Mechanical Engineering /
Mechanical Engineering (RAC)

4.2 HYDRAULICS AND PNEUMATICS

L	T	P
4	-	2

RATIONALE

Diploma holders in this course are required to deal with problems of fluid and use of hydraulics and pneumatics in power generation. For this purpose, knowledge and skills about fluid mechanics and machinery, hydraulics and pneumatics systems are required to be imparted for enabling them to perform above functions.

DETAILED CONTENTS

1. Introduction (03 hrs)

   Fluid, types of fluid; properties of fluid viz mass density, weight density (specific weight), specific volume, capillarity, specific gravity, viscosity, compressibility, surface tension, kinematic viscosity and dynamic viscosity and their units.

2. Pressure and its Measurement (06 hrs)
   - 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 including simple problems
   - 2.3 Bourdon pressure gauge, Diaphragm pressure gauge, dead weight pressure gauge

3. Flow of Fluids (07 hrs)

   Types of fluid flow – steady and unsteady, uniform and non-uniform, laminar and turbulent; rate of flow and their units; continuity equation of flow; potential energy of a flowing fluid; total head; Bernoulli's theorem (statement and proof) and its applications. Discharge measurement with the help of venturi-meter, orifice meter, pitot-tube, limitations of Bernoulli's theorem simple problems.

4. Flow through Pipes (10 hrs)

   - 4.1 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 (without proof), Reynold's number and its effect on pipe friction; siphon, Nozzle - definition, velocity of liquid flowing through the nozzle, power developed. Water hammer, anchor block, syphon, surge tank (concept only).
   - 4.2 Loss of head in pipes due to sudden enlargement, sudden contraction, obstruction on flow path, change of direction and pipe fittings (without proof)

5. Hydraulic System (05 hrs)

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

hydraulic press, selection of specification of above systems for different applications

6. Water Turbines and Pumps (14 hrs)

6.1 Concept of a turbine, types of turbines –impulse and reaction type (concept only), difference between them. Construction and working of pelton wheel, Francis turbine, Propeller and Kaplan turbines. Unit speed, unit power, unit discharge, specific speed of turbines, selection of turbines based on specific speed.

6.2 Concept of hydraulic pump, single acting reciprocating pump (construction and operation only), vane, screw and gear pumps.

6.3 Construction, working and operation of centrigual pump. Performance, efficiencies and specifications of a centrifugal pump. Trouble shooting and problems in centrifugal pumps and remedial measures, pitting, cavitation, priming.

7. Introduction to Oil Power Hydraulics and Pneumatics (03 hrs)

7.1 Introduction to oil power hydraulics and pneumatic system
7.2 Statement of Pascal law and its applications
7.3 Industrial applications of oil power hydraulics and pneumatic system
7.4 Cavitation

8. Components of Hydraulic Systems (08 hrs)

8.1 Basic components of hydraulic system, function of each component in a hydraulic circuit.

8.2 Oil reservoirs, couplings, motors and pumps – definition and functions of the parts,

8.3 Filters- definition and purpose, classification

8.4 Seals and packing- classification of seals, sealing materials.

9. Components of Pneumatic Systems (08 hrs)

9.1 Basic components – function of each component
9.2 Air compressors – type, working
9.3 Air cylinder – types, function, single acting, double acting, rotating, non-rotating, piston type, diaphragm type, tanden cylinder, double ended cylinder, duplex cylinder.
9.4 Air filter, regulator and lubricator – their necessity in pneumatic circuit.
9.5 Installation, maintenance and application of air cylinders.

LIST OF PRACTICALS

1. Measurement of pressure head by employing.

    i) Piezometer tube
    ii) Single and double column manometer

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 find coefficient of friction for a pipe (Darcy's friction).
6. To study hydraulic circuit of an automobile brake and hydraulic ram.
7. Study the working of a Pelton wheel and Francis turbine.
8. To study a single stage centrifugal pump for constructional details and its operation to find out its normal head and discharge.

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS

1. Fluid Mechanics by KL Kumar; S Chand and Co Ltd., Ram Nagar, New Delhi.
2. Hydraulics and Fluid Mechanics Machine by RS Khurmi ; S.Chand & Co. Ltd., New Delhi.
3. Fluid Mechanics through Problems by RJ Garde; Wiley Eastern Ltd., New Delhi.
4. Fluid Mechanics by Dr AK Jain, Khanna Publishers, New Delhi.
5. Hydraulic and Pneumatic Control by K Shammuga Sundaram, S. Chand & Co. Ltd., New Delhi
6. Hydraulics and Hydraulic Machinery by Dr. Jagadish Lal; Metropolitan Book Company Ltd., Delhi.
7. Hydraulic and Pneumatic Power and Control Design, Performance and Application by Yeaple, McGraw Hill, New York..
8. Pneumatic Controls by Festo Didactic; Bangalore.
9. Pneumatics Control: An Introduction to the Principles by Werner Deppert and Kurt Stoll; Vogel – Verlag.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	03	06
2	06	10
3	07	10
4	10	16
5	05	08
6	14	20
7	03	06
8	08	12
9	08	12
Total	**64**	**100**

4.3 THERMODYNAMICS - I

L	T	P
4	-	2

RATIOANLE

A diploma holder in this course is supposed to maintain steam generators, turbines, compressors and other power plant equipment. Therefore, it is essential to impart him basic concepts of thermodynamics, steam generators, steam turbines, compressors and about IC engines.

DETAILED CONTENTS

1. Fundamental Concepts (06 hrs)

   Thermodynamic state and system, boundary, surrounding, 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, Zeroth law of thermodynamics, definition of properties like pressure, volume, temperature, enthalpy, internal energy.

2. Laws of Perfect Gases (05 hrs)

   Definition of gases, explanation of perfect gas laws – Boyle's law, Charle's law, Avagadro's law, Regnault's law, Universal gas constant, Characteristic gas constants, derivation

   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 (08 hrs)

   Types of thermodynamic processes – isochoric, isobaric, isothermal, hyperbolic, isentropic, polytropic and throttling processes, equations representing the processes

   Derivation of work done, change in internal energy, change in entropy, rate of heat transfer for the above processes

4. Laws of Thermodynamics (12 hrs)

   Laws 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 to equation, turbines, pump, boilers, compressors, nozzles, evaporators, limitations.

Heat source and heat sinks, statement of second laws of thermodynamics: Kelvin Planck's statement, Classius statement, equivalence of statements, Perpetual motion Machine of first kind, second kind, Carnot engine, Introduction of third law of thermodynamics, concept of irreversibility, entropy.

5. Ideal and Real Gases (06 hrs)

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

6. Properties of Steam (05 hrs)

Formation of steam and related terms, thermodynamics properties of steam, steam tables, internal latent heat, internal energy of stream, entropy of water, entropy of steam, T- S diagrams, Mollier diagram (H – S Chart), Expansion of steam, Hyperbolic, reversible adiabatic and throttling processes

Quality of steam (dryness fraction),

7. Steam Generators (05 hrs)

Uses of steam, classification of boilers, comparison of fire tube and water tube boilers. Construction features of Lancashire boiler, nestler boiler, Babcock & Wilcox Boiler. Introduction to modern boilers.

8. Air Standard Cycles (06 hrs)

Meaning of air standard cycle – its use, condition of reversibility of a cycle

Description of Carnot cycle, Otto cycle, Diesel cycle, simple problems on efficiency, calculation for different cycles

Comparison of Otto, Diesel cycles for same compression ratio or same peak pressure developed

Reasons for highest efficiency of Carnot cycle and all other cycles working between same temperature limits

9. Air Compressors (08 hrs)

Functions of air compressor – uses of compressed air, type of air compressors

Single stage reciprocating air compressor, its construction and working, representation of processes involved on P – V diagram, calculation of work done.

Multistage compressors – advantages over single stage compressors, use of air cooler – condition of minimum work in two stage compressor (without proof), simple problems

Rotary compressors – types, descriptive treatment of centrifugal compressor, axial flow compressor, vane type compressor

10. Introduction to Heat Transfer (03 hrs)

Modes of heat transfer, Fourier's law, steady state conduction, composite structures, Natural and forced convection, thermal radiation

LIST OF PRACTICALS

1. Determination of temperature by
   - 1.1 Thermocouple
   - 1.2 Pyrometer
   - 1.3 Infrared thermometer
2. Demonstration of mountings and accessories on a boiler.
3. Study of boilers (through industrial visit)
4. Study of air compressors.
5. Demonstration of heat transfer through conduction, convection and Radiation

INSTRUCTIONAL STRATEGY

1. Expose the students to real life problems.
2. Plan assignment so as to promote problem solving abilities.

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.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	10
2	05	08
3	08	12
4	12	20
5	06	10
6	05	08
7	05	08
8	06	10
9	08	10
10	03	04
Total	**64**	**100**

4.4 STRENGTH OF MATERIALS

L	T	P
4	-	2

RATIONALE

Diploma holders in this course are required to analyze reasons for failure of different components and select the required 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. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles in the solution of applied problems to develop the required competencies.

DETAILED CONTENTS

1. Stresses and Strains (08 hrs)

    1.1. Concept of load, stresses and strain
    1.2. Tensile compressive and shear stresses and strains
    1.3. Concept of Elasticity, Elastic limit and limit of proportionality.
        1.3.1. Hook's Law
        1.3.2. Young Modulus of elasticity
        1.3.3. Nominal stress
        1.3.4. Yield point, plastic stage
        1.3.5 Ultimate strength and breaking stress
        1.3.6. Percentage elongation
        1.3.7. Proof stress and working stress
        1.3.8. Factor of safety
        1.3.9 Shear modulus

    1.4. Longitudinal and circumferential stresses in seamless thin walled cylindrical shells (derivation of these formulae not required)

2. Resilience (04 hrs)

    2.1 Resilience, proof resilience and modulus of resilience
    2.2 Strain energy due to direct stresses
    2.3 Stresses due to gradual, sudden and falling load.

3. Moment of Inertia (10 hrs)

    3.1. Concept of moment of inertia and second moment of area
    3.2 Radius of gyration
    3.3 Theorm of perpendicualr axis and parallel axis (without derivation)

3.4 Second moment of area of common geometrical sections :Rectangle, Triangle, Circle (without derivation); Second moment of area for L,T and I section

3.5 Section modulus

4. Bending Moment and Shearing Force (10 hrs)

4.1 Concept of beam and form of loading

4.2 Concept of end supports-Roller, hinged and fixed

4.3 Concept of bending moment and shearing force

4.4 B.M. and S.F. Diagram for cantilever and simply supported beams with and without overhang subjected to concentrated and U.D.L.

5. Bending stresses (06 hrs)

5.1 Concept of Bending stresses

5.2. Theory of simple bending

5.3. Use of the equation $f/y = M/I = E/R$

5.4. Concept of moment of resistance

5.5. Bending stress diagram

5.6. Calculation of maximum bending stress in beams of rectangular, circular, and T section.

5.7 Permissible bending stress Section modulus for rectangular, circular and symmetrical I section.

6 Columns (08 hrs)

6.1. Concept of column, modes of failure

6.2. Types of columns

6.3. Buckling load, crushing load

6.4. Slenderness ratio

6.5. Factors effecting strength of a column

6.6 End restraints

6.7 Effective length

6.8 Strength of column by Euler Formula without derivation

6.9. Rankine Gourdan formula (without derivation)

7. Torsion (10 hrs)

7.1. Concept of torsion- difference between torque and torsion.

7.2. Use of torque equation for circular shaft

7.3. Comparison between solid and hollow shaft with regard to their strength and weight.

7.4. Power transmitted by shaft

7.5. Concept of mean and maximum torque

8. Springs (8 hrs)

8.1. Closed coil helical springs subjected to axial load and impact load
8.2 Stress deformation
8.3 Stiffness and angle of twist and strain energy
8.4 Proof resilience
8.5 Laminated spring (semi elliptical type only)
8.6 Determination of number of plates

LIST OF PRACTICALS

1. Tensile test on bars of Mild steel and Aluminium.
2. Bending tests on a steel bar or a wooden beam.
3. Impact test on metals
   a) Izod test
   b) Charpy test
4. Torsion test on specimens of different metals for determining modulus of rigidity.
5. To determine the stiffness of a helical spring and to plot a graph between load and extension.
6. Hardness test on different metals.

INSTRUCTIONAL STRATEGY

1. Expose the students to real life problems.
2. Plan assignments so as to promote problem solving abilities and develop continued learning skills.

.RECOMMENDED BOOKS

1. SOM by Birinder Singh,; Katson Publishing House, New Delhi.
2. SOM by RS Khurmi; S.Chand & Co; New Delhi
3. Elements of SOM by D.R. Malhotra & H.C.Gupta; Satya Prakashan, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	08	12
2	04	06
3	10	16
4	10	16
5	06	10
6	08	12
7	10	16
8	08	12
Total	**64**	**100**

4.5 WORKSHOP TECHNOLOGY-II

L	T	P
4	-	6

RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various machining processes, modern machining methods, processing of plastic, tools, jigs and fixtures and processing of plastics is required to be imparted. Hence the subject of workshop technology.

DETAILED CONTENTS

1. Cutting Tools and Cutting Materials (06 hrs)

   1.1. Cutting Tools - 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

   1.2 Cutting Tool Materials - 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.

2. Lathe (10 hrs)

   2.1 Principle of turning
   2.2 Description and function of various parts of a lathe
   2.3 Classification and specification of various types of lathe
   2.4 Drives and transmission
   2.5 Work holding devices
   2.6 Lathe tools: Parameters/Nomenclature and applications
   2.7 Lathe operations :- Plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling, form turning, spinning.
   2.8 Cutting parameters – Speed, feed and depth of cut for various materials and for various operations, machining time.
   2.9 Speed ratio, preferred numbers of speed selection.
   2.10 Lathe accessories:- Centers, dogs, different types of chucks, collets, face plate, angle plate, mandrel, steady rest, follower rest, taper turning attachment, tool post grinder, milling attachment, Quick change device for tools.
   2.11 Brief description of capstan and turret lathe, comparison of capstan/Turret lathe, work holding and tool guiding devices in capstan and turret lathe.

3. Drilling (08 hrs)

3.1 Principle of drilling.
3.2 Classification of drilling machines and their description.
3.3 Various operation performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping.
3.4 Speeds and feeds during drilling, impact of these parameters on drilling, machining time.
3.5 Types of drills and their features, nomenclature of a drill
3.6 Drill holding devices.
3.7 Types of reamers.

4. Boring (06 hrs)
4.1 Principle of boring
4.2 Classification of boring machines and their brief description.
4.3 Specification of boring machines.
4.4 Boring tools, boring bars and boring heads.
4.5 Description of jig boring machine.

5. Shaping, Planing and Slotting (10 hrs)
5.1 Working principle of shaper, planer and slotter.
5.2 Type of shapers
5.3 Type of planers
5.4 Quick return mechanism applied to shaper, slotter and planer machine.
5.5 Work holding devices used on shaper, planer and slotter.
5.6 Types of tools used and their geometry.
5.7 Specification of shaper, planer and slotting machine.
5.8 Speeds and feeds in above processes.

6. Broaching (06 hrs)
6.1 Introduction
6.2 Types of broaching machines – Single ram and duplex ram horizontal type, vertical type pull up, pull down, push down.
6.3 Elements of broach tool, broach tooth details – nomenclature, types, and tool material.

7. Jigs and Fixtures (08 hrs)

7.1 Importance and use of jigs and fixture
7.2 Principle of location
7.3 Locating devices
7.4 Clamping devices
7.5 Types of Jigs – Drilling jigs, bushes, template jigs, plate jig, channel jig, leaf jig.
7.6 Fixture for milling, turning, welding, grinding
7.7 Advantages of jigs and fixtures

8. Cutting Fluids and Lubricants (10 hrs)

8.1 Function of cutting fluid
8.2 Types of cutting fluids
8.3 Difference between cutting fluid and lubricant
8.4 Selection of cutting fluids for different materials and operations
8.5 Common methods of lubrication of machine tools.

PRACTICAL EXERCISES

Turning Shop

Job 1. Grinding of single point turning tool.

Job 2. Exercise of simple turning and step turning.
Job 3. A composite job involving, turning, taper turning, external thread cutting and knurling.

Advance Fitting Shop

Job 1. Exercise on drilling, reaming, counter boring, counter sinking and taping
Job 2. Dove tail fitting in mild steel
Job 3. Radius fitting in mild steel
Job 4. Pipe threading with die

Machine Shop

Job 1. Prepare a V-Block up to ± 0.5 mm accuracy on shaper machine
Job 2. Exercise on key way cutting and spline cutting on shaper machine.

INSTRUCTIONAL STRATEGY

1. Teachers should lay emphasis in making students conversant with concepts and principles of manufacturing processes.
2. Focus should be on preparing jobs using various machines in the workshop

RECOMMENDED BOOKS

1. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Sons; Delhi
2. Manufacturing Technology by M. Adithan and A.B. Gupta; New Age International (P) Ltd, Delhi.
3. Elements of Workshop Technology by SK Choudhry and Hajra; Asia Publishing House
4. A Text Book of Production Engineering by PC Sharma; S Chand and Company Ltd. Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	10
2	10	18
3	08	12
4	06	10
5	10	15
6	06	10
7	08	10
8	10	15
Tot1al	**64**	**100**

4.6 MECHANICAL ENGINEERING DRAWING-II

L T P
- - 7

RATIONALE

Diploma holders in Mechanical Engineering are required to interpret drawings and therefore it is essential that they have skills of preparing drawings and sketches of mechanical components. This subject aims at development of skills and understanding of mechanical engineering drawings.

DETAILED CONTENS

1. Introduction to drawing office equipment, through a visit to modern drawing office of an industry
2. Drilling Jig (Detail and Assembly) — 2 sheets
3. Vices — 3 sheets
   - 3.1 Machine vice (Detailed and Assembly drawing)
4. I.C. Engine Parts — 3 sheets
   - 4.1 Piston
   - 4.2 Connecting rod (Assembly drawing)
   - 4.3 Crankshaft and flywheel assembly
5. Boiler Parts — 2 sheets
   - 5.1 Steam Stop Valve (Assembled drawing)
   - 5.2 Blow off cock. (Assembled drawing)
6. Mechanical Screw Jack (Assembled Drawing) — 1 sheet
7. Cams — 4 sheets
   - 7.1 Types of cams and followers (Theoretical)
   - 7.2 Profile of cams for imparting following motions with knife edge and roller followers.:
     - Uniform motion
     - Simple Harmonic Motion
     - Uniformity accelerated and retarded motion:
8. Gears — 4 sheets
   - 8.1 Nomenclature of gears and conventional representation
   - 8.2 Drawing the actual profile of involute teeth of spur gear by different methods.

Note:
1. 1st angle projection should be followed. 20% of the drawings may be made using 3rd angle projection.
2. SP- 46-1998 should be followed. The drawings should include dimensions with tolerance wherever necessary and material as per BIS/ISO specifications.

RECOMMENDED BOOKS

1. Machine Drawing by P.S. Gill; S.K. Kataria & Sons, Ludhiana
2. A Text Book of Machine Drawing by RK Dhawn; S.Chand & Co. Ltd., New Delhi.
3. Machine drawing by N.D Bhatt, Charotar Book Depot, Anand

INDUSTRIAL TRAINING

Industrial Training aims at exposing the students to field practices, size and scale of operation and work culture at practical sites. For this purpose, students at the end of fourth semester are required to be sent for a period of 4 weeks to industry.

Each student is supposed to study the material and technology used at site and prepares a detailed report of the observation of process seen by him/her. These students should be supervised and guided by respective subject teachers. Each teacher may guide a group of four to five students.

The teacher along with field supervisors will conduct performance assessment of students. 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%