

3.1 APPLIED MECHANICS

Periods/week L T P
 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 Riser 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

Elementary 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 and heterogeneous, macroscopic and microscopic, properties of system – intensive and extensive, thermodynamic equilibrium, quasi – static process, reversible and irreversible processes, concept of work and heat, equality of temperature, Zeroth law of thermodynamics, definition of properties like pressure, volume, temperature, enthalpy, internal energy, 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, Charles's law, Avogadro's law, Regnault's law, Universal gas constant, Characteristic gas equations, 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's experiment), Application of first law of thermodynamics to non-flow systems – Constant volume, constant pressure, Adiabatic and polytropic processes, steady flow 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: Kelvin-Planck's statement, Clausius 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 steam, 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, throttling calorimeter, 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 PRACTICES

- 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 mountings
- 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 analyse 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 moment.
- 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), determination 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
- 10.5 Efficiency of riveted joints

- 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, thermodynamics 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 petrol 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), CO₂, R - 11, R - 12, R - 502, Properties of ideal refrigerant, selection of refrigerant

7. Vapour Absorption System

04 Period

Introduction, principle, NH₃ 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

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, " Reinforced 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,

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, Measurement 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, hysteresis, 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 software 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 its 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 its classification .
- 1.8 Classification of mechanisms.
- 1.9 Equivalent mechanism.
- 1.10 Laws of inversion of mechanisms.
- 1.11 Four bar chain and its inversion
- 1.12 Single slider crank chain and its inversions.
- 1.13 Double slider crank mechanism and its 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 Governor 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
- 7.1 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 riveted joint

- 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 STRATEGY

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, charts and 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 programmes 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 fresh lubricant.
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 charts

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

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 ALLOTTED (Periods)	MARKS ALLOTTED (%)
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

RATIONALE

A diploma holder in mechanical engineering is supposed to manage the power generating plant. In Uttaranchal state, hydropower potential is supposed 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, terrestrial 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, vacuum 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 reactor, candu type reactor-system components, advantages and disadvantages 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 plant. 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 Uttarakhand 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 pawl Belt 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	Satisfactory	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	<i>Excellent</i>
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)