used in plane table survey:

5.2 Setting of a plane table:
(a) Centering
(b) Levelling
(c) Orientation

5.3 Methods of plane table surveying
(a) Radiation,
(b) Intersection
(c) Traversing
(d) Resection

5.4 Concept of Two point and Three point problems (Concept only)

5.5 Errors in plane table survey and precautions to control them. Testing and adjustment of plane table and alidad

PRACTICAL EXERCISES

I. Chain surveying:

i) a) Ranging a line
b) Chaining a line and recording in the field book
c) Taking offsets - perpendicular and oblique (with a tape only)
d) Setting out right angle with a tape

ii) Chaining of a line involving reciprocal ranging

iii) Chaining a line involving obstacles to ranging

iv) Chain Survey of a small area.

II. Compass Surveying:

i) a) Study of prismatic compass
b) Setting the compass and taking observations
c) Measuring angles between the lines meeting at a point

III. Levelling:

i) a) Study of dumpy level and levelling staff
b) Temporary adjustments of various levels
c) Taking staff readings on different stations from the single setting and finding differences of level between them

ii) To find out difference of level between two distant points by shifting the instrument

iii) Longitudinal and cross sectioning of a road/railway/canal

iv) Setting a gradient by dumpy and auto-level

IV. Plane Table Surveying:

i) a) Study of the plane table survey equipment
b) Setting the plane table
c) Marking the North direction
d) Plotting a few points by radiation method

ii) a) Orientation by
- Trough compass
- Back sighting

b) Plotting few points by intersection, radiation and resection method

iii) Traversing an area with a plane table (at least five lines)

INSTRUCTIONAL STRATEGY

This is highly practice-oriented course. While imparting theoretical instructions, teachers are expected to demonstrate the use of various instruments in surveying, stress should be laid on correct use of various instruments so as to avoid/minimize errors during surveying. It is further recommended that more emphasis should be laid in conducting practical work by individual students. Technical visit to Survey of India, Northern Region and Great Trignometrical Survey(GTS), Dehradun.

RECOMMENDED BOOKS

1. Hussain, SK and Nagraj, MS; "Text Book of Surveying"; New Delhi, S Chand and Co Ltd. New Delhi
2. Deshpande, RS; "A Text Book Surveying and Levelling"; Poona, United Book Corporation, New Delhi
3. Kocher, CL; "A Text Book of Surveying"; Ludhiana, Katson Publishing House, New Delhi
4. Kanetkar,TP and Kulkarni, SV., "Surveying and Leveling", Poona, AVG Parkashan, New Delhi
5. Kanetkar, TP; and Kulkarni, SV; "Surveying and Leveling" Poona, AVG Prakashan, Delhi
6. Mahajan, Sanjay “Surveying -I”, Tech. Publication, Delhi
7. Punmia, BC; "Surveying and Leveling", Delhi Standard Publishers Distributors, Delhi
8. Shahai, PB; "A Text Book of Surveying", Oxford and IBH Publishing Co. New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted Periods)	Marks Allotted (%)
1	05	07
2	06	09
3	10	24
4	14	30
5	13	30
Total	**48**	**100**

3.4 CONSTRUCTION MATERIALS

	L	T	P
Periods/week	4	-	2

RATIONALE

Civil Engineering diploma holders have to supervise construction of various types of civil works involving use of various materials like stones, bricks and tiles, cement and cement based products, lime, timber and wood based products, paints and varnishes, metals and other miscellaneous materials. The students should have requisite knowledge regarding characteristics, uses and availability of various building materials and skills in conducting tests to determine suitability of materials for various construction purposes. In addition, specifications of various materials should also be known (PWD/BIS) for effective quality control.

DETAILED CONTENTS
THEORY

1. Building Stones: (06 periods)

    1.1 Classification of Rocks: (General Review)

        1.1.1 Geological classification: Igneous, sedimentary and metamorphic rocks

        1.1.2 Chemical classification; Calcareous, argillaceous and siliceous rocks

        1.1.3 Physical classification: Unstratified , startified and foliated rocks

    1.2 General characteristics of stones – Marble, Kota stone, Granite, Sand, Trap, Basalt stone, Lime stone and Slate

    1.3 Requirements of good building stones

    **1.4 Identification of common building stones

    1.5 Various uses of stones in construction

    1.6 Quarrying of stones by blasting and its effect on environment

2. Bricks and Tiles: (13 periods)

    2.1 Introduction to bricks

    2.2 Raw materials for brick manufacturing and properties of good brick making earth
    2.3 Manufacturing of bricks

        2.3.1 Preparation of clay (manual/mechanically)

**2.3.2 Moulding: hand moulding and machine moulding brick table; drying of bricks, burning of bricks, types of kilns (Bull's Trench Kiln and Hoffman's Kiln), process of burning, size and weight of standard brick; traditional brick, refractory brick, clay-flyash bricks, sun dried bricks, only line diagram of kilns

2.4 Classification and specifications of bricks as per BIS: 1077

2.5 Testing of common building bricks as per BIS: 3495

Compressive strength, water absorption – hot and cold water test, efflorescence, Dimensional tolerance, soundness

2.6 Tiles

2.6.1 Building tiles; Types of tiles-wall, ceiling, roofing and flooring tiles

2.6.2 Ceramic, terrazo and PVC tiles, : their properties and uses,
2.6.3 Vitrified tiles, Paver blocks.

2.7 Stacking of bricks and tiles at site

3. Cement: (10 periods)

**3.1 Introduction, raw materials, flow diagram of manufacturing of cement

3.2 Various types of Cements, their uses and testing: Ordinary portland cement, rapid hardening cement, low heat cement, high alumina cement, blast furnace slag cement, white and coloured cement, portland pozzolana cement, super sulphate cement, Tests of cement – fineness, soundness, initial and final setting time etc.as per B.I.S. Code.

3.3 Properties of cement

4. Lime: (04 periods)

4.1 Introduction: Lime as one of the cementing materials

4.2 Classification and types of lime as per BIS Code

4.3 Calcination and slaking of lime

5. Timber and Wood Based Products: (10 periods)

5.1 Identification and uses of different types of timber: Teak, Deodar, Shisham, Sal, Mango, Kail, Chir, Fir, Hollock, Champ

** 5.2 Market forms of converted timber as per BIS Code

5.3 Seasoning of timber: Purpose, methods of seasoning as per BIS Code

5.4 Properties of timber and specifications of structural timber

5.5 Defects in timber, decay in timber

5.6 Preservation of timber and methods of treatment as per BIS

5.7 Other wood based products, their brief description of manufacture and uses: laminated board, block board, fibre board, hard board, sunmica, plywood, veneers, nu-wood and study of the brand name and cost of the wood based products available in the market, Cement Panel Board, Moulded Door.

6. Paints and Varnishes: (07 periods)

6.1 Introduction, purpose and use of paints

6.2 Types, ingredients, properties and uses of oil paints, water paints and cement paints

6.3 Covering capacity of various paints

6.4 Types, properties and uses of varnishes

6.5 Trade name of different products.

7. Metals: (04 periods)

7.1 Ferrous metals: Composition, properties and uses of cast iron, mild steel, HYSD steel, high tension steel as per BIS.

7.2 Commercial forms of ferrous, metals.
7.3 Aluminium & Stainless Steel.

8. Miscellaneous Materials: (10 periods)

8.1 Plastics – Introduction and uses of various plastic products in buildings such as doors, water tanks and PVC pipes

8.2 Fibre Sheets and their manufacture process.

8.3 Types and uses of insulating materials for sound and thermal insulation

8.4 Construction chemicals like water proofing compound, epoxies, polymers

8.5 Water proofing, termite proofing and fire resistance materials – types and uses

8.6 Materials used in interior decoration works like POP, methods of doing POP

NOTE: **A field visit may be planned to explain and show the relevant things

PRACTICAL EXERCISES:

i) To identify the stones used in building works by visual examination

ii) To determine the crushing strength of bricks

iii) To determine the water absorption of bricks and efflorescence of bricks

iv) To identify various types of timbers such as: Teak, Sal, Chir, Sissoo, Deodar, Kail & Hollock by visual examination only

v) To determine fineness (by sieve analysis) of cement

vi) To conduct field test of cement.

vii) To determine normal consistency of cement

viii) To determine initial and final setting times of cement

ix) To determine soundness of cement

x) To determine compressive strength of cement

xi) The students should submit a report work on the construction materials, covering water proofing material, cements, steel, paints and timber products available in the local market. They will also show the competitive study based upon the cost, brand name, sizes available in the local market.

INSTRUCTIONAL STRATEGY

Teachers are expected to physically show various materials while imparting instructions. Field-visits should also be organized to show manufacturing processes and use of various materials in Civil engineering works. Students should be encouraged to collect sample of various building materials so as to create a museum of materials in the polytechnic.

RECOMMENDED BOOKS

1) Sharma, SK; and Mathur, GC; "Engineering Materials;" Delhi-Jalandhar, S. Chand and Co.
2) Surendra Singh; "Engineering Materials;" New Delhi, Vikas Publishing House Pvt. Ltd.
3) Chowdhuri, N; "Engineering Materials;" Calcutta, Technical Publishers of India.
4) Bahl, SK; "Engineering Materials;" Delhi, Rainbow Book Co.
5) TTTI, Chandigarh "Civil Engineering Materials:" New Delhi Tata McGraw Hill Publication
6) Kulkarni, GJ; "Engineering Materials;" Ahmedabad, Ahmedabad Book Depot.
7) Shahane; "Engineering Materials"; Poona, Allied Book Stall.
8) Gurcharan Singh; "Engineering materials", Delhi Standard Publishers Distributors
9) SC Rangawala, "Construction Materials", Charotar Publishers
10) Alam Singh, "Constrution Materials"
11) Dr. Hemant Sood "Lab Manual in Testing of Engineering Materials", New Age International (P) Ltd., New Delhi
12) Handbook of Civil Engineering by PN Khanna.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	06	08
2	13	20
3	10	16
4	04	08
5	10	14
6	07	12
7	04	08
8	10	14
Total	**64**	**100**

3.5 BUILDING CONSTRUCTION

	L	T	P
Periods/Week	5	-	2

RATIONALE

Diploma holders in Civil Engineering are supposed to effectively supervise construction of buildings. Effective supervision is essential to obtain/provide a fault free service from contractors to users. To perform above task, it is essential that students should have knowledge of various sub components of buildings like foundations, walls, roofs, staircases, floors etc., and their constructional details as well as preventive, remedial and corrective methods of common construction faults. Therefore, the subject of Building Construction is very important for Civil Engineering diploma holders.

DETAILED CONTENTS

THEORY:

1. Introduction: (01 periods)

    1.1 Definition of a building, classification of buildings based on occupancy
    1.2 Different parts of a building

2. Foundations: (06 periods)

    2.1 Concept of foundation and its purpose
    2.2 Types of foundation-shallow and deep

        **2.2.1 Shallow foundation - constructional details of: Spread foundations for walls, thumb rules for depth and width of foundation and thickness of concrete block, stepped foundation, masonry pillars and concrete columns

    2.3 Earthwork

        2.3.1 Layout/setting out for surface excavation, cutting and filling
        2.3.2 Excavation of foundation, trenches, shoring, timbering and de- watering

3. Walls: (07 periods)

    3.1 Purpose of walls
    3.2 Classification of walls - load bearing, non-load bearing, dwarf wall, retaining, breast walls and partition walls
    3.3 Classification of walls as per materials of construction: brick, stone, reinforced brick, reinforced concrete, precast, hollow and solid concrete block and composite masonry walls
    3.4 Partition walls: Constructional details, suitability and uses of brick and wooden partition walls
    3.5 Mortars: types, selection of mortar and its preparation
    3.6 Scaffolding, construction details and suitability of mason’s brick layers and tubular scaffolding, shoring, underpinning

4. Masonry (08 periods)

4.1 Brick Masonry: Definition of terms like header, stretcher, queen closer, king closer, frog and quoin, course, bond, facing, backing, hearting, jambs, reveals, soffit, plinth, pillars and pilasters

4.1.1 Bond – meaning and necessity; English, flemish bond and other types of bonds

4.1.2 Construction of brick walls –methods of laying bricks in walls, precautions observed in the construction of walls, methods of bonding new brick work with old (toothing, raking, back and block bonding), Expansion and contraction joints

4.1.3 Importance towards special care during execution on: soaking of bricks, maintenance of bonds and plumb, filling of horizontal and vertical joints, masonry work, restriction height of construction on a given day, every fourth course, earthquake resistance measure, making of joints to receive finishes

4.2 Stone Masonry

4.2.1 Glossary of terms – natural bed, bedding planes, string course, corbel, cornice, block in course grouting, moulding, templates, corner stone, bond stone, throating, through stone, parapet, coping, pilasters and buttress

4.2.2 Types of stone masonry: rubble masonry - random and coursed; Ashlar masonry, principles to be observed in construction of stone masonry walls

4.2.3 Importance towards special care during execution of stone masonry work on dressing of stone, size and placing of bond and corner stones, filling joints, proper packing of internal cavities of rubble masonry wall, raking of joints to receive finishes

5. Arches and Lintels: (06 periods)

5.1 Meaning and use of arches and lintels:

5.2 Glossary of terms used in arches and lintels - abutment, pier, arch ring, intrados, soffit, extrados, voussoiers, springer, springing line, crown, key stone, skew back, span, rise, depth of an arch, haunch, spandril, jambs, bearing, thickness of lintel, effective span

5.3 Arches:

5.3.1 Types of Arches - Semi circular, segmental, elliptical and parabolic, flat, inverted and relieving

5.3.2 Stone arches and their construction

5.3.3 Brick arches and their construction

5.4 Lintels

5.4.1 Purpose of lintel

5.4.2 Materials used for lintels

5.4.3 Cast-in-situ and pre-cast lintels

5.4.4 Lintel along with sun-shade or chhajja

**6. Doors, Windows and Ventilators: (05 periods)

6.1 Glossary of terms with neat sketches

6.2 Classification based on materials i.e. wood, metal and plastic and their suitability for different situations. Different type of doors- panel door, flush door, flazed door, rolling shutter, steel door, sliding door, plastic and aluminium doors

6.3 Window – Panel window, glazed windows (fixed and openable) ventilators, sky light window, Louvres shutters, plastic and aluminium windows.

6.4 Door and window frames – materials and sections, door closures, hold fasts

*7. Damp Proofing and Water Proofing (08 periods)

7.1 Dampness and its ill effects on bricks, plaster, wooden fixtures, metal fixtures and reinforcement, damage to aesthetic appearance, damage to heat insulating materials, damage to stored articles and health, sources and causes of dampness

7.2 Sources of dampness - moisture penetrating the building from outside e.g. rainwater, surface water, ground moisture. Moisture entrapped during construction i.e. moisture in concrete, masonry construction and plastering work etc. Moisture which originates in the building itself i.e. water in kitchen and bathrooms etc.

7.3 Damp proofing materials and their specifications: rich concrete and mortar, bitumen, bitumen mastic, polymer coating, use of chemicals

7.4 Damp proofing of : basement, ground floors, plinth and walls, special damp proofing arrangements in bathrooms, WC and kitchen, damp proofing for roofs and window sills

**8. Floors (07 periods)

8.1 Glossary of terms-floor finish, topping, under layer, base course, rubble filling and their purpose

8.2 Types of floor finishes - cast-in-situ, concrete flooring (monolithic, bonded) Terrazzo tile flooring, stone (marble and kota) flooring, PVC flooring, Terrazzo flooring, glazed tiles flooring, Timber flooring, description with sketches. The methods of construction of concrete, terrazzo and timber floors and their BIS specifications

8.3 Special emphasis on level/slope/reverse slope in bathrooms, toilets, kitchen, balcony and staircase

9. Roofs (05 periods)

9.1 Types of roofs, concept of flat, pitched and arched roofs

9.2 Glossary of terms for pitched roofs - batten, eaves, facia board, gable, hip, lap, purlin, rafter, rag bolt, valley, ridge, rain water gutter, anchoring bolts

9.3 False ceilings using gypsum, plaster boards, cellotex, fibre boards

9.4 Special emphasis on maintenance of slopes, overlaps of roofing materials, applicability and problems of wind ties, size of anchoring bolts

10. Stairs (05 periods)

10.1 Glossary of terms: Staircase, winders, landing, stringer, newel, baluster, riser, tread, width of staircase, hand-rail, nosing
10.2 Classification of staircase on the basis of material – RCC, timber, steel, Aluminium
10.3 Planning and layout of staircase: Relations between rise and tread, determination of width of stair, landing etc
10.4 Various types of layout - straight flight, dog legged, open well, quarter turn, half turn (newel and geometrical stairs), bifurcated stair, spiral stair

11. Surface Finishes (05 periods)

11.1 Plastering - classification according to use and finishes like plain plaster, grit finish, rough cast, pebble dashed, concrete and stone cladding etc., dubbing, proportion of mortars used for different plasters, techniques of plastering and curing
11.2 Pointing - different types of pointing and their methods
11.3 Painting - preparation of surface, primer coat and application of paints on wooden, steel and plastered wall surfaces
11.4 Application of white washing, colour washing and distempering, polishing, application of cement and plastic paints
11.5 Selection of appropriate paints/finishes for interior and exterior surfaces
11.6 Importance of preparation of surfaces such as hacking, grooving etc before application of surface finishes

12. Anti Termite Measures (As per IS 6313 –I – III) (04 periods)

12.1 Introduction, site preparation and chemicals used in anti-termite treatment
12.2 Treatment of masonry foundation
12.3 Treatment of RCC foundation
12.4 Treatment of top surface of earth filling
12.5 Treatment of junction of walls and floors
12.6 Treatment along external perimeter of building
12.7 Treatment and selection of timber
12.8 Treatment in existing buildings

13. Building Planning (06 periods)

13.1 Site selection: Factors to be considered for selection of site for residential, commercial, industrial and public building
13.2 Basic principles of building planning, arrangement of doors, windows, cupboards etc for residential building
13.3 Orientation of building as per IS: 7662 in relation to sun and wind direction, rains, internal circulation and placement of rooms within the available area, concept of Vastu-Shastra
13.4 Planning of building services
13.5 Introduction to National Building code.

14 Building Services (05 periods)

Introduction to fire fighting systems, Ducting for Air-conditioning, service lines for cable telephone, and electrical wiring , garbage disposal systems.

15. Elementary idea of interior decoration, wall paneling, false ceiling, flooring etc. (02 periods)

Note * An expert may be invited from field/industry for extension lecture
** A field visit may be planned to explain and show the relevant things

PRACTICAL EXERCISES

i) Demonstration of tools and plants used in building construction
ii) To prepare Layout of a building: two rooms building with front verandah
iii) To construct brick bonds (English bond only) in one, one and half and two brick thick: (a) Walls for L, T and cross junction (b) Columns
iv) Demonstration of following items of work at construction site by:
   a) Timbering of excavated trenching
   b) Damp proof courses laying
   c) Construction of masonry walls
   d) Laying of flooring on an already prepared lime concrete base
   e) Plastering and pointing exercise
   f) Constructing RCC work
   g) Pre-construction and post construction termite treatment of building and woodwork

INSTRUCTIONAL STRATEGY

While imparting instructions in this subject, teachers are expected to take students to work site and explain constructional process and special details for various sub-components of a buildings. It is also important to make use of audio visual aids/video films (if available) to show specialised operations. The practical work should be given due importance and efforts should be made that each student should perform practical work independently. For carrying out practical works, polytechnics should have construction yard where enough raw materials is made available for students to perform practical work

RECOMMENDED BOOKS

1. Gupta, Sushil Kumar, Singla, DR, and Juneja BM; "A Text Book of Building Construction"; Ludhiana, Katson Publishing House.
2. Deshpande, RS and Vartak, GV; "A Text Book of Building Construction"; Poona, United Book Corporation.
3. Rangwala, SC: "Building Construction"; Anand, Charotar Book Stall
4. Kulkarni, GJ; "A Text Book of Building Construction"; Ahmedabad Book Depot
5. Arora, SP and Bindra, SP; "A Text Book of Building Construction"; New Delhi Dhanpt Rai and Sons.
6. Sharma,SK and Kaul, BK; "A Text Book of Building Construction"; Delhi, S Chand and Co.

7. Sushil Kumar; "Building Construction"; Standard Publishers Distributors, Delhi
8. Moorthy, NKR; "A Text Book of Building Construction"; Poona, Engineering Book Publishing Co.
9. SP – 62 Hand Book of BIS
10. B.I.S. – 6313 Part 1, 2, 3
11. National Building Code
12. Handbook of Civil Engineering by PN Khanna
13. Video films on Damp proofing, water proofing, surface finishes

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	01	01
2	06	08
3	07	08
4	08	10
5	06	08
6	05	06
7	08	11
8	07	08
9	05	06
10	05	06
11	05	06
12	04	06
13	06	08
14	05	06
15	02	02
Total	**80**	**100**

3.6 BUILDING DRAWING

L	T	P
-	-	4

RATIONALE

Drawing is the language of engineers. Engineering is incomplete without a thorough knowledge of drawing. A Civil Engineering diploma holder must be capable of sketching detailed constructional drawing of various components of building for the purpose of communication with the craftsman. Planning of small buildings, developing a line plan, dimensioning, key plan, drainage plan should be a part of curriculum. The diploma engineer must be conversant with reading and interpretation of drawing for execution of work.

DETAILED CONTENTS

Drawing No. 1: (2 sheets)

Details of spread footing foundations, load bearing and non-load bearing wall for given thickness of walls with the help of given data or rule of the thumb, showing offsets, position of DPC. The details of the concrete and brick plinth protection have to be shown in the drawing.

Drawing No. 2: (one sheet)

Plans of 'T' and Corner junction of walls of 1 Brick, 1-1/2 Brick and 2 brick thick in English bond

Drawing No. 3: (2 sheets)

Detailed drawing of basement, single wooden floor, double wooden floor.

Drawing No.4 (3 sheets)

Elevation, sectional plan and sectional side elevation of flush door, glazed door, panelled door and window, Aluminium door and window with wire gauge shutter. Sketches of various joints of different members.

Drawing No.5 (one sheet)

Draw at least one sheet using CAD software

Drawing No. 6: (2 sheet)
Drawing plan, elevation of a small building by measurement and foundation detail and sectional elevation.

Drawing No.7 (4 sheets)

Drawing detailed plan, elevation and section of a two room residential building from a given line plan, showing details of foundations, roof and parapet

Drawing No. 8 (one sheet)

Drawings of following floors

Cement concrete floors on ground and at first floor

i) Conglomerate (Concrete Flooring)
ii) Bonded cement concrete flooring
iii) Terrazo flooring
iv) Ceramic/vitrified tile flooring

Drawing No. 9: (one sheet)

Drawing of flat roof, showing the heat/thermal insulation provisions.

Drawing No.10

Draw at least one sheet using CAD software

NOTE:

a) All drawings should be as per BIS code and specifications in SI Units
b) Intensive practice of reading and interpreting building drawings should be given
c) Some practice should be done to prepare drawings on AutoCAD

RECOMMENDED BOOKS

1. Civil Engineering Drawing by RS Malik, Asia Publishing House
2. Civil Engineering Drawing by V.B.Sikka. Katson Publishing, Ludhiana
3. Civil Engineering Drawing by NS Kumar; IPH, New Delhi
4. Principles of Building Drawing by MG Shah and CM Kale, MacMillan, Delhi
5. Building Construction by Moorthy NRK
6. Civil Engg Drawing by Layal
7. Zaidi, SKA and Siddiqui, Suhail; Drawing and Design of Residential and Commercial Buildings, Standard Publishers and Distributors, Delhi.
8. SP : 20
9. National Building Code

3.7. ELECTRICAL & MECHANICAL ENGINEERING SYSTEMS

	L	T	P
Periods/week	4	-	2

RATIONALE

A diploma holder has to assist in activities of installation, operation and maintenance etc of different machines and equipment. These activities are not branch specific and instead require him to know basics of civil, electrical and mechanical engineering. The subject of General Engineering has been included to impart basic knowledge of civil, electrical and mechanical engineering to the students.

DETAILED CONTENTS
PART-A

MECHANICAL ENGINEERING

Theory

1. Transmission of Power (8 periods)

1.1 Belt Drives:
Types of belts, belt materials, cross and flat belt drives, advantages of V-belt drive over flat belt drive.

1.2 Gears Drives:
Types of gears (briefly), types of gear trains

2. Internal Combustion Engines (09 periods)

2.1 Classification of IC engines

2.2 Working principles of two stroke and four stroke engines

2.3 Working principles of petrol engine and diesel engines

2.4 Gas turbines (working principle only)

2.5 Using principle of prime motor used in high power single phase and three phase generators used in building

3. Refrigeration and Air Conditioning System (8 periods)

3.1 Different types of refrigeration principles and refrigerants

3.2 Working of domestic refrigerator

3.3 Working of Window type AC system

3.4 Working of Split AC System

3.5 Working of Centralized Air Conditioning System

4. Hydraulics (6 periods)

4.1 Classification of pumps (reciprocating and centrifugal)
4.2 Working principles of both reciprocating and centrifugal pumps
4.3 Turbine: Working principles of impulse turbine and reaction turbine

5. Working principle of lift used in modern building (1 period)

PRACTICAL EXERCISES IN MECHANICAL ENGINEERING

1. Demonstration and study of main parts of 4 stroke petrol and diesel engines by actually dismantling them (The idea is to acquaint the students with the most common troubles occurring in the engines)
2. Demonstration and study of main parts of 2 stroke petrol engine by actually dismantling it. (The idea is to acquaint the students with the most common trouble occurring in the engines)
3. Demonstration and study of gas turbines through models
4. Demonstration and study of different hydraulic pumps
5. Demonstration and study of various drives for transmission of powers i.e. models of belts and gears.
6. Demonstration and study of air conditioning system in a building
7. Demonstration and study of domestic refrigerating system
8. Demonstration and study of Prime motor used in three phase generating set

PART B

ELECTRICAL ENGINEERING

Theory

Electrical:

1. Basic Quantities of Electricity: (4 periods)

1.1 Definition of voltage, current, power and energy with their units
1.2 Name of the instruments used for measurement of different electrical quantities such as voltmeter, ammeter, wattmeter, energy meter.
1.3 Connection of the instruments in electric circuit

2. Application and Advantages of Electricity: (3 periods)

2.1 Difference between AC and DC
2.2 Various applications of electricity
2.6 Advantages of electrical energy over other types of energy

3. Various Types of Power Plants: (3 periods)

3.1 Elementary block diagram of thermal, hydro and nuclear power stations
3.2 Brief explanation of the principle of power generation in above power stations

4. Transmission and Distribution System (6 periods)

4.1 Key diagram of 3 phase transmission and distribution system
4.2 Brief functions of accessories of transmission line
4.3 Distinction between high and low voltage distribution system
4.4 Identification of three phase wires, neutral wires and the earth wire on a low voltage distribution system
4.5 Identification of the voltage between phases and between one phase and neutral
4.6 Distinction between three phase and single phase supply

5. Supply from the Poles to the Distribution Board: (4 periods)

5.1 Arrangement of supply system from pole to the distribution board
5.2 Function of service line, energy meter, main switch, distribution board

6. Domestic Installation: (4 periods)

6.1 Distinction between light and fan circuits and single phase power circuit, sub circuits
6.2 Various accessories and parts of installation, identification of wiring systems, such as batton, conduct, caring and coping
6.3 Common safety measures and earthing
6.4 Introduction to BIS code of safety and wiring installation

7. Electric Motors and Pumps: (6 periods)

7.1 Definition and various application of single phase and three phase motors
7.3 Conversion of horse power in watts or kilowatts
7.4 Type of pumps and their applications
7.5 Use of direct online starter and star delta starter

8. Installation of Generators (2 periods)

8.1 Working of single phase and three phase generators.
8.2 Installation of generators with panel diagram etc.

9. Electrical circuits idea used in buildings (2 periods)

9.1 Basic elementary circuit idea of lift, stage lightening, internal wiring for telephone, internet and PBX.

PRACTICAL EXERCISES IN ELECTRICAL ENGINEERING:

1. Use of Megger:

Objective: To make the students familiar with different uses of different electrical instruments.

2. Connection of a three phase motor and starter including fuses and reversing of direction of rotation.

   Objective: Students may be made familiar with the equipment needed to control a three-phase motor
   The students must experience that by changing any two phases, the direction of rotation is reversed.

3. Connection of a lamp, ceiling fan, socket outlet, geyser, floor grinder, voltage stabilizer etc.

   Objective: Students may be made familiar with the different types of equipment and circuits used in the domestic installations

4. Treatment of electric shock

   Note: The teacher may give a demonstration how an electric shock must be treated.

   Objective: Students must be trained to treat the persons suffering from an electric shock

5. Demonstration and study of Domestic installation components used in single phase and three phase wiring

6. Demonstration and study of distribution line components

1. Demonstration and study of different electrical circuits used in Generator, Lift, Stage lightening etc.

8. Demonstration and study of distribution board

   Note: Students may be asked to study the distribution board in the institution and note down all accessories.

   Objective: Students must be made familiar with the distribution board

9. Connections and taking reading of an energy meter (1ϕ & 3ϕ)

   Objective: Students may be asked to connect an energy meter to a load and calibrate reading

10. Demonstration and study of submersible motor pump set and its working

    Objective: To tell use of the set in water supply and irrigation works.

RECOMMENDED BOOKS

Mechanical Engineering

1. General Mechanical Engineering by M. Adithan; TTTI, Chandigarh
2. Basic Civil and Mechanical Engineering by Jayagopal; Vikas Publications, New Delhi
3. IC Engines and Automobile Engineering by Dr.MP Poonia, Standard Publishers, New Delhi
4. Refrigeration and Air Conditioning by RK Rajput; SK Kataria and sons; Ludhiana
5. Theory of Machines by RS Khurmi and JK Gupta; S. Chand and Company Ltd., New Delhi

Electrical Engineering

1. Electrical Technology Part 1: Basic Electrical Engineering by Theraja, BL; S Chand and Company, New Delhi
2. Principles of Electrical Engineering by Gupta BR, S Chand and Company, New Delhi
3. Basic Electrical Engineering by Mehta VK; S Chand and Company, New Delhi
4. Basic Electricity and Measurements by Suryanarayan NV and N Delhi; Tata McGraw Hill, 1987, New Delhi
5. Basic Electrical and Electronics Engineering by SK Sahdev; Dhanpat Rai and sons, New Delhi
6. Basic Electrical Engineering by PS Dhogal, Tata McGraw Hill, New Delhi
7. Basic Electricity by BR Sharma; Satya Parkashan, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Part-A

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	8	25
2	9	29
3	8	25
4	6	19
5	1	2
Total	**32**	**100**

Part-B

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	4	12
2	3	9
3	3	9
4	6	18
5	4	16
6	4	14
7	4	14
8	2	4
9	2	4
Total	**32**	**100**

4.1 CONCRETE TECHNOLOGY

	L	T	P
Periods/week	**4**	**-**	**2**

RATIONALE

Diploma holders in Civil Engineering are supposed to supervise concreting operations involving proportioning, mixing, transporting, placing, compacting, finishing and curing of concrete. To perform above functions, it is essential to impart knowledge and skills regarding ingredients of concrete and their properties; properties of concrete in plastic and hardened stage, water cement ratio and workability; proportioning for ordinary concrete; concreting operations and joints in concrete.

DETAILED CONTENTS
THEORY

1. Introduction: Definition of concrete, uses of concrete in comparison to other building materials. (03 periods)

2. Ingredients of Concrete: (07 periods)

   2.1 Cement: physical properties of cement; different types of cement as per IS Codes

   2.2 Aggregates:

      2.2.1 Classification of aggregates according to size and shape

      2.2.2 Characteristics of aggregates: Particle size and shape, surface texture, specific gravity of aggregate; bulk density, water absorption, surface moisture, bulking of sand, deleterious materials, soundness

      2.2.3 Grading of aggregates: coarse aggregate, fine aggregate; All-in- aggregate; fineness modulus; interpretation of grading charts

   2.3 Water: Quality requirements as per IS:456-2000

3. Water Cement Ratio: (03 periods)

   3.1 Hydration of cement, principle of water-cement ratio, Duff Abram's Water-cement ratio law: Limitations of water-cement ratio law and its effects on strength of concrete

4. Workability: (08 periods)

   4.1 Workability factors affecting workability, Measurement of workability: slump test, compacting factor and Vee Bee consistometer; Recommended slumps for placement in various conditions as per IS:456-2000/SP-23

5. Properties of Concrete: (09 periods)

5.1 Properties in plastic state: Workability, Segregation, Bleeding and Harshness

5.2 Properties in hardened state: Strength, Durability, Impermeability, Dimensional changes;

6. Proportioning for Normal Concrete: (05 periods)

6.1 Objectives of mix design, introduction to various grades as per IS:456-2000; proportioning for nominal mix design as prescribed by IS 456-2000

6.2 Adjustment on site for: Bulking of fine aggregate, water absorption of aggregate, workability

6.3 Difference between nominal and controlled concrete

6.4. Introduction to IS-10262-2009-Code for controlled mix design

7. Introduction to Admixtures (chemicals and minerals) for improving performance of concrete (04 periods)

8. Special Concretes (only features) (07 periods)

8.1 Concreting under special conditions, difficulties and precautions before, during and after concreting
- 8.1.1 Cold weather concreting
- 8.1.2 Under water concreting
- 8.1.3 Hot weather concreting

8.2 Ready mix concrete

8.3 Fibre reinforced concrete

8.4 Polymer Concrete

8.5 Fly ash concrete

8.6 Silica fume concrete

9. Concreting Operations: (16 periods)

**9.1 Storing of Cement:

- 9.1.1 Storing of cement in a warehouse
- 9.1.2 Storing of cement at site
- 9.1.3 Effect of storage on strength of cement
- 9.1.4 Determination of warehouse capacity for storage of Cement

**9.2 Storing of Aggregate: Storing of aggregate at site

9.3 Batching (to be shown during site visit)

9.3.1 Batching of Cement
9.3.2 Batching of aggregate by:
9.3.2.1 Volume, using gauge box (farma) selection of proper gauge box
9.3.2.2 Weight spring balances and batching machines
9.3.3 Measurement of water

** 9.4 Mixing:

9.4.1 Hand mixing
9.4.2 Machine mixing - types of mixers, capacities of mixers, choosing appropriate size of mixers, operation of mixers
9.4.3 Maintenance and care of machines

**9.5 Transportation of concrete: Transportation of concrete using: wheel barrows, transit mixers, chutes, belt conveyors, pumps, tower crane and hoists etc.

9.6 Placement of concrete:

Checking of form work, shuttering and precautions to be taken during placement

** 9.7 Compaction:

9.7.1 Hand compaction

9.7.2 Machine compaction - types of vibrators, internal screed vibrators and form vibrators

9.7.3 Selection of suitable vibrators for different situations

9.8 Finishing concrete slabs - screeding, floating and trowelling

9.9 Curing:

9.9.1 Objectives of curing, methods of curing like ponding, membrane curing, steam curing, chemical curing

9.9.2 Duration for curing and removal of form work

9.10 Jointing: Location of construction joints, treatment of construction joints, expansion joints in buildings - their importance and location

9.11 Defects in concrete: Identification of and methods of repair

10. Importance and methods of non-destructive tests (introduction only) (02 periods)

NOTE: ** A field visit may be planned to explain and show the relevant things

PRACTICAL EXERCISES:

i) To determine the physical properties of cement as per IS Codes
ii) To determine flakiness and elongation index of coarse aggregates
iii) To determine silt in fine aggregate
iv) Determination of specific gravity and water absorption of aggregates
v) Determination of bulk density and voids of aggregates
vi) To determine surface moisture in fine aggregate by displacement method
vii) Determination of particle size distribution of fine, coarse and all in aggregate by sieve analysis (grading of aggregate)
viii) To determine necessary adjustment for bulking of fine aggregate
ix) To determine workability by slump test:
x) To verify the effect of water, fine aggregate/coarse aggregate ratio and aggregate/Cement ratio on slump
xi) Compaction factor test for workability
xii) Non destructive test on concrete by:
    a) Rebound Hammer Test
    b) Ultrasonic Pulse Velocity Test
xiii) Tests for compressive strength of concrete cubes for different grades of concrete

INSTRUCTIONAL STRATEGY

This subject is of practical nature. While imparting instructions, teachers are expected to organize demonstrations and field visits to show various stages of concreting operations. While working in the laboratory, efforts should be made to provide extensive practical training to students so as to make them confident in the preparation and testing of concrete. Teachers should also organize viva examination so as to develop understanding about concepts and principles involved. The experiments may be demonstrated to students through video programmes developed in the field of 'concrete technology' by NITTTR, Chandigarh.

RECOMMENDED BOOKS

i) Kulkarni, PD; Ghosh, RK and Phull, YR; "Text Book of Concrete Technology"; Oxford and IBH Publishing Co. New Delhi
ii) Krishnamurthy, KT; Rao, A Kasundra and Khandekar, AA; "Concrete Technology"; Dhanpat Rai and Sons, Delhi,

iii) Gupta BL and Gupta Amit; "Text Book of Concrete Technology"; Standard Publishers Distributors, Delhi.
iv) Varshney, RS;"Concrete Technology";, Oxford and IBH Publishing, New Delhi
v) Neville, AM; "Properties of Concrete", Pitman (ELBS Edition available), London
vi) Orchard; "Concrete Technology"; Vol I, II, and III
vii) Handoo, BL; Puri, LD and Mahajan Sanjay "Concrete Technology"; Satya Prakashan, New Delhi,
viii) Sood, Hemant, Mittal LN and Kulkarni PD; "Laboratory Manual on Concrete Technology", CBS Publishers, New Delhi, 2002
ix) Vazirani, VN; and Chandola, SP; "Concrete Technology"; Khanna Publishers, Delhi,
x) Gambhir, ML; "Concrete Technology";, MacMillan India Ltd., New Delhi
xi) Siddique, R., "Special Structural Concretes", , Galgotia Publishers Pvt. Ltd. Delhi
xii) Birinder Singh, "Concrete Technology", Kaption Publications, Ludhiana,
(xiii) Module on 'Special Concretes by Dr Hemant Sood , NITTTR Chandigarh
(xiv) Concrete Technology by P Dayaratman
(xv) Video programme on different experiments in 'Concrete Technology' developed by NITTTR, Chandigarh.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	03	04
2	07	12
3	03	04
4	08	08
5	09	18
6	05	08
7	04	07
8	07	12
9	16	25
10	02	02
Total	**64**	**100**

4.2 SOIL AND FOUNDATION ENGINEERING

	L	T	P
Periods/week	**4**	**-**	**2**

RATIONALE

Civil Engineering diploma engineers are required to supervise the construction of structural buildings, roads, pavements, dams, embankments, and other Civil Engineering structures. As such the knowledge of basic soil engineering is the pre-requisite for these engineers for effective discharge of their duties. This necessitates the introduction of Soil and Foundation Engineering subject in the curriculum for Diploma Course in Civil Engineering.

The subject covers only such topics which will enable the diploma engineers to identify and classify the different types of soils, their selection and proper use in the field for various types of engineering structures.

The emphasis will be more on teaching practical aspect rather than theory.

DETAILED CONTENTS

THEORY

1. Introduction: (03 periods)

   1.1 Importance of soil studies in Civil Engineering

   1.2 Geological origin of soils with special reference to soil profiles in India: residual and transported soil, alluvial deposits, lake deposits, local soil found in J&K, dunes and loess, glacial deposits, black cotton soils, conditions in which above deposits are formed and their engineering characteristics.

   1.3 Names of organizations dealing with soil engineering work in India, soil map of India

2. Physical Properties of Soils: (04 periods)

   2.1 Constituents of soil and representation by a phase diagram

   2.2 Definitions of void ratio, porosity, water content, degree of saturation, specific gravity, unit weight, bulk density/bulk unit weight, dry unit weight, saturated unit weight and submerged unit weight of soil grains and correlation between them

   2.3 Simple numerical problems with the help of phase diagrams

3. Classification and Identification of Soils (04 periods)

   3.1. Particle size, shape and their effect on engineering properties of soil, particle size classification of soils

3.2 Gradation and its influence on engineering properties

3.3 Relative density and its use in describing cohesionless soils

3.4 Behaviour of cohesive soils with change in water content, Atterberg's limit - definitions, use and practical significance

3.5 Field identification tests for soils

3.6 Soil classification system as per BIS 1498; basis, symbols, major divisions and sub divisions, groups, plasticity chart; procedure for classification of a given soil

4. Flow of Water Through Soils: (04 periods)

4.1 Concept of permeability and its importance

4.2 Darcy's law, coefficient of permeability, seepage velocity and factors affecting permeability

4.3 Comparison of permeability of different soils as per BIS

4.4 Measurement of permeability in the laboratory

5. Effective Stress: (Concept only) (04 periods)

5.1 Stresses in subsoil

5.2 Definition and meaning of total stress, effective stress and neutral stress

5.3 Principle of effective stress

5.4 Importance of effective stress in engineering problems

6. Deformation of Soils (04 periods)

6.1 Meaning, conditions/situations of occurrence with emphasis on practical significance of:

a) Consolidation and settlement
b) Creep
c) Plastic flow
d) Heaving
e) Lateral movement
f) Freeze and thaw of soil

6.2 Definition and practical significance of compression index, coefficient of consolidation, degree of consolidation.

6.3 Meaning of total settlement, uniform settlement and differential settlement; rate of settlement and their effects

6.4 Settlement due to construction operations and lowering of water table

6.5 Tolerable settlement for different structures as per BIS

7. Shear Strength Characteristics of Soils: (09 periods)

7.1. Concept and Significance of shear strength

7.2 Factors contributing to shear strength of cohesive and cohesion less soils, Coulomb's law

7.3 Examples of shear failure in soils

8. Compaction: (04 periods)

8.1 Definition and necessity of compaction

8.2 Laboratory compaction test (standard and modified proctor test as per BIS) definition and importance of optimum water content, maximum dry density; moisture dry density relationship for typical soils with different compactive efforts

8.3. Compaction control; Density control, measurement of field density by core cutter method and sand replacement method, moisture control, Proctor's needle and its use, thickness control, jobs of an embankment supervisor in relation to compaction

9. Soil Exploration: (08 periods)

9.1 Purpose and necessity of soil exploration

9.2 Reconnaissance, methods of soil exploration, Trial pits, borings (auger, wash, rotary, percussion to be briefly dealt)

9.3 Sampling; undisturbed, disturbed and representative samples; selection of type of sample; thin wall and piston samples; area ratio, recovery ratio of samples and their significance, number and quantity of samples, resetting, sealing and preservation of samples.

9.4 Presentation of soil investigation results

10 Bearing Capacity of soil

(10 periods)

10.1 Concept of bearing capacity

10.2 Definition and significance of ultimate bearing capacity, net safe bearing capacity and allowable bearing pressure

10.3 Guidelines of BIS (IS 6403) for estimation of bearing capacity of soil

10.4 Factors affecting bearing capacity

10.5 Concept of vertical stress distribution in soils due to foundation loads, pressure bulb

10.6 Applications of SPT, unconfined compression test and direct shear test in estimation of bearing capacity

10.7 Plate load test (no procedure details) and its limitations

10.8 Improvement of bearing capacity by sand drain method, compaction, use of geo-synthetics.

11. Foundation Engineering: (10 periods)

Concept of shallow and deep foundation; types of shallow foundations: isolated, combined, strip, mat, and their suitability. Factors affecting the depth of shallow foundations, deep foundations, type of piles and their suitability; pile classification on the basis of material, pile group and pile cap.

PRACTICAL EXERCISES

1. To determine the moisture content of a given sample of soil

2. Auger Boring and Standard Penetration Test

a) Identifying the equipment and accessories
b) Conducting boring and SPT at a given location
c) Collecting soil samples and their identification
d) Preparation of boring log and SPT graphs
e) Interpretation of test results

3. Extraction of Disturbed and Undisturbed Samples

a) Extracting a block sample
b) Extracting a tube sample
c) Extracting a disturbed samples for mechanical analysis.
d) Field identification of samples

4. Field Density Measurement (Sand Replacement and Core Cutter Method)

   a) Calibration of sand
   b) Conducting field density test at a given location
   c) Determination of water content
   d) Computation and interpretation of results

5. Liquid Limit and Plastic Limit Determination:

   a) Identifying various grooving tools
   b) Preparation of sample
   c) Conducting the test
   d) Observing soil behaviour during tests
   e) Computation, plotting and interpretation of results

6. Mechanical Analysis

   a) Preparation of sample
   b) Conducting sieve analysis
   c) Computation of results
   d) Plotting the grain size distribution curve
   e) Interpretation of the curve

7. Laboratory Compaction Tests (Standard Proctor Test)

   a) Preparation of sample
   b) Conducting the test
   c) Observing soil behaviour during test
   d) Computation of results and plotting
   e) Determination of optimum moisture content and maximum dry density

8. Demonstration of Unconfined Compression Test

   a) Specimen preparation
   b) Conducting the test
   c) Plotting the graph
   d) Interpretation of results and finding/bearing capacity

9. Demonstration of:
   a) Direct Shear and Vane Shear Test on sandy soil samples
   b) Permeability test apparatus

INSTRUCTIONAL STRATEGY

The teacher while imparting instructions are expected to lay greater emphasis on the practical aspects rather than theory and mathematical treatment. To bring clarity regarding concepts and principles involved, teachers should organize demonstrations in the laboratories and fields. It is necessary to create understanding that soils fail either under shear or settlement due to heavy loads. This can be shown by making use of photographs on working models of such failures. Efforts should be made in the practical classes that students perform practical exercises individually. Conduct of viva examination at the end of each practical work will develop clear understanding about the concepts and principles related to this subject.

RECOMMENDED BOOKS

i) Punmia, BC, "Soil Mechanics and Foundations"; Standard Publishers, Delhi

ii) Bharat Singh and Shamsher Prakash; "Soil Mechanics and Foundations Engineering", Nem Chand and Bros, Roorkee,

iii) Sehgal, SB, "A Text Book of Soil Mechanics"; CBS Publishers and Distributors, Delhi,

iv) Gulati, SK and Manoj Dutta, "Geotechnical Engineering ", Tata McGraw Hill, Delhi,

v) Ranjan Gopal and Rao ASR "Basic and Applied Soil Mechanics", New Age Publication (P) Ltd., New Delhi

vi) Singh Harbhajan "Soil and Foundation Engineering", Abhishek Publishers, Chandigarh

vii) S Mittal and JP Shukla, "Soil Testing for Engineers", Khanna Publishers Ltd., Delhi

viii) BIS Codes IS 6403 (latest edition) and IS 1498 (latest edition)

ix) Jagroop Singh, "Soil and Foundation Engineering", Eagle Parkashan, Jalandhar

x) Rabinder Singh, " Soil and Foundation Engg." SK Kataria and Sons, Ludhiana

xi) NITTTR, Chandigarh, "Shallow Foundations"

xii) Video films on Geo-technical Laboratory Practices by NITTTR, Chandigarh

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	03	05
2	04	06
3	04	06
4	04	06
5	04	06
6	04	06
7	09	14
8	04	06
9	08	16
10	10	12
11	10	17
Total	**64**	**100**

4.3 WATER SUPPLY AND WASTE WATER ENGINEERING

	L	T	P
Periods/week	**5**	**-**	**2**

RATIONALE

One of the basic necessities of life is water which is not easily available to a lot of people. Providing potable water at the first place then collection and disposal of waste solids and liquids are important activities of civil engineering field. This subject provides basic knowledge and skills in the field of water supply system and waste disposal system. Classroom instructions should be supplemented by field visits to show functional details of water supply and waste disposal systems. It will also be advantageous to invite professionals from field to deliver extension lectures on specialised operations.

DETAILED CONTENTS

A. WATER SUPPLY

1. Introduction (02 periods)
   - 1.1 Necessity and brief description of water supply system.

2. Quantity of Water (06 periods)
   - 2.1 Water requirement
   - 2.2 Rate of demand and variation in rate of demand
   - 2.3 Per capita consumption for domestic, industrial, public and fire fighting uses as per BIS standards (no numerical problems)
   - 2.4 Population Forecasting

3. Quality of Water (04 periods)
   - 3.1 Meaning of pure water and methods of analysis of water
   - 3.2 Physical, Chemical and bacteriological tests and their significance
   - 3.3 Standard of potable water as per Indian Standard
   - 3.4 Maintenance of purity of water (small scale and large scale quantity)

4. Water Treatment (brief introduction) (09 periods)
   - **4.1 Sedimentation - purpose, types of sedimentation tanks
   - **4.2 Coagulation floculation - usual coagulation and their feeding
   - **4.3 Filtration - significance, types of filters, their suitability
   - 4.4 Necessity of disinfection of water, forms of chlorination, break point chlorine, residual chlorine, application of chlorine.
   - 4.5 Flow diagram of different treatment units, functions of (i) Areation fountain (ii) mixer (iii) floculator, (iv) classifier, (v) slow and rapid sand filters (vi) chlorination chamber.

5. Conveyance of Water (09 periods)

**5.1 Different types of pipes - cast iron, PVC, steel, asbestos cement, concrete and lead pipes. Their suitability and uses, types of joints in different types of pipes.

5.2 Appurtenances: Sluice, air, reflux valves, relief valves, scour valves, bib cocks, stop cocks, fire hydrants, water meters their working and uses

5.3 Distribution site: Requirement of distribution, minimum head and rate, methods of layout of distribution pipes

5.3.1 Systems of water supply - Intermittent and continuous service reservoirs - types, necessity and accessories.

5.3.2 Wastage of water - preventive measures

5.3.3 Maintenance of distribution system

5.3.4 Leakage detection

6. Laying out Pipes (06 periods)

6.1 Setting out alignment of pipes

6.2 Excavation for laying of pipes and precautions to be taken in laying pipes in black cotton soil.

6.3 Handling, lowering beginning and jointing of pipes

6.4 Testing of pipe lines

6.5 Back filling

6.6 Use of boring rods

7. Building Water Supply (02 periods)

7.1 Connections to water main (practical aspect only)

**7.2 Water supply fixtures and installations and terminology related to plumbing

B. WASTE WATER ENGINEERING

8. Introduction (04 periods)

8.1 Purpose of sanitation

8.2 Necessity of systematic collection and disposal of waste

8.3 Definition of terms in sanitary engineering

8.4 Collection and conveyance of sewage

8.5 Conservancy and water carriage systems, their advantages and Disadvantages

8.6 (a) Surface drains (only sketches) : various types, suitability

(b) Types of sewage: Domestic, industrial, storm water and its seasonal variation

9. Sewerage System (05 periods)

9.1 Types of sewerage systems, materials for sewers, their sizes and joints

9.2 Appurtenance: Location, function and construction features. Manholes, drop manholes, tank hole, catch basin, inverted siphon, flushing tanks grease and oil traps, storm regulators, ventilating shafts

10. Laying and Construction of Sewers: (6 periods)
    - 10.1 Setting out/alignment of sewers
    - 10.2 Excavations, checking the gradient with boning rods preparation of bedding, handling and jointing testing and back filling of sewers/pipes.
    - 10.3 Construction of surface mains and different sections required

11 Sewage characteristics: (4 periods)
    - 11.1 Properties of sewage and IS standards for analysis of sewage
    - 11.2 Physical, chemical and bacteriological parameters

12. Natural Methods of Sewerage Disposal (5 periods)
    - 12.1 General composition of sewage and disposal methods
    - 12.2 Disposal by dilution
    - 12.3 Self purification of stream
    - 12.4 Disposal by land treatment
    - 12.5 Nuisance due to disposal

13. Sewage Treatment (9 periods)
    - 13.1 Meaning and principle of primary and secondary treatment and activated sludge process their flow diagrams
    - 13.2 Introduction and uses of screens, grit chambers, detritus tanks, skimming tanks, plain sedimentation tanks, primary clarifers, secondary clarifers, filters, control beds, intermittent sand filters, trickling filters, sludge treatment and disposal, oxidation ponds (Visit to a sewage treatment plant)

14. Building Drainage (9 periods)
    - 14.1 Aims of building drainage and its requirements
    - **14.2 Different sanitary fittings and installations
    - 14.3 Traps, seals, causes of breaking seals

** A field visit may be planned to explain and show the relevant things.

LIST OF PRACTICALS

1) To determine turbidity of water sample
2) To determine dissolved oxygen of given sample
3) To determine pH value of water
4) To perform jar test for coagulation
5) To determine BOD of given sample
6) To determine residual chlorine in water
7) To determine conductivity of water and total dissolved solids
8) To study the installation of following:
    a) Water meter
    b) Connection of water supply of building with main
    c) Pipe valves and bends
    d) Water supply and sanitary fittings
9) To determine Bacteriological Quality of Drinking Water

10) To study and demonstrate the joining/threading of GI Pipes, CI Pipes, SW pipes, D.I. pipes and PVC pipes.
11) To demonstrate the laying of SW pipes for sewers
12) Study of water purifying process by visiting a field lab.
13) To test house drainage
14) To determine TDS by TDS meter.

INSTRUCTIONAL STRATEGY:

Before imparting the instructions in the class room, visits to water works and sewage treatment plants can go a long way for increased motivation of students for learning in the class room. As the subject is of practical nature, lecture work be supplemented by field visits from time to time. Home assignments related to collection of information, pamphlets and catalogues from hardware shop dealing water supply and sanitary fittings will be very helpful for the students.

RECOMMENDED BOOKS

1. Duggal, KN; "Elements of Public Health Engineering";, S. Chand and Co. New Delhi
2. Rangwala, SC; "Water Supply and Sanitary Engineering"; Anand Charotar Book Stall
3. Kshirsagar, SR; "Water Supply Engineering"; Roorkee Publishing House, Roorkee
4. Kshirsagar, SR; "Sewage and Sewage Tratement"; Roorkee, Roorkee Publishing House
5. Hussain, SK; "Text Book of Water Supply and Sanitary Engineering"; Oxford and IBH Publishing Co, New Delhi,
6. Birdie, GS; "Water Supply and Sanitary Engineering"; Dhanpat Rai and Sons, Delhi
7. Garg, Santosh Kumar; "Water Supply Engineering"; Khanna Publishers, Delhi
8. Garg, Santosh Kumar; "Sewage and Waste Water Disposal Engineering"; Khanna Publishers, Delhi
9. Steel, EW; "Water Supply and Sewerage"; McGraw Hill.
10 Duggal, Ajay K and Sharma, Sanjay, "A Laboratory Manual in Public Health Engineering", , Galgotra Publications, 2006, New Delhi
11 Gurjar,B.R. " Sludge Treatment & Disposal" Oxford and IBH Co Pvt Ltd New Delhi.
12. Mahajan Sanjay, Water Supply and Waste Water Engineering, Satya Prakashan Ltd., Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	02	03
2	06	07
3	04	05
4	09	12
5	09	11
6	06	07
7	02	03
8	04	05
9	05	06
10	06	07
11	04	05
12	05	06
13	09	12
14	09	11
Total	**80**	**100**

4.4 IRRIGATION ENGINEERING

	L	T	P
Periods/week	**4**	**-**	**-**

RATIONALE

Diploma holders in civil engineering have to supervise the construction, repair and maintenance of canals, head works, river training works, cross drainage works, regulatory and other works . Some of diploma holders are also engaged for preventing water logging and irrigation by tubewells. This subject imparts knowledge regarding hydrology, flow irrigation – storage and distribution system, constructional features of head works, river training works, cross drainage works, causes and prevention of water logging and construction of tube wells.

DETAILED CONTENTS

1. Introduction: (02 periods)

   1.1 Definition of irrigation

   1.2 Necessity of irrigation

   1.3 History of development of irrigation in India

   1.4 Major, medium and minor irrigation projects

2. Water Requirement of Crops (06 periods)

   2.1 Principal crops in India and their water requirements

   2.2 Crop seasons – Kharif and Rabi

   2.3 Soil water, soil crop and water relationships, duty, delta and base period, their relationship and evapotranspiration

   2.4 Gross commanded area (GCA), culturable commanded area (CCA), intensity of irrigation, irrigable area

3. Hydrological Cycle, Catchment Area and Run-off (06 periods)

   Rainfall , definition rain-gauges – automatic and non-automatic, methods of estimating average rainfall (Arithmatic system); catchment area runoff, factors affecting runoff, hydrograph, basic concept of unit hydrograph.

4. Methods of Irrigation (07 periods)

   4.1 Flow irrigation - its advantages and limitations

   4.2 Lift Irrigation – Tube well and open well irrigation, their advantages and disadvantages

4.3 Sprinkler irrigation conditions favourable and essential requirements for sprinkler irrigation, sprinkler system – classification and component parts

4.4 Drip irrigation, suitability of drip irrigation, layout, component parts, advantages

5. Canals (08 periods)

5.1 Classification, apurtenancs of a canal and their functions, sketches of different canal cross-sections (unlined)

5.2 Various types of canal lining - their related advantages and disadvantages, sketches of different lined canal x-sections

5.3 Breaches and their control

5.4 Maintenance of lined and unlined canals

6. Tube Well Irrigation (09 periods)

6.1 Introduction, occurrence of ground water, location and command, advantages and disadvantages, comparison with canal irrigation

6.2 Tube wells, explanation of terms: water table, radius of influence, depression head, cone of depression, confined and unconfined aquifers. Yield of a well and methods of determining yield of well

6.3 Types of tube wells, cavity, strainer and slotted type;

6.4 Method of boring, installation of well assembly, development of well, pump selection and installation and maintenance

6.5 Water Harvesting Techniques: Need and requirement of various methods, Run-off from roof top and ground surface, techniques for ground water recharge construction of recharge pits and recharge wells and their maintenance.

7. Dams (07 periods)

7.1 Classification of dams; earthen dams - types, causes of failure; cross-section of zoned earthen dams, method of construction, gravity dams – types, cross-sections of a dam, method of construction

7.2 Concept of small and micro dams

7.3 Concept of spillways and energy dissipators

8. Canal Head Works and Regulatory Works (06 periods)

Definition, object, general layout, functions of different parts of head works. Difference between weir and barrage

9. Cross Drainage Works (04 periods)

9.1 Functions and necessity of the following types: aqueduct, super passage, level crossing, inlet and outlet, pipe crossing

9.2 Sketches of the above cross drainage works

10. Definitions of following Hydraulic Structures with Sketches (02 periods)

10.1 Falls

10.2 Cross and head regulators

10.3 Outlets

10.4 Canal Escapes

11. River Training Works (04 periods)

Methods of river training, guide banks, retired (levees) embankments, groynes and spurs, pitched island, cut-off

12. Water Logging and Drainage (03 periods)

12.1 Definition of water logging – its causes and effects, detection, prevention and remedies

12.2 Reclamation of soil

12.3 Surface and sub-surface drains and their layout

INSTRUCTIONAL STRATEGY

The teaching of the subject should be supplemented by field visits at regular intervals of time to expose the students to irrigation works. Students should be asked to prepare and interpret drawings of various irrigation works.

RECOMMENDED BOOKS

1. Bharat Singh, `Fundamentals of Irrigation Engineering', , Nem Chand and Bros, Roorkee

2. Garg, Santosh Kumar, `Irrigation Engineering and Hydraulics Structures', Khanna Publishers, Delhi,

3. Punmia, BC; and Pande Brij Bansi Lal, `Irrigation and Water Power Engineering', Delhi, Standard Publishers Distributors, Delhi,

4. Sharma, RK; `Text Book of Irrigation Engineering and Hydraulics Structures', , Oxford and IBH Publishing Company, New Delhi

5. Sharma, SK; `Principles and Practice of Irrigation Engineering', Prentice Hall of India Pvt. Ltd., New Delhi,

6. Varshney RS, Gupta SC, Gupta RL at all. "Theory and Design of Irrigation Structures", Vol. I and II,

7. Saharsabudhe SR, "Irrigation Engineering and Hydraulic Structures"

8. Priyani BB, 'The Fundamental Principles of Irrigtion and Water Power

9. BIS Codes

10. Wan. E. Houk, "Irrigation Engineering" Vol. I and II

11. Central Ground Water Board and Central Water Commission Guidelines and Reference Books.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	02	03
2	06	08
3	06	08
4	07	13
5	08	12
6	09	15
7	07	12
8	06	09
9	04	06
10	02	03
11	04	06
12	03	05
Total	**64**	**100**

4.5 SURVEYING – II

	L	T	P
Periods/week	3	-	6

RATIONALE

The important functions of a civil engineer includes the jobs of detailed surveying, plotting of survey data, preparation of survey maps and setting out works

While framing the curriculum for the subject of surveying, stress has been given to the development of knowledge and skill in theodolite surveying; tachometry surveying, curves and use of minor and modern instruments have been included in this subject.

Field work should be a selected one so that student can check his work and have an idea of the results the extent of error in the work done by him. As far as possible, the surveys done should be got plotted, as this will also reveal errors in the work and develop skill in plotting.

DETAILED CONTENTS

1. Contouring: (08 periods)

   Concept of contours, purpose of contouring, contour interval and horizontal equivalent, factors effecting contour interval, characteristics of contours, methods of contouring: Direct and indirect, use of stadia measurements in contour survey, interpolation of contours; use of contour map, Drawing cross section from a contour map; marking alignment of a road, railway and a canal on a contour map, computation of earth work and reservoir capacity from a contour map

2. Theodolite Surveying: (12 periods)

   Working of a transit vernier theodolite, axes of a theodolite and their relation; temporary adjustments of a transit theodolite; concept of transiting, swinging, face left, face right and changing face; measurement of horizontal and vertical angles. Prolonging a line (forward and backward) measurement of bearing of a line; traversing by included angles and deflection angle method; traversing by stadia measurement, theodolite triangulation, plotting a traverse; concept of coordinate and solution of omitted measurements (one side affected), errors in theodolite survey and precautions taken to minimize them; limits of precision in theodolite traversing. Height of objects – accessible and non-accessible bases

3. Tacho-metric surveying (06 periods)

   Tachometry, Instruments to be used in tachometry, methods of tachometry, stadia system of tachometry, general principles of stadia tachometry, examples of stadia tachometry and Numerical problems.

4. Curves: (15 periods)

4.1 Simple Circular Curve:
Need and definition of a simple circular curve; Elements of simple circular curve - Degree of the curve, radius of the curve, tangent length, point of intersection (Apex point), tangent point, length of curve, long chord deflection angle, Apex distance and Mid-ordinate. Setting out of simple circular curve:

a) By linear measurements only:
   - Offsets from the tangent
   - Successive bisection of arcs
   - Offsets from the chord produced

b) By tangential angles using a theodolite

4.2 Transition Curve:

Need (centrifugal force and super elevation) and definition of transition curve; requirements of transition curve; length of transition curve for roads; by cubic parabola; calculation of offsets for a transition curve; setting out of a transition curve by tangential offsets only

4.3 Vertical curve

Setting out of a vertical curve

5. Introduction to the use of Modern Surveying equipment and techniques such as: (03 periods)

a) EDM or Distomat
b) Total station
c) Introduction to remote sensing and GPS

6 Minor Instruments:- (04 periods)

6.1. Introduction and use of minor instruments like Ceylon Ghat Tracer, Clinometer, Pantograph, Abney Level etc.

6.2. Use of planimeter for computing areas

NOTE: No sketch of the instruments may be asked in the examination

PRACTICAL EXERCISES

I. Contouring:

i) Preparing a contour plan by radial line method by the use of a Tangent Clinometer/Tachometer

ii) Preparing a contour plan by method of squares

iii) Preparing a contour plan of a Road/Railway track/Canal by taking cross sections.

II. Theodolite:

i) Taking out the Theodolite, mounting on the tripod and placing it back in the box

ii) Study of a transit vernier theodolite; temporary adjustments of theodolite

iii) Reading the vernier and working out the least count, measurement of horizontal angles by repetition and reiteration methods

iv) Measurement of vertical angles and use of tachometric tables

v) Measurement of magnetic bearing of a line

vi) Running a closed traverse with a theodolite (at least five sides) and its plotting

vii) Height of objects with and without accessible bases

III. Curves

i) Setting out of a simple circular curve with given data by the following methods
   a) Offsets from the chords produced
   b) One theodolite method

IV Minor instruments:

i) Demonstration and use of minor instruments like Ceylon Ghat Tracer, Tangent Clinometer, Pantograph, Abney level etc.
ii) Use of planimeter for computing areas

V Demonstration of digital instruments through field visits to Survey of India and other government agencies.

VI Total Station (only demonstrations).

INSTRUCTIONAL STRATEGY

This is highly practice-oriented course. While imparting theoretical instructions, teachers are expected to demonstrate the use of various instruments in surveying, stress should be laid on correct use of various instruments so as to avoid/minimize errors during surveying. It is further recommended that more emphasis should be laid in conducting practical work by individual students

RECOMMENDED BOOKS

1. Hussain, SK and Nagraj, MS "Text Book of Surveying";, S Chand and Co Ltd., New Delhi
2. Deshpande, RS "A Text Book Surveying and Levelling"; United Book Corporation, Pune,
3. Kocher, CL; "A Text Book of Surveying"; Katson Publishing House Ludhiana,
4. Kanetkar,TP and Kulkarni, SV., "Surveying and Leveling", Poona, AVG Parkashan, Pune
5. Kanetkar, TP; and Kulkarni, SV; "Surveying and Leveling-Vol.2" AVG Prakashan, Pune
6. Punima, BC; "Surveying and Leveling ", Standard Publishers Distributors, Delhi
7. Shahai, PB; "A Text Book of Surveying ", Oxford and IBH Publishing Co.
8. Lilly Sant "Remote Sensing and Image Interpretation"
9. Mahajan, Sanjay, "Surveying-II", Satya Prakashan, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	16
2	12	28
3	06	12
4	15	34
5	03	05
6	04	05
Total	**32**	**100**

4.6 STRUCTURAL MECHANICS

	L	T	P
Periods/week	5	-	2

RATIONALE

This is a basic engineering subject. The purpose of the subject is to impart basic knowledge and skill regarding properties of materials, concept of stresses and strains, bending moment and shear force diagrams, second moment of area, bending and shear stresses, slope and deflection and analysis of trusses. The above knowledge will be useful for designing simple structural components. This subject is very important to develop basic concepts and principles related to strength of materials. This subject will also enable the students to continue their further education.

DETAILED CONTENTS

THEORY:

1. Properties of Materials (02 periods)

    1.1 Classification of materials, elastic materials, plastic materials, ductile materials, brittle materials.

    1.2 Introduction to tensile test, compressive test, impact test, fatigue test, torsion test on metals.

2. Simple Stresses and Strains: (14 periods)

    2.1 Concept of stress, normal and shear stresses,

    2.2 Concept of strain and deformation, longitudinal and transverse strain, poisson's ratio, volumetric strain

    2.3 Hooke's law, modulii of elasticity and rigidity, Bulk modulus of elasticity, relationship between the elastic constants.

    2.4 Stresses and strains in bars subjected to tension and compression. Extension of uniform bar under its own weight, stress produced in compound bars (two or three) due to axial load.

    2.5 Stress-strain diagram for mild steel and HYSD steel, mechanical properties, factor of safety.

    2.6 Temperature stresses and strains

3. Shear Force and Bending Moment: (18 periods)

3.1 Concept of a beam and supports (Hinges, Roller and Fixed), types of beams: simply supported, cantilever, propped, over hang, cantilever and continuous beams (only concept).

3.2 Types of loads (dead load, live load, snow load, wind load seismic load as per IS Codes etc) and types of loading (point, uniformly distributed and uniformly varying loads)

3.3 Concept of bending moment and shear force, sign conventions

3.4 Bending Moment and shear force diagrams for cantilever, simply supported and overhanging beams subjected to concentrated, uniformly distributed

3.5 Relationship between load, shear force and bending moment, point of maximum bending moment, and point of contraflexure.

4. Bending Stresses in Beams: (08 periods)

4.1 Concept of pure/simple bending

4.2 Assumptions made in the theory of simple bending, derivation and application of bending equation to circular cross-section, I section, T&L sections only

4.3. Moment of resistance

4.4 Calculations of bending stresses in simply supported beam

5. Combined Direct and Bending Stresses: (10 periods)

5.1. Concentric and eccentric loads single axis eccentricity only
5.2. Effect of eccentric load on the section stresses due to eccentric loads, Numerical in the case of short columns.
5.3. Simple problems on stability of masonry dams and retaining walls

6. Shear Stresses in Beams (06 periods)

6.1 Concept of shear stresses in beams, shear stress distribution in rectangular, circular I, T, L sections (Formula to be stated, no derivation)

7. Slope and Deflection: (08 periods)

Necessity for determination of slope and deflection
Moment area theorem (no derivation, numerical problems)

8. Columns: (06 periods)

8.1 Theory of columns
8.2 Euler's and Rankine Formula (No derivation)

9. Analysis of Trusses: (08 periods)

9.1 Concept of a perfect, redundant and deficient frames
9.2 Assumptions and analysis of trusses by:

a) Method of joints
b) Method of sections
c) Graphical method

PRACTICAL EXERCISES

i) Determination of yield stress, ultimate stress, percentage elongation and plot the stress strain diagram and compute the value of young's modulus on mild steel

ii) Testing of HYSD Steel

iii) Determination of Young's modulus of elasticity for steel wire with searl's apparatus

iv) Determination of modulus of rupture of a concrete beam

v) Determination of maximum deflection and young's modulus of elasticity in simply supported beam with load at middle third point

vi) Verification of forces in a framed structure

INSTRUCTIONAL STRATEGY

Teachers are expected to give simple exercises involving the applications of various concepts and principles being taught in the subject. Efforts should be made to prepare tutorial sheets on various topics and students should be encouraged/guided to solve tutorial sheets independently. In the practical works, individual students should be given opportunities to do practical work, make observations and draw conclusions. Teachers should also conduct viva examination in which stress should be given on the understanding of basic concepts and principles.

RECOMMENDED BOOKS

i) Mechanics & Material by Kirpal Singh, Standard Publication, New Delhi

ii) Ramamrutham, S., "Strength of Materials", Dhanpat Rai and Sons., New Delhi

iii) Ram Chandra, "Applied Mechanics and Strength of Materials", Standard Publishers. Delhi:

iv) Punmia, BC., "Strength of Materials", Standard Publishers, Delhi,

v) Prasad VS " Structural mechanics Galgotia publications Pvt Ltd, Delhi

vi) Sadhu Singh "Strengths of Materials" Standard Publishers, New Delhi

vii) Singh Birinder "Structural Mechanics" Kaption Publishers, Ludhiana

viii) Singh Harbhajan, " Structural Mechanics" ., Abhishek Publishers, Chandigarh

ix) Singh Harbhajan, "Design of Masonry and Timber Structures" Abhishek Publishers, Chandigarh.

x) SOM by C.M.Verma, J.P.N. Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	02	04
2	14	17
3	18	27
4	08	10
5	10	12
6	06	06
7	08	08
8	06	06
9	08	10
Total	**80**	**100**

4.7 PHE & IRRIGATION ENGINEERING DRAWING

	L	T	P
Periods/week	-	-	6

RATIONALE

Diploma holders in Civil Engineering are expected to supervise construction of water supply and wastewater treatment works and irrigation structures. This subject aims at imparting skills for preparing water supply and waste water and irrigation engineering drawings to develop competencies for reading the drawings, and their execution in their field

DETAILED CONTENTS

Drawings Exercises

A) WATER SUPPLY AND WASTE WATER ENGINEERING DRAWING

1. Drains and Sewers

   Cross section of standard types of open drains (circular, v-shaped and μ-shaped) with their foundations
   Cross section of earthen ware and RCC sewer pipes
   Cross sections of masonry sewers (circular and egg shaped)

2. Traps, manholes and inspection chamber

   Detailed section of floor trap and gully trap
   Detailed plan and section of an inspection chamber
   Detailed plan and section of a manhole

3. Septic Tank and Soak Pit

   Detailed plan and cross sections of a domestic septic tank with soak pit for 25 users

4. Bath room and W.C connections:

   4.1 Cross-section through the external wall of lavatories at ground and first floor showing the one and two pipe system and the connections of the lavatory to inspection chamber

   4.2. Plan of a bathroom showing positions of lavatory, bath tub, wash-basin, taps and showers

5. Draw sectional elevation of a two storeyed building showing details of one pipe and two pipes systems with sanitation system.

6. Practice of reading water supply and sanitary engineering working drawings (PWD/urban Development agencies) including hot water and cold water supply system of a two room set.

B) IRRIGATION ENGINEERING DRAWING:

1. Typical cross-section of a channel
   - L-section of a channel for given data
   - Typical cross section of an unlined and lined channel in cutting, partly cutting and partly filling and fully in filling with given design data.

2. Layout plan of a canal head works.
3. Draw the typical L-section of a weir
4. Draw the X-section of an Earthen Dam
   i) Homogeneous
   ii) Zoned type
   iii) Diaphragm type

5. Cross section of a tube well
6 Layout and cross section of rain water harvesting system.

INSTRUCTIONAL STRATEGY

Teachers are expected to develop skills in preparation and interpretation of water supply and waste water engineering drawings as per BIS codes of practice. Attention must be paid towards line work, specifications writing, dimensioning, proportioning and accuracy for industrial unit at different intervals of time. Reading and interpreting actual field drawings should also be practiced so as to develop necessary competency in the students.

RECOMMENDED BOOKS

1. Layal JS "Civil Engineering Drawing", Satya Parkashan, New Delhi

2. Chandel RP " Civil Engineering Drawings"

3. Kumar; NS " Civil Engineering Drawing " IPH, New Delhi

4. Malik RS and Meo GA, "Civil Engineering Drawing" Asian Publishing House, New Delhi

4.8 **INDUSTRIAL TRAINING**

Industrial training 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.

For this purpose, students at the end of fourth semester need to be sent for industrial training for a minimum of 4 weeks duration to be organised during the semester break starting 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 teacher may guide a group of 4-5 students. A minimum of one visit 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.

Internal assessment and external assessment 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, if any. The components of evaluation will include the following.

a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with workers	15%
d)	Industrial training report	55%

5.1 REINFORCED CONCRETE DESIGN

L T P
Period/Week 6 - -

RATIONALE

This subject is an applied engineering subject. Diploma holders in Civil Engineering will be required to supervise RC Construction and fabrication. He may also be required to design simple structural elements, make changes in design depending upon availability of materials (bars of different diameters). This subject thus deals with elementary design principles as per IS:456-2000

DETAILED CONTENTS

1. Introduction (03 periods)
   - 1.1 Concept of Reinforced Cement Concrete (RCC)
   - 1.2 Reinforcement Materials:
     - Suitability of steel as reinforcing material
     - Properties of mild steel and HYSD steel
   - 1.3. Loading on structures as per IS: 875

2. Introduction to following methods of RCC design (03 periods)
   - 2.1 Working stress method
   - 2.2 Limit state method

3. Shear and Development Length (05 periods)
   - 3.1 Shear as per IS:456-2000 by working stress method
     - i) Shear strength of concrete without shear reinforcement
     - ii) Maximum shear stress
     - iii) Shear reinforcement

4. Singly Reinforced Beam (Working stress method) (12 periods)
   - 4.1 Basic assumptions and stress strain curve, neutral axis, balanced, under-reinforcement and over reinforced beams, Moment of resistance for singly reinforced beam.
   - 4.2 Design of singly reinforced beam including sketches showing reinforcement details.

5. Concept of Limit State Method (09 periods)
   - 5.1 Definitions and assumptions made in limit state of collapse (flexure)
   - 5.2 Partial factor of safety for materials
   - 5.3 Partial factor of safety for loads
   - 5.4 Design loads
   - 5.5 Stress block, parameters

6. Singly Reinforced beam (11 periods)

Theory and design of singly reinforced beam by Limit State Method. Check for shear, Check for deflection, check for development length

7. Doubly Reinforced Beams (11 periods)
Theory and design of simply supported doubly reinforced rectangular beam by Limit State Method

8. Behaviour of T beam, inverted T beam, isolated T beam and 'L' beams (No Numericals) (05 periods)

9. One Way Slab (11 periods)
Theory and design of simply supported one way slab including sketches showing reinforcement details (plan and section) by Limit State Method. Check for shear, Check for deflection,

10. Two Way Slab (11 periods)
Theory and design of two-way simply supported slab with corners free to lift, no provisions for torsional reinforcement by Limit State Method including sketches showing reinforcement details (plan and two sections)

11. Axially Loaded Column (11 periods)
    - 11.1 Definition and classification of columns
    - 11.2. Effective length of column,
    - 11.3. Specifications for longitudinal and lateral reinforcement
    - 11.4. Design of axially loaded square, rectangular and circular short columns by Limit State Method including sketching of reinforcement(sectional elevation and plan)

12. Prestressed Concrete (04 periods)
    - 12.1. Concept of pre-stressed concrete
    - 12.2. Methods of pre-stressing : pre-tensioning and post tensioning
    - 12.3. Advantages and disadvantages of prestressing
    - 12.4. Losses in pre-stress

Important Note: Use of BIS:456-2000 is permitted in the examination.

INSTRUCTIONAL STRATEGY

Teachers are expected to give simple problems for designing various RCC structural members. For creating comprehension of the subject, teachers may prepare tutorial sheets, which may be given to the students for solving. It would be advantageous if students are taken at construction site to show form work for RCC as well as placement of reinforcement in various structural members. Commentary on BIS:456 may be referred along with code for relevant clauses.

RECOMMENDED BOOKS

1. Punmia, BC; "Reinforced Concrete Structure Vol I", Standard Publishers, Delhi
2. Ramamurtham, S; "Design and Testing of Reinforced Structures", Dhanpat Rai and Sons, Delhi
3. Gambhir, M.L., "Reinforced Concrete Design", Macmillan India Limited
4. Singh, Birinder "RCC Design and Drawing", Kaption Publishing House, New Delhi

5. Singh Harbhajan “Design of Reinforced Concrete Structures” Abhishek Publishers Ltd., Chandigarh
6. Mallick, SK; and Gupta, AP; "Reinforced Concrete", Oxford and IBH Publishing Co, New Delhi.
7. Singh Harbhajan “Limit State RCC Design” Abhishek Publishers Ltd., Chandigarh

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	03	03
2	03	03
3	05	05
4	12	10
5	09	10
6	11	12
7	11	12
8	05	5
9	11	12
10	11	12
11	11	12
12	04	04
Total	**96**	**100**

5.2 HIGHWAY & AIRPORTS ENGINEERING

	L	T	P
Period/Week	**5**	**-**	**2**

RATIONALE

Construction of roads is one of the area in which diploma holders in Civil Engineering may get employment. These diploma holders are responsible for construction and maintenance of highways and airports. Basic concepts of road geo-metrics, surveys and plans, elements of traffic engineering, road materials, construction of rigid and flexible pavements, special features of hill roads, road drainage system and various aspects of maintenance find place in above course.

DETAILED CONTENTS

1. Introduction (02 periods)

   1.1 Importance of Highway engineering

   1.2 Functions of IRC, CRRI, MORT&H, NHAI

   1.3 IRC classification of roads

   1.4 PMGSY and MNERGA Roads

2. Road Geometrics (10 periods)

   2.1 Glossary of terms used in road geo-metrics and their importance: Right of way, formation width, road margin, road shoulder, carriage way, side slopes, kerbs, formation levels, camber and gradient

   2.2 Average running speed, stopping and passing sight distance

   2.3 Necessity of curves, horizontal and vertical curves including transition curves. Super elevation and methods of providing super elevation

   2.4 Sketch of typical cross-sections in cutting and filling on straight alignment and at a curve

   (Note: No design/numerical problem to be taken)

3. Highway Surveys and Plan (10 periods)

   3.1 Topographic map, reading the data given on a topographic map

   3.2 Basic considerations governing alignment for a road in plain and hilly area

   3.3 Highway location; marking of alignment

4. Road Materials (10 periods)

4.1 Different types of road materials in use; soil, aggregate, binders – bitumen, cutback, Emulsion and Modified Bitumen (CRMB, PMB)

4.2 Binders: Common binders; bitumen, properties as per BIS specifications, penetration, softening point, ductility and viscosity test of bitumen, procedures and significance, cut back and emulsion and their uses, Bitumen modifiers

5. Road Pavements (12 periods)

5.1 Road pavement: Flexible and rigid pavement, their merits and demerits, typical cross-sections, functions of various components

5.2. Introduction to California Bearing Ratio, method of finding CBR value and its significance. Aggregate : Source and types, important properties, strength, durability

5.3 Sub-grade preparation: Setting out alignment of road, setting out bench marks, control pegs for embankment and cutting, borrow pits, making profiles of embankment, construction of embankment, compaction, preparation of subgrade, methods of checking camber, gradient and alignment as per recommendations of IRC, equipment used for subgrade preparation. Stabilization of subgrade. Types of stabilization mechanical stabilization, lime stabilization, cement stabilization, fly ash stabilization etc.(introduction only)

5.4 Introduction to Sub Base Course and Base Course:

a) Granular base course:

(i) Water Bound Macadam (WBM)

(ii) Wet Mix Macadam (WMM)

b) Bitumen Courses:

(i) Bituminous Macadam

(ii) Dense Bituminous Macadam (DBM)

c) *Methods of construction as per MORT&H

5.5 Surfacing:

a) * Types of surfacing

i) Prime coat and tack coat

ii) Surface dressing with seal coat

iii) Open graded premix carpet

iv) Mix seal surfacing

v) Semi dense bituminous concrete

vi) Bituminous Concrete/Asphaltic concrete

vii) Mastic Asphalt

b) * Methods of constructions as per MORT&H specifications and quality control..

5.6 Rigid Pavements:

Construction of concrete roads as per IRC specifications: Form work laying, mixing and placing the concrete, compacting and finishing, curing, joints in concrete pavement, equipment used.

6. Hill Roads: (06 periods)

6.1 Introduction: Typical cross-sections showing all details of a typical hill road, partly in cutting and partly in filling

6.2 Special problems of hill areas

6.2.1 Landslides: Causes, prevention and control measures, use of geogrids, geoflexiles, geo-synthetics

6.2.2 Drainage

6.2.3 Soil erosion

6.2.4 Snow: Snow clearance, snow avalanches, frost

6.2.5 Land Subsidence

7. Road Drainage: (06 periods)

7.1 Necessity of road drainage work, cross drainage works

7.2 Surface and subsurface drains and storm water drains. Location, spacing and typical details of side drains, side ditches for surface drainage. Intercepting drains, pipe drains in hill roads, details of drains in cutting embankment, typical cross sections

8. Road Maintenance: (06 periods)

8.1 Common types of road failures of flexible pavements: Pot hole, rutting, alligator cracking, upheaval - their causes and remedies (brief description)

8.2 Maintenance of bituminous road such as seal-coat, patch-work and recarpeting.

8.3 Maintenance of concrete roads-filling cracks, repairing joints, maintenance of shoulders (berms), maintenance of traffic control devices

9. Road Construction Equipment: (08 periods)

Output and use of the following plant and equipment

9.1 Hot mix plant

9.2 Tipper, tractors (wheel and crawler) scraper, bulldozer, dumpers, shovels, grader, roller, dragline

9.3 Asphalt mixer and tar boilers

9.4 Road pavers

10 Airport Engineering :- (10 periods)

10.1 Necessity of study of airport engineering, aviation transport scenario in India.

10.2 Factors to be considered while selecting a site for an airport with respect to zoning laws.

10.3 Introduction to Runways, Taxiways and Apron

*** An expert may be invited from field/industry for extension lecture on this topic.**

PRACTICAL EXERCISES

1. Determination of penetration value of bitumen
2. Determination of softening point of bitumen
3. Determination of ductility of bitumen
4. Determination of impact value of the road aggregate
5. Determination of abrasion value (Los Angeles') of road aggregate
6. Determination of the California bearing ratio (CBR) for the sub-grade soil
7. Visit to Hot mix plant
8. Visit to highway construction site for demonstration of operation of:
   Tipper, tractors (wheel and crawler), scraper, bulldozer, dumpers, shovels, grader, roller, dragline, road pavers, JCB etc.
9. Mixing and spraying equipment
10 A compulsory visit to Ready Mix Concrete plant.
11. Determination of Viscosity of Tar/Bitumen

INSTRUCTIONAL STRATEGY

While imparting instructions, it is recommended that emphasis should be laid on constructional details and quality control aspects. Students should be asked to prepare sketches and drawings, clearly indicating specifications and constructional details for various sub components of a highway. It will be also advantageous to organize field visits to show the actual construction of roads at site.

RECOMMENDED BOOKS

i) Khanna, SK and Justo, CEG, "Highway Engineering", Nem Chand and Bros., Roorkee

ii) Vaswani, NK, "Highway Engineering" , Roorkee Publishing House, Roorkee,

iii) Priyani, VB, "Highway and Airport Engineering" Anand, Charotar Book Stall

iv) Sehgal, SB; and Bhanot, KL; "A Text Book on Highway Engineering and Airport" S Chand and Co, Delhi

v) Bindra, SP; "A Course on Highway Engineering" , Dhanpat Rai and Sons, New Delhi

vi) Sharma, RC; and Sharma, SK; "Principles and Practice of Highway Engineering", Asia Publishing House, New Delhi

vii) Duggal AK, Puri VP., "Laboratory Manual in Highway Engineering", New Age Publishers (P) Ltd, Delhi,

viii) NITTTR, Chandigarh "Laboratory Manual in Highway Engineering",

ix) RK Khitoliya, "Principles of Highway Engineering (2005)", Dhanpat Rai Publishing Co., New Delhi

x) Rao, GV' Transportation Engineering

xi) Duggal AK, "Maintenance of Highway – a Reader", NITTTR, Chandigarh

xii) Duggal AK "Types of Highway constitution ", NITTTR Chandigarh

xiii) Rao, "Airport Engineering"

xiv) Singh,Jagrup, "Highway Engineering", Eagle Publications Jalandhar

IRC Publications

i) MORTH Specifications for Road and Bridge Works (Fifth Revision)

ii) MORTH Pocket book for Highway Engineers, 2001

iii) MORTH Manual for Maintenance of Roads, 1983

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted	Marks Allotted (%)

	(Periods)	
1	02	04
2	10	12
3	10	12
4	10	12
5	12	14
6	06	08
7	06	08
8	06	08
9	08	10
10	10	12
Total	**80**	**100**

5.3 RAILWAYS, BRIDGES AND TUNNELS

	L	T	P
Period/Week	**5**	**-**	**-**

RATIONALE

The subject will cater to the needs of those technicians who would like to find employment in the construction of railway tracks, bridges and tunnels. The subject aims at providing broad based knowledge regarding various components and construction of railway track, bridges and tunnels

DETAILED CONTENTS

PART – I: RAILWAYS (35 periods)

1. Introduction to Indian Railways
2. Railway surveys: Factors influencing the railways route, brief description of various types of railway survey
3. Classification of permanent way describing its component parts
4. Rail Gauge: Definition, types, practice in India
5. Rails – types of rails
6. Rail Fastenings: Rail joints, types of rail joints, fastenings for rails, fish plates, bearing plates
7. Sleepers: Functions of sleepers, types of sleepers, requirements of an ideal material for sleepers.
8. Ballast: Function of ballast, requirements of an ideal material for ballast
9. Crossings and signallings: Brief description regarding different types of crossings/ signallings (Latest electronics operated signal devices)
10. Maintenance of track: Necessity, maintenance of track, inspection of soil, track and fixtures; maintenance and boxing of ballast maintenance gauges, tools
11. Earth work an drainage: Features of rail road, bed level, width of formation, side slopes, drains, methods of construction, requirement of drainage system

PART-II: BRIDGES (35 periods)

12. Introduction
Bridge – its function and component parts, difference between a bridge and a culvert

13. Classification of Bridges
Their structural elements and suitability:

13.1 According to life-permanent and temporary

13.2 According to deck level – Deck, through and semi-through

13.3 According to material –timber, masonry, steel, RCC, pre-stressed

13.4 According to structural form;

- Grade Seperators-Railway Overbridges (ROB), Railway underbridge (RUB)
- Beam type –RCC, T-Beam, steel girder bridges, plate girder and box girder, balanced cantilever, Trussed bridges.
- Arch type – open spandrel and filled spandrel barrel and rib type
- Suspension type – unstiffened and stiffened and table (its description with sketches)
- According to the position of highest flood level submersible and non submersible

13.5 IRC classification

14. Bridge Foundations: Introduction to open foundation, pile foundation, well foundation

15. Piers, Abutments and Wingwalls

15.1 Piers-definition, parts; types –solid (masonry and RCC), open

15.2 Abutments and wing walls – definition, types of abutments (straight and tee), abutment with wing walls (straight, splayed, return and curved)

15.3 Launching of Equipment Bridges

16. Bridge bearings

Purpose of bearings; types of bearings – fixed plate, rocker and roller.

17. Maintenance of Bridges

17.1 Inspection of Steel and Equipment bridges

17.2 Routine maintenance

PART - III: TUNNELS (10 periods)

18. Definition and necessity of tunnels
19. Typical section of tunnels for a national highway and single and double broad gauge railway track
20. Ventilation –necessity and methods of ventilation, by blowing, exhaust and combination of blowing and exhaust
21. Drainage method of draining water in tunnels
22. Lighting of tunnels

Notes: i) Field visits may be organized to Bridge construction site or a Bridge/Tunnel construction site/Railways tracks to explain the various components and a field visit report shall be prepared by the students, as teamwork

ii) Examiners should set questions from all the parts

INSTRUCTIONAL STRATEGY

This subject is of practical nature. While imparting instructions, teachers are expected to organize demonstrations and field visits to show various components and construction of railway track, bridges and tunnel.

RECOMMENDED BOOKS

1. Vaswani, NK, "Railway Engineering", Publishing House, Roorkee
2. Rangwala, SC, "Railway Engineering", Anand, Charotar Book Stall
3. Deshpande, R, "A Text Book of Railway Engineering", Poonam United Book Corporation
4. Algia, JS "Bridge Engineering", Anand, Charotar Book Stall
5. Victor Johnson, "Essentials of Bridge Engineering" Oxford and IBH, Delhi
6. Rangwala S.C., "Bridge Engineering", Anand, Charotar Book Stall
7. IRC Bridge Codes
8. MORTH drawings for various types of bridges
9. MORTH pocket books for bridge Engineers, 2000 (First Revision)
10. Subhash C Saxena, "Tunnel Engineering", Dhanpat Rai and Sons, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	35	43
2	35	43
3	10	14
Total	**80**	**100**

5.4 QUANTITY SURVEYING AND VALUATION

	L	T	P
Periods/week	**6**	**-**	**-**

RATIONALE

Diploma holders in Civil Engineering are supposed to prepare material estimates for various Civil Engineering works namely; buildings, irrigation works, public health works and roads etc. In addition, they must have basic knowledge regarding analysis of rates, contracting, principles of valuation. Therefore, this subject has great importance for diploma holders in Civil Engineering.

DETAILED CONTENTS

1. Introduction to quantity surveying and its importance. Duties of quantity surveyor (02 periods)

2. Types of estimates (03 periods)
   - 2.1 Preliminary estimates
     - Plinth area estimate
     - Cubic rate estimate
     - Estimate per unit base
   - 2.2 Detailed estimates
     - Definition
     - Stages of preparation – details of measurement and calculation of quantities and abstract

3. Measurement (03 periods)
   - 3.1 Units of measurement for various items of work as per BIS:1200
   - 3.2 Rules for measurements
   - 3.3 Different methods of taking out quantities – centre line method and long wall and short wall method

4. Preparation of Detailed and Abstract Estimates from Drawings for: (28 periods)
   - 4.1 A small residential building with a flat roof and pitched roof building comprising of
     - Two rooms with W.C., bath, kitchen and verandah
   - 4.2 Earthwork for unlined channel
   - 4.3 WBM road and pre-mix carpeting
   - 4.4 Single span RCC slab culvert

4.5 Earthwork for plain and hill roads

4.6 RCC work in beams, slab, column and lintel, foundations

4.7 users septic tank - 25 users

5. Calculation of quantities of materials for (12 periods)

5.1 Cement mortars of different proportion

5.2 Cement concrete of different proportion

5.3 Brick/stone masonry in cement mortar

5.4 Plastering and pointing

5.5 White washing, painting

5.6 R.C.C. work in slab, beams

6. Analysis of Rates (16 periods)

6.1 Steps involved in the analysis of rates. Requirement of material, labour, sundries, contractor's profit and overheads

6.2 Analysis of rates for finished items when data regarding labour, rates of material and labour is given:

- Earthwork in excavation in hard/ordinary soil and filling with a concept of lead and lift
- RCC in roof slab/beam/lintels/columns
- Brick masonry in cement mortar
- Cement Plaster
- White washing, painting
- Stone masonry in cement mortar

7 Contractorship (10 periods)

- Meaning of contract
- Qualities of a good contractor and their qualifications
- Essentials of a contract
- Types of contracts, their advantages, dis-advantages and suitability, system of payment
- Single and two cover-bids; tender, tender forms and documents, tender notice, submission of tender and deposit of earnest money, security deposit, retention money, maintenance period

- Classification and types of contracting firms/construction companies

8 Preparation of Tender Document based on Common Schedule Rates (CSR/SOR) (14 periods)

- Introduction to CSR and calculation of cost based on premium on CSR/SOR
- Exercises on writing detailed specifications of different types of building works from excavation to foundations, superstructure and finishing operation
- Exercises on preparing tender documents for the following
  a) Earth work
  b) Construction of a small house as per given drawing
  c) RCC works
  d) Pointing, plastering and flooring
  e) White-washing, distempering and painting
  f) Wood work including polishing
  g) Sanitary and water supply installations
  h) False ceiling, aluminum (glazed) partitioning
  i) Tile flooring including base course
  j) Construction of W.B.M/Concrete road

9. Exercises on preparation of comparative statements for item rate contract (02 periods)

10. Valuation (06 periods)
  a) Purpose of valuation, principles of valuation
  b) Definition of various terms related to valuation like depreciation, sinking fund, salvage and scrap value, market value, fair rent, year's purchase etc.
  c) Methods of valuation (i) replacement cost method (ii) rental return method

INSTRUCTIONAL STRATEGY

This is an applied engineering subject. Teachers are expected to provide working drawings for various Civil Engineering works and students be asked to calculate the quantities of materials required for execution of such works and use of relevant software for preparing estimates. Teachers should conceptualize making analysis of rates for different items of works. It will be advantageous if students are given valuation reports for reading.

RECOMMENDED BOOKS

1. Pasrija, HD, Arora, CL and S. Inderjit Singh, "Estimating, Costing and Valuation (Civil)", New Asian Publishers, Delhi,

2. Rangwala, S.C, Estimating and Costing", Anand, Charotar Book Stall
3. Chakraborti, M, "Estimating, Costing and Specification in Civil Engineering", Calcutta
4. Dutta, BN, "Estimating and Costing
5. Mahajan Sanjay, "Estimating and Costing" Satya Parkashan, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	02	02
2	03	03
3	03	03
4	28	30
5	12	12
6	16	18
7	10	10
8	14	14
9	02	02
10	06	06
Total	**96**	**100**

5.5 REPAIR AND MAINTENANCE OF BUILDINGS

L T P
Period/Week 4 - 2

RATIONALE

One of the major concerns of a civil engineer is to take care of the building works, already constructed, in order to keep these buildings in utmost workable conditions. Usually it is being felt that the buildings deteriorate faster for want of care and proper maintenance. The buildings usually have a shabby appearance due to cracks, leakage from the roofs and sanitary/water supply fittings. Thus the need for teaching the subject in proper perspective has arisen making students aware of importance of maintenance of buildings.

DETAILED CONTENTS

1. Need for Maintenance (09 periods)

    1.1 Importance and significance of repair and maintenance of buildings
    1.2 Meaning of maintenance
    1.3 Objectives of maintenance
    1.4 Factors influencing the repair and maintenance

2. Agencies Causing Deterioration (Sources, Causes, Effects) (08 periods)

    2.1 Definition of deterioration/decay
    2.2 Factors causing deterioration, their classification
        2.2.1 Human factors causing deterioration
        2.2.2 Chemical factors causing deterioration
        2.2.3 Environmental conditions causing deterioration
        2.2.4 Miscellaneous factors
    2.3 Effects of various agencies of deterioration on various building materials i.e. bricks, timber, concrete, paints, metals, plastics, stones

3. Investigation and Diagnosis of Defects (08 periods)

    3.1 Systematic approach/procedure of investigation
    3.2 Sequence of detailed steps for diagnosis of building defects/problems
    3.3 List non-destructive and others tests on structural elements and materials to evaluate the condition of the building and study of three most commonly used tests

4. Defects and their root causes (09 periods)

    4.1 Define defects in buildings
    4.2 Classification of defects
    4.3 Main causes of building defects in various building elements
        4.3.1 Foundations, basements and DPC
        4.3.2 Walls
        4.3.3 Column and Beams
        4.3.4 Roof and Terraces
        4.3.5 Joinery

4.3.6 Decorative and protective finishes
4.3.7 Services
4.3.8 Defects caused by dampness

5. Materials for Repair, maintenance and protection (09 periods)

5.1 Compatibility aspects of repair materials
5.2 State application of following materials in repairs:
5.2.1 Anti corrosion coatings
5.2.2 Adhesives/bonding aids
5.2.3 Repair mortars
5.2.4 Curing compounds
5.2.5 Joints sealants
5.2.6 Waterproofing systems for roofs
5.2.7 Protective coatings

6. Remedial Measures for Building Defects (21 periods)

6.1 Preventive maintenance considerations
6.2 Surface preparation techniques for repair
6.3 Crack repair methods
6.3.1 Epoxy injection
6.3.2 Grooving and sealing
6.3.3 Stitching
6.3.4 Adding reinforcement and grouting
6.3.5 Flexible sealing by sealant
6.4 Repair of surface defects of concrete
6.4.1 Bug holes
6.4.2 Form tie holes
6.4.3 Honey comb and larger voids
6.5 Repair of corrosion in RCC elements
6.5.1 Steps in repairing
6.5.2 Prevention of corrosion in reinforcement
6.6 Material placement techniques with sketches
6.6.1 Pneumatically applied (The gunite techniques)
6.6.2 Open top placement
6.6.3 Pouring from the top to repair bottom face
6.6.4 Birds mouth
6.6.5 Dry packing
6.6.6 Form and pump
6.6.7 Preplaced – aggregate concrete
6.6.8 Trowel applied method
6.7 Repair of DPC against Rising Dampness
6.7.1 Physical methods
6.7.2 Electrical methods
6.7.3 Chemical methods

6.8 Repair of walls
6.8.1 Repair of mortar joints against leakage

6.8.2 Efflorescence removal

6.9 Waterproofing of wet areas and roofs
- 6.9.1 Water proofing of wet areas
- 6.9.2 Water proofing of flat RCC roofs
- 6.9.3 Various water proofing systems and their characteristics

6.10 Repair of joints in buildings
- 6.10.1 Types of sealing joints with different types of sealants
- 6.10.2 Techniques for repair of joints
- 6.10.3 Repair of overhead and underground water tanks

PRACTICAL EXERCISES

Identify the different defects in buildings and their remedies as per list given below. Building Maintenance/Different Remedies should be comprised with the technical support of teachers and labour support. For this purpose labour should be hired from open market at government rate on daily basis of expenditure regarding items required for maintenance should be procured from student funds of maintenance. For major maintenance, Expert Masons required, should also be hired. Building comprises the residential/non residential/hostel etc.

List of Defects

1. To Identity dampers on walls
2. Cracks on Roof level and on walls
3. Corrosion on iron window and door chaukhats
4. Decay of wooden structures
5. Cracks on R.C.C structures.
6. To perform the anti-termite treatment
7. Removal of damaged or decay plaster and guniting

INSTRUCTIONAL STRATEGY

This is very important course and efforts should be made to find damaged/defective work spots and students should be asked to think about rectifying/finding solution to the problem. Visits to work site, where repair and maintenance activities are in progress can be very useful to students. The students will also prepare a project report based upon the available water proofing materials, sealant, special concrete for repair and adhesives and other repair material available in the market.

RECOMMENDED BOOKS

1. Gahlot P.S. and Sanjay Sharma, “Building Defects and Maintenance Management”, CBS Publishers, New Delhi
2. Nayak, BS, "Maintenance Engineering for Civil Engineers", Khanna Publishers, Delhi
3. Ransom, WH "Building Failures - Diagnosis and Avoidance", Publishing E and F.N. Span
4. Hutchinson, BD; et al, "Maintenance and Repair of Buildings", Published by Newness – Butterworth

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	09	13
2	08	13
3	08	13
4	09	13
5	09	13
6	21	35
Total	**64**	**100**

5.6 APPLICATIONS AND USES OF VARIOUS SOFTWARE IN CIVIL ENGINEERING

	L	T	P
Periods/Week	-	-	6

RATIONALE

Computer applications plays a very vital role in present day life and more so, in the professional life of diploma engineer. In order to enable the students use the computers effectively in problem solving, this course offers applications of various computer softwares in civil engineering.

DETAILED CONTENTS

PRACTICAL EXERCISES

1. Introduction and use of AutoCAD for making 2D Drawings and develop plan, section and elevation of 2 rooms building..
2. Demonstration of various civil engineering softwares like STAAD-Pro, MS Project or Primavera Project Planner, Auto Civil, MX Road or any other equivalent software for above mentioned software

Note:

i) The polytechnics may use any other software available with them for performing these exercises

ii) If the above softwares are not available in the institution, the demonstration of the above said software should be arranged outside the institute.

5.7 MINOR PROJECT WORK

	L	T	P
Period/week	**-**	**-**	**8**

Minor project work aims at exposing the students to field practices, size and scale of operations and work culture at works sites. For this purpose, students during middle of course, are required to be sent at different work sites where some construction activities are in progress or some operations are going on. Depending on the interests of the students, they may be sent to following (or any other field project related to Civil Engineering):

i) Building construction sites

ii) Water treatment plant, Sewage treatment plant

iii) Crusher plant, Cement Manufacturing Plant, Brick kiln

iv) Highway construction site

v) Material and Soil testing laboratory, Soil investigation projects

vi) Hydel Power Project

vii) Land surveying projects

viii) Community development works

ix) Constructional site like building, bridge, tunnel, canal lining, highway, railway track, irrigation works etc

As a minor project activity, each student is supposed to study the operations at site and prepare a detailed project report of the observations/processes seen by him/her and give seminar using computer aided presentation slides using photographs. These students should be guided by respective subject teachers. Each teacher may guide a group of 10 – 15 students.
The teachers along with field supervisors will conduct performance assessment of students. Some of the projects are suggested below:

1. Survey of a village approach road, drawings of L-section and x-sections
2. Estimation of white washing and distempering in hostel building
3. Preparation of detailed estimate with drawings of septic tank for 30-40 users
4. Plumbing work and installation of PVC over-head water tank on a toilet block and then prepare report
5. Construction of different components of a building
6. Identification of water-supply fittings and replacement of defective fittings and then prepare report.
7. Construction of a pipe/slab culvert
8. Ferro-cement construction techniques

a) Low cost housing

b) New construction materials

9. Study and preparation of models of hydraulic pumps.

A group of students not exceeding 5 may work on any one project. Each student will prepare the project report of the activities observed by him. They will study the whole process of the plant, and explain the same in their project report. Further they are required to present the Project Report of work done by them through seminar in the class for internal assessment. External examiner will ask the questions on the construction, working, processes observed by the students during their project work: Shortcomings in the works (site) and their remedial measures may be suggested by the students.

6.1 STEEL STRUCTURES DESIGN

	L	T	P
Period/Week	**6**	**0**	**0**

RATIONALE

This subject is an applied engineering subject. Diploma holders in Civil Engineering will be required to supervise steel construction and fabrication. He may also be required to design simple structural elements, make changes in design depending upon availability of materials. This subject thus deals with elementary design principles as per BIS code of practice IS: 800

DETAILED CONTENTS
THEORY

1. Structural Steel and Sections: (03 periods)

   1.1 Properties of structural steel as per IS Code
   1.2 Designation of structural steel sections as per IS handbook and IS:800-2007

2. Riveted Connections: (11 periods)

   Types of rivets, permissible stresses in rivets, types of riveted joints, specifications for riveted joints as per IS 800. Failure of a riveted joint. Assumptions in the theory of riveted joints. Strength and efficiency of a riveted joint. Design of riveted joints for axially loaded members.

3. Welded connections: (07 periods)

   Types of welds and welded joints, advantages and disadvantages of welded joints design of fillet and butt weld. Plug and slot welds (Descriptive No numerical on plug and slot welds)

4. Tension Members (17 periods)

   Analysis and design of single and double angle section tension members and their rivetted and welded connections with gusset plate as per IS:800

5. Compression Members (17 periods)

   Analysis and design of single and double angle sections compression members (struts) and their rivetted and welded connections with gusset plate as per BIS:800

6. Roof Trusses (07 periods)

Form of trusses, pitch of roof truss, spacing of trusses, spacing of purlins, connection between purlin and roof covering. Connection between purlin and principal rafter (no design, only concept)

7. Columns: (11 periods)

7.1 Concept of buckling of columns, effective length and slenderness ratio, permissible stresses in compression as per IS:800 for different end conditions. Analysis and Design of axially loaded single section steel column

8. Beams (11 periods)

Analysis and design of single section simply supported laterally restrained steel beams.

9 Fabrication and Erection of Steel Structures like trusses, columns and girders (06 periods)

10 Masonry structures – Design of brick column and wall foundations (06 periods)

Important Note:

Use of IS: 800 and Steel Tables are permitted in examination.

INSTRUCTIONAL STRATEGY

Teachers are expected to give simple problems for designing various steel structural members. For creating comprehension of the subject, teachers may prepare tutorial sheets, which may be given to the students for solving. It would be advantageous if students are taken at construction site to show fabrication and erection of steel structures. IS:800 may be referred along with code for relevant clauses

RECOMMENDED BOOKS

1. Duggal SK, "Design of Steel Structures" by Standard Publishers, Delhi
2. Birinder Singh, “Steel Structures Design and Drawing”, Kaption Publishing House, Ludhiana
3. Ram Chandra, "Design of Steel Structures", Standard Publishers,Delhi
4. LS Negi, “Design of Steel Structure” Tata McGraw Hill, New Delhi
5. S Ramamurthan, “Design of Steel Structures”,
6 Harbhajan Singh ,“Design and Drawing of Steel Structures” , Abhishek Publishing, Chandigarh
7 IS Code : 800-2007

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	03	03
2	11	12
3	07	08
4	17	17
5	17	17
6	07	08
7	11	12
8	11	13
9	06	05
10	06	05
Total	**96**	**100**

6.2 EARTHQUAKE RESISTANT BUILDING CONSTRUCTION

	L	T	P
Periods/Week	4	-	-

RATIONAL

Diploma holders in civil engineering have to supervise construction of various earthquake resistant buildings. Therefore, the students should have requisite knowledge regarding terminology of earthquake and the precautions to be taken while constructing earthquake resistant buildings

DETAILED CONTENTS

1. Elements of Engineering Seismology (12 periods)

   General features of tectonic of seismic regions. Causes of earthquakes, Seismic waves, earthquake size (magnitude and intensity), Epicentre, Seismograph, Classification of earthquakes, Seismic zoning map of India, Static and Dynamic Loading, Fundamental period.

2. Seismic Behaviour of Traditionally-Built Constructions of India (08 periods)

   Performance of building during earthquakes and Mode of failure (Out-of-plane failure, in-plane failure, Diaphragm failure, Connection failure, Non-structural components failure)

3. Special construction method, tips and precautions to be observed while planning, designing and construction of earthquake resistant building. (10 periods)

4. Introduction to IS: 4326, IS: 13828, IS: 1893(Part 1), 154326 and IS: 13920 (latest edition) (08 periods)

5. Seismic Provision of Strengthening and Retrofitting Measures for Traditionally-Built Constructions, Brick and RCC Structures (10 periods)

6. Provision of reinforcement detailing in masonry and RC constructions (08 periods)

7. Disaster Management: Disaster rescue, psychology of rescue, rescue workers, rescue plan, rescue by steps, rescue equipment, safety in rescue operations, debris clearance and casuality management. (08 periods)

INSTRUCTIONAL STRATEGY

The student may be taken for visit to various building construction sites where precautions related to earthquake resistant construction are being taken so that the students may appreciate the importance of the subject.

RECOMMENDED BOOKS

1. Elements of Earthquake Engineering by Jai Krishana and AR Chandersekaran; Sarita Parkashan, Meerut.

2. Manual Published by Earthquake Engineering department, IIT Roorkee / IIT Kanpur

3. IS 13920, IS: 13827, IS: 13828, IS 1893, IS 4326 (latest edition)

4 Singh, Harbhajan " Earthquake Resistant Building Construction" Abhishek Publishers, Chandigarh

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	12	19
2	08	15
3	10	17
4	08	10
5	10	19
6	08	08
7	08	12
Total	**64**	**100**

6.3 CONSTRUCTION MANAGEMENT AND ACCOUNTS AND ENTREPRENEURSHIP DEVELOPMENT

	L	T	P
Periods/Week	**6**	**-**	**-**

RATIONALE

This is an applied civil engineering subject. The subject aims at imparting basic knowledge about construction planning and management, site organisation, construction labour, control of work progress, inspection and quality control, accidents and safety and accounts.

DETAILED CONTENTS
THEORY

CONSTRUCTION MANAGEMENT:

1. Introduction: (06 periods)

   1.1 Significance of construction management

   1.2 Main objectives of construction management and overview of the subject

   1.3 Functions of construction management, planning, organising, staffing, directing, controlling and coordinating, meaning of each of these with respect to construction job.

   1.4 Classification of construction into light, heavy and industrial construction

   1.5 Stages in construction from conception to completion

   1.6 The construction team: owner, engineer, architect and contractors, their functions and inter-relationship

2. Construction Planning: (12 periods)

   2.1 Importance of construction planning

   2.2 Stages of construction planning

   - Pre-tender stage
   - Contract stage

   2.3 Scheduling construction works by bar charts

   - Definition of activity, identification of activities
   - Preparation of bar charts for simple construction work

- Preparation of schedules for labour, materials, machinery and finances for small works
- Limitations of bar charts

2.4 Scheduling by network techniques

- Introduction to network techniques; PERT and CPM, differences between PERT and CPM terminology

3. Organization: (06 periods)

3.1 Types of organizations: Line, line and staff, functional and their characteristics

4. Site Organization: (06 periods)

4.1 Principle of storing and stacking materials at site

4.2 Location of equipment

4.3 Preparation of actual job layout for a building

4.4 Organizing labour at site

5. Construction Labour: (08 periods)

5.1 Conditions of construction workers in India, wages paid to workers

5.2 Important provisions of the following Acts:

- Labour Welfare Fund Act 1936 (as amended)
- Payment of Wages Act 1936 (as amended)
- Minimum Wages Act 1948 (as amended)

6. Control of Progress: (04 periods)

6.1 Methods of recording progress

6.2 Analysis of progress

6.3 Taking corrective actions keeping head office informed

6.4 Cost time optimization for simple jobs - Direct and indirect cost, variation with time, cost optimization

7. Inspection and Quality Control: (08periods)

7.1 Need for inspection and quality control
7.2 Principles of inspection
7.3 Stages of inspection and quality control for

- Earth work
- Masonry
- RCC
- Sanitary and water supply services

8. Accidents and Safety in Construction: (10 periods)

8.1 Accidents – causes and remedies
8.2 Safety measures for

- Excavation work
- Drilling and blasting
- Hot bituminous works
- Scaffolding, ladders, form work
- Demolitions

8.3 Safety campaign and safety devices

ACCOUNTS

9. Public Work Accounts: (20 periods)

Introduction, technical sanction, administrative approval, allotment of funds, re-appropriation of funds bill, contractor ledger, measurement book running and final account bills complete, preparation of bill of quantities (BOQ), completion certificate & report, hand receipt, aquittance roll. Muster Roll labour, casual labour roll-duties and responsibility of different cadres, budget-stores, returns, account of stock, misc. P.W. advances T & P – verification, survey report, road metal material charged direct to works, account - expenditure & revenue head, remittance and deposit head, definition of cash, precaution in custody of cash book, imprest account, temporary advance, treasury challan, preparation of final bills. Students must learn to prepare accounts register, stock register.

10. Entrepreneurship Development (14 periods)

10.1 Introduction

Entrepreneur-entrepreneurship, its meaning & importance. Qualities of an entrepreneur. Entrepreneur Motivation Training

10.2 Financing Agencies:

Financing agencies for land, infra structure, machinery, raw material, import of raw material and machinery. Role and function of Govt. department connected with the development of industries/business ventures in the State.

10.3 Industrial Legislation and taxes:

Industrial and labour laws, production tax, local tax, sales tax, excise duty and income tax.

10.4 Project Report:

Component of project report – Land building, electricity, water, equipment and other utilities. Materials, its availability, cost, labour availability and wage rates. Project report preparation, provisional registration and plan of acquiring finance from proper source (financing agencies).

INSTRUCTIONAL STRATEGY

This is highly practice-based course and efforts should be made to relate process of teaching with direct experiences at work sites. Participation of students should be encouraged in imparting knowledge about this subject. To achieve this objective the students should be taken to different work sites for clear conception of particular topics, such as site organization, inspection of works at various stages of construction and working of earth moving equipment

RECOMMENDED BOOKS

1. Harpal Singh, "Construction Management and Accounts", Tata McGraw Hill Publishing Company., New Delhi
2. Peurifoy, RL, "Construction Planning, Equipment and Methods", McGraw Hill, Tokyo
3. Singh, Harbhajan " Construction Project Management" Abhishek Publishers, Chandigarh
4. Verma, Mahesh; "Construction Equipment and its Planning and Application
5. Dharwadker, PP; "Management in Construction Industry", , Oxford and IBH Publishing Company, New Delhi
6. Gahlot PS; Dhir, BM; "Construction Planning and Management", Wiley Eastern Limited, New Delhi
7. Softwares :
   (a) MS Project – Microsoft USA
   (b) Primavera

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	06	06
2	12	12
3	06	06
4	06	06
5	10	08
6	04	04
7	08	08
8	10	11
9	20	22
10	14	17
Total	**96**	**100**

6.4 ADVANCED CONSTRUCTION TECHNOLOGY

	L	T	P
Periods/ Week	4	-	-

RATIONALE

This is an applied technology subject. In this subject, knowledge regarding earth work, construction of high rise buildings and precast and pre stressed concreting operations and piles has been given.

DETAILED CONTENTS

1. Earth Work (20 Periods)

   1.1 Excavation in ordinary and hard soils, excavation in soft and hard rock, blasting techniques excavation in weak soils

   1.2 Side slopes of excavation; minimum working space at bottom, shoring strutting

   1.3 Dewatering technique – pumping and well points

   1.4 Disposal of spoil and balancing

   1.5 Safety aspects

   1.6 Embankments, compaction of earth fills, protection and drainage of embankments

2. High Rise Construction (12 Periods)

   2.1 Construction techniques for high rise buildings

   2.2 Construction techniques for chimneys and cooling towers

3. Precast and Prestressed Concrete Construction (20 Periods)

   3.1 Introduction of prestressed concrete, general theory. Linear post tensioning – general, post tensioning advantages to the design engineer and the contractor

   3.2 Linear post tensioning system, high strength post tensioned stands, parallel lay wire, high strength alloy steel bars

   3.3 Techniques of post tensioning – general, special requirements for forming and false work, ducts or tendons, concreting, stressing procedure, grouting, protecting anchorage from corrosion

   3.4 Pretensioning - general, pretensioning yards set up, forms for pretensioned structural elements, special techniques of pretensioning

3.5 Materials of prestressing – cement, aggregates concrete, admixtures, vibration, curing, light weight aggregates, high strength steel bars, high strength stand, stress relaxation, galvanization. Codes specifications and inspection, manufacturers of prestressing equipment, specifications, sizes and costs

4. Piles (12 Periods)

Piles; basic piling methods for various types of piles, methods of pile driving, non – displacement piles, problems in pile construction, pile testing

Note: To visit high rise buildings and flyovers construction site and their report writing

INSTRUCTIONAL STRATEGY

The subject shall consist of visits by the students to various construction sites where they shall see the heavy construction works. They shall also contact the representatives of the manufacturers of various construction equipment and collect information from practical demonstration, discussions and technical information received from the firms.

RECOMMENDED BOOKS

1. Gupta, Sushil Kumar, Singla, DR. and juneja BM, "A Text Book of Building Construction"; Ludhiana Katson Publishing House.
2. Deshpande, RS and Vartak, GV; "A Text Book of Building Construction''; Poona United Book Corporation.
3. Kulkarni, GJ; "A Text Book of Building Construction"; Ahmedabad Book Depot.
4. Arora, SP and Bindra, SP; "A Text Book of Building Construction"; New Delhi Dhanpt Rai and Sons.
5. Sharma, SK and Kaul, BK; "A Text Book of Building Construction"; Delhi, S Chand and Corporation
6. Sushil Kumar; "Building Construction"; Delhi Standard Publishers Distributors.
7. Moorthly, NKR; "A Text Book of Building Construction"; Poona, Engineering Book Publishing Corporation
8. N.Krishna Raju, "Prestressed Concrete", Tata McGraw Hills, New Delhi
9. P Dayaratnam, "Prestressed Conctrete, "Laxmi Publication, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	20	30
2	12	20
3	20	30
4	12	20
Total	**64**	**100**

6.5 ENVIRONMENTAL POLLUTION CONTROL

	L	T	P
Periods/Week	4	-	-

RATIONALE

Civil Engineering diploma holders must have the knowledge of different types of environmental aspects related to development activities so that they may help in maintaining the ecological balance and control pollution. They should also be aware of the related environmental laws for effectively combating environmental pollution. The class room instructions should be supplemented by field visits to show the pollution caused by urbanization and the combatment measures being adopted at site. Extension lectures by experts may be encouraged.

DETAILED CONTENTS

1. Study of Importance of Environmental Engineering (04 periods)

   Importance of clean environment, control of environmental pollution with respect to air, land and water. Conservation of natural resources, environmental education and awareness, sustainable development.

2. Water Pollution (06 periods)

   Causes of pollution in surface and underground water eutrophication of lakes and its preventing measure; BIS standards for water quality.

3. Air Pollution (09 periods)

   Definition, principal air pollutants, atmospheric parameters influencing air pollution, types of air contaminants and their sources, effects of air pollution on human beings, plants, animals, automobile pollution, BIS ambient air quality standards and measures to combat air pollution

4. Noise Pollution (05 periods)

   Definition, unit of measurement of noise, sources and effects of noise pollution and control of noise pollution

5. Effects of mining, blasting and deforestation (04 periods)

   Ill effects of mining, blasting and deforestation on the environment human life and wild life.

6. Land Use (08 periods)

Effect of land use on environmental quality, land use and natural disasters,(land slides etc) soil degradation problems - erosion, water logging, soil pollution etc.

7. Environmental Impact Assessment (08 periods)

Definition and requirements, environmental impact assessment. Flour chart of environmental impact assessment methodology. Describe the need and importance of EIA.

8. Legislation to Control Environmental Pollution (idea) (05 periods)

Indian legislative acts for water, land and air pollution control – provisions, scope and implementation

9. Global Issues of Environmental Engineering (07 periods)

Global warming, ozone depletion, acid rain, oil pollution; radiation hazards and their control, concept of clean technology and carbon credits.

10. Renewable Source of Energy (08 periods)

Role of non-conventional sources of energy (biogas, solar, wind etc) in environmental protection. Conservation of energy resources like coal, oil etc., alternative fuels, bio-diesel etc.

INSTRUCTIONAL STRATEGY

Students should be encouraged to undertake project work related to environmental problems. They should visit industrial effluent treatment plant, water treatmet plant and environmental engineering laboratory and study the impact of utilization of reclaimed by products

RECOMMENDED BOOKS

1. Deswal DS and Deswal SS “Environmental Engineering” Dhanpat Rai and Company (P) Ltd., Delhi

2. Odum EP, “Fundamentals of Ecology”, Amarind Publication Co., Delhi

3. Dhamija SK “Environmental Engineering and Management ; SK Kataria and Sons, Delhi

4. De AK, “Engineers Chemistry”, New Age Publication, Delhi

5. Kendeigh SC, “Ecology”, Prentice Hall of India, Delhi

6. Khitoliya, RK, “Environmental Pollution’, S Chand & Co. Ltd., New Delhi

7. Bhatia, HS, “A text book of Environmental Pollution and Control”, Galgotia. Publishers, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	04
2	06	10
3	09	16
4	05	08
5	04	06
6	08	12
7	08	12
8	05	08
9	07	12
10	08	12
Total	**64**	**100**

6.6 STRUCTURAL DRAWINGS

L T P
Periods/Week - - 8

RATIONALE

Diploma holders in Civil Engineering are required to supervise the construction of RC and steel structures. Thus one should be able to read and interpret structural drawings of RC and steel structures. The competence to read and interpret structural drawings is best learnt by being able to draw these drawings. Hence there is a need to have a subject devoted to preparation of structural drawings.

DETAILED CONTENTS

PART A

Drawing Exercises

1. RC Structures:

   Reinforcement details from the given data for the following structural elements with bar bending schedules

   (i) Drawing No. 1: RC Slabs - One way slab and Two way slab.

   (ii) Drawing No.2 : Beams - Singly and doubly reinforced rectangular beams and Cantilever beam (All beams with vertical stirrups)

   (iii) Drawing No.3 : Columns and Footings – Square, Rectangular and Circular Columns with lateral ties and their isolated sloped column footings.

   (iv) Drawing No. 4 : Portal Frame – Three bay two storey RC portal frame with blow up of column beam junctions.

   (v) Drawing No.5: Dog legged stairs for single storey building

   (vi) Drawing No.6 : Draw atleast one sheet using CAD software

PART B

2. Steel Structures:

   Structural drawing from given data for following steel structural elements.

   (i) Drawing No. 1: Roof Truss – Drawing of Fink Roof Truss with details of joints, fixing details of purlins and roof sheets.

   (ii) Drawing No.2 : Column and Column Bases - Drawing of splicing of steel columns. Drawings of slab base, gusseted base and grillage base for single section steel columns.

(iii) Drawing No.3 : Column Beam Connections

(a) Sealed and Framed Beam to Beam Connections
(b) Sealed and Framed beam o Column Connections

(iv) Drawing No. 4 : Plate Girder

Plan and Elevation of Plate Girder with details at supports and connection of stiffness, flange angles and cover plate with web highlighting curtailment of plates.

(v) Drawing No. 5 : Draw atleast one sheet using CAD software

RECOMMENDED BOOKS

1. Layal JS "Civil Engineering Drawing", Satya Parkashan, New Delhi
2. Chandel RP " Civil Engineering Drawings"
3. Kumar; NS " Civil Engineering Drawing " IPH, New Delhi
4. Malik RS and Meo GA, "Civil Engineering Drawing" Asian Publishing House, New Delhi
5. Singh, Birinder "RCC Design and Drawing" Kaption Publishing House, New Delhi.
6. Singh, Birinder "Steel Structures Design and Drawing", Kaption Publishing House, New Delhi
7. Singh, Harbhajan, "Structural Drawings", Abhishek Publishers, Chandigarh
8. B.V. Sikka, Civil Engineering Drawing.

6.7 MAJOR PROJECT WORK
(INDUSTRY/FIELD ORIENTED - PRACTICE BASED)

	L	T	P
.	-	-	8

As far as possible students should be given live project problems with a view to :

i) Develop understanding regarding the size and scale of operations and nature of field work in which students are going to play their role after completing the courses of study.

ii) Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.

iii) Provide first hand experience to develop confidence amongst the students to enable them to use and apply classroom based knowledge and skills to solve practical problems of the world of work.

iv) Develop special skills and abilities like interpersonal skills, communication skills, attitudes and values.

For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience. It is necessary that each organization is visited well in advance by respective teachers and activities to be performed by students are well defined. The chosen activities should be such which are of curricular interest to students and of professional value to industrial/field organizations. Each teacher is expected to supervise and guide 5 - 6 students.

Effort should be made to identify actual field problems to be given as project work to the students. Project selected should not be too complex which is beyond the comprehension level of the students. The placement of the students for such a practical cum project work should match with the competency profile and interest of students. Students may be assessed both by industry and polytechnic faculty. The suggested performance criteria is given below:

a)	Punctuality and regularity	10
b)	Initiative in learning/working at site	10
c)	Level/proficiency of practical skills acquired	10
d)	Sense of responsibility	10
e)	Self expression/Communication skills	10
f)	Interpersonal skills	10
g)	Report writing skills	20
h)	Viva voce	20

Some of suggested projects are given below: These are only guidelines, teacher may take any project related to Civil Engineering depending upon the availability of projects. Preference should be given to practical oriented projects.

According to the need of the polytechnic, the following major projects are suggested:

1. Construction of a small concrete road consisting of following activities
   - Survey and preparation of site plan
   - Preparation of drawings i.e. L-Section and X-Section
   - Estimating earth work
   - Preparation of sub grade with stone ballast
   - Laying of concrete
   - Testing of slump, casting of cubes and testing
   - Material estimating and costing with specifications
   - Technical report writing

2. Water Supply system for a one or two villages
   - Surveying
   - Design of water requirements and water distribution system
   - Preparation of drawing of overhead tank
   - Material estimating and costing
   - Specifications
   - Technical report writing

3. Construction of seating benches in polytechnic campus

4. Welding of angle iron and Expanded metal jali to prepare fencing in polytechnic campus

5. Construction of toilets and baths for a shopping complex in a township

6. Construction of bridal path 4 kms long

7. Construction of shopping complex by detailing of RCC drawings, estimating and costing of material

8. Rainwater harvesting
   - Assessment of catchment's area
   - Intensity of rainfall
   - Collection of water
   - Soak pit design
   - Supply of water
   - Monitoring during rainy season

9. Design and construction of septic tank with soak pit for 100 users

10. Preparing plumbing detailed drawings of a two storey building and material estimate and costing

11. Planning and design of sports stadium in a township or cluster of villages

12. Design of small residential building including structural members, specifications, estimating and costing of materials, report writing and municipal drawings for water supply and sewerage system

13. Concrete Mix Design

14. Construction of concrete cubes by mixing appropriate quantity of fly ash with fibres
    (i) the fibres like polypropylene, carbon, steel etc. can be used
    (ii) students will show the comparison between concrete mixed with fibres verses the quality controlled concrete.

15. Estimation and designing of Highway Road
    (i) Reconniance survey of proposed road
    (ii) To take L - section and cross sections
    (iii) Fixing of grades
    (iv) Estimation of cutting and filling of earth mass
    (v) Plane tabling survey of proposed road
    (vi) Estimation of proposed road

16. Designing a small height gravity dam
    (i) Constructing of catchment area
    (ii) Calculating the reservoir capacity
    (iii) Designing of gravity dam by taking into account various forces

17. Designing of ferro-cement water tank and toilet. Testing of the ferro-cement products in civil engineering labs.

Note: The projects undertaken should be field oriented

6.8 SURVEY CAMP

10 Days Duration

Purpose

a) Making the students conversant with the camp life

b) Providing an opportunity to the students to develop team spirit

c) Training the students to communicate with the local population

d) To impart intensive training in the use of all surveying instruments viz. Theodolite , Dumpy level, Compass, tachometer etc.

e) To train the students to appreciate practical difficulties in surveying on the field

f). To train the students for self management

Task:

Preparation of topographical plan of a given area. The survey camp will be organized for a duration of 10 days time span.

The students may be assigned an undulated area of about 1.5 to 2.00 sq.km. with level difference of 15m consisting of good number of physical features such as buildings, roads, bridges, culverts, railway tracks, electric lines etc. They are required to prepare the topographic map of above areas showing various features along with contours using a suitable contour intervals. They will mark a road alignment of given gradient connecting any two stations on the map consisting some horizontal and vertical curves and will prepare estimate of earthwork and submit the detailed technical report indicating therein practical difficulties faced during surveying for the features like ridge, line, valley lines, saddle cliffs etc.

The students should be divided in the groups consisting of 5-7 in numbers. They are required to submit the Report of work done, during survey camp, which will be dully examined, while awarding the internal assessment.

6.9 EMPLOYABLE SKILLS

	L	T	P
Periods per week	-	-	4

RATIONALE

Diploma holders are required to not only possess subject related knowledge but also soft skills to get good jobs and to rise steadily at their workshop. This subject is included to develop employability skills amongst the students

DETAILED CONTENTS

1. Industrial Scenario Engineering Education and expectations of competences from an engineer by employer (04 period)
2. Personality types, characteristic and features for a successful engineer (04 period)
3. Professional Engineer desirable values and ethics and their development. Relation between engineering profession, society and environment (04 period)
4. Managing project (16 period)
   - Leadership
   - Motivation
   - Time management
   - Resource management
   - Computer Software
   - Interpersonal relationship
   - Engineer economics and fundamentals
5. Effective Communication (08 period)
   - Listening
   - Speaking
   - Writing
   - Presentation Technique/Seminar
   - Group discussion
6. Preparing for Employment (08 period)
   - Searching for job/job hunting
   - Resume Writing
   - Interview technique in personal interview telephonic interview, panel interview, group interview, video conference
7. Managing Self (06 period)
   - Managers body, mind, emotion and spirit
   - Stress Management
   - Conflict resolution

8. Continuing professional development (04 period)
   - Organising learning and knowledge
   - Use of computer for organising knowledge resource

9. Creativity, Innovation and Intellectual property right (06 period)
   - Concept and need in present time for an engineer

10. Basic rules, laws and norms to be adhered by engineers during their working (04 period)