

COURSE TITLE : **FLUID MECHANICS & PNEUMATICS**
COURSE CODE : **3022**
COURSE CATEGORY : **B**
PERIODS/ WEEK : **6**
PERIODS/ SEMESTER : **90**
CREDIT : **6**

TIME SCHEDULE

MODULE	TOPIC	PERIODS
1	Properties of fluid. Fluid pressure and its measurement.	21
2	Kinematics and dynamics of fluid flow. Flow through Orifice, Notches, Pipes and nozzles.	25
3	Power hydraulics technology	22
4	Pneumatic system and Design of Circuits.	22
TOTAL		90

COURSE OUTCOME :

Sl.no.	Sub	Student will be able to
1	1	Appreciate the fluid properties, pressure and its measurement.
	2	Understand the Kinematics and dynamics of fluid flow.
	3	Appreciate the flow through Orifice, Notches, Pipes and Nozzles
	4	Comprehend the Power Hydraulics Technology
	5	Understand the Pneumatic system and Design of Circuits

SPECIFIC OUTCOME

MODULE I

1.1.0 Understand the Properties of Fluid, Fluid Pressure and its Measurements

- 1.1.1 Explain the areas of application of Hydraulics
- 1.1.2 Appreciate the properties of Hydraulic Fluids
- 1.1.3 Solve Simple problems related to density, specific weight, specific volume, and specific gravity.
- 1.1.4 Understand the Fluid Pressure and the methods to Measure it
- 1.1.5 Explain the terms pressure and pressure head and solve problems on these
- 1.1.6 State and explain Pascal's law
- 1.1.7 Explain Absolute, Gauge, Atmospheric and Vacuum pressures.
- 1.1.8 State the fundamental principles of pressure measuring devices
- 1.1.9 illustrate the principle of working of piezometer, simple U-tube manometer, differential manometer, inverted differential manometer, bourdon's tube pressure gauge and solve simple problems on those.

- 1.1.10 Explain the term total pressure
- 1.1.11 Solve problems using equations of total pressure on an immersed surface in horizontal, vertical and inclined positions.
- 1.1.12 State buoyancy and the buoyant forces and solve simple problem
- 1.1.13 Describe Metacentre and met centric height

MODULE II

2.1.0 Understand the Kinematics and dynamics of fluid flow

- 2.1.1 Explain the term Kinematics
- 2.1.2 Explain the types of fluid flow –
- 2.1.3 Explain the Rate of Discharge
- 2.1.4 Explain the equation for continuity of flow with derivation
- 2.1.5 Explain the energies possessed by a liquid particle that is potential, kinetic and pressure
- 2.1.6 Define total energy and total head
- 2.1.7 Derive & State Bernoulli's equation .
- 2.1.8 State the limitations of the Bernoulli's theorem
- 2.1.9 Solve the problems using Bernoulli's equation
- 2.1.10 Explain the practical applications of Bernoulli's equation, Venturimeter, Pitot Tube, solve problems using it.

2.2.0 Understand the Flow Through Orifice, Notches Pipes and Nozzles

- 2.2.0 Illustrate the Flow of Liquids through Orifices, Notches and Pipes, also find the coefficient & discharge
- 2.2.1 List the losses of head in pipes and identify Major losses and Minor losses
- 2.2.2 Derive Darcy's formula and Chezy's formula for loss of head in pipes and explain the terms hydraulic mean depth, hydraulic gradient line and total energy line.
- 2.2.3 Understand the transmission of power through pipes and the equation for power transmitted through a pipe
- 2.2.4 State the functions of Nozzle and derive the exit velocity.
- 2.2.5 Explain water hammer

MODULE III

3.1.0 Understand the Power Hydraulics Technology

- 3.1.1 Understand the basic law of Power Hydraulics Technology
- 3.1.2 Identify the applications of hydraulic power
- 3.1.3 Know the essential properties of the hydraulic oils and codes
- 3.1.4 Illustrate the elements of Hydraulic System with standard symbols.
- 3.1.5 Classify the pumps
- 3.1.6 Explain the working principle of different type Positive displacement pumps
- 3.1.7 Explain the Types of Hydraulic Actuators – Rotary (Hydraulic motor) – Semi-rotary-linear motion type (Hydraulic cylinders)
- 3.1.8 Describe the working principle of different control valves – pressure control valves, direction control valves and flow control valves.
- 3.1.9 Describe the types of accumulator
- 3.1.10 Know the hydraulic circuits and its elements
- 3.1.11 Illustrate Automatic cylinder reciprocating circuit and hydraulic circuit for robotic arm

MODULE IV

4.1.0 Understand the Pneumatic system and Design of Circuits

- 4.1.1 Compare the Pneumatic system with hydraulic system
- 4.1.2 Identify the standard pneumatic symbols
- 4.1.3 Understand the pneumatic control elements and components
- 4.1.4 Explain with sketches pneumatic valves – direction control valves- pressure control valves and flow control valves
- 4.1.5 Describe the pneumatic actuators – pneumatic cylinders, air motors – types applications
- 4.1.6 Understand the simple pneumatic circuit
- 4.1.7 Describe the principle of power operated holding devices - clamping circuits
- 4.1.8 Understand hydraulic, pneumatic and hydro pneumatic systems
- 4.1.9 Explain the principle of working of air controlled valves and oil controlled valves
- 4.1.10 Sketch the arrangements for the control of hydraulic circuits by air
- 4.1.11 Know the elementary idea about design of hydraulic/pneumatics circuits and its simulation

CONTENT DETAILS

MODULE – I

Introduction- Importance of Hydraulics-Properties of Fluid- Density- specific weight- specific volume-specific gravity – problems – viscosity- kinematic viscosity -Newton's law of viscosity - compressibility - surface tension - capillarity- Types of fluids-Ideal- Real- Newtonian and non newtonian – Fluid pressure and its measurement- Fluid pressure at a point – pressure head – problems – Pascal's law – absolute-gauge- atmospheric and vacuum pressures – measurement of fluid pressure – Piezometer tube – simple manometer – differential manometer – inverted differential manometer – problems – Bourdon's tube pressure gauge– Total pressure – total pressure on immersed surface – horizontal – vertical – inclined – problems. Buoyancy –buoyant forces-- Meta centre and meta centric height- solve simple problems

MODULE – II

matics and Dynamics of fluid flow- Introduction – types of fluid flow – steady and unsteady flow – uniform and non-uniform flow – laminar and turbulent flow – compressible and incompressible flow – rotational and irrotational flow – one- two and three dimensional flow – Rate of flow or discharge – equation of continuity of liquid flow – simple problems – Energy of a liquid in motion – potential energy- kinetic energy- pressure energy- total energy- Total head of liquid in motion – Bernoulli's equation (with derivation) – assumptions – simple problems – practical applications of Bernoulli's equation – venturimeter – Orifice meter – Pitot tube – simple problems. Flow through Orifices-Notches- Pipes and Nozzles -Orifices – types of orifices – Vena contracta – coefficient of contraction – coefficient of velocity – coefficient of discharge – simple problems- Notches – types of notches – Rectangular notches – triangular notch – trapezoidal notch – discharge over notches – simple problems – loss of head in pipes – major energy losses – minor energy losses – loss of energy due to friction – Darcy's formulae(with derivation) for loss of head in pipes – Chezy's formula for loss of head in pipes – simple problems– transmission of power through pipes – simple problems – flow through Nozzle and derive the expression for velocity - water hammer

MODULE – III .

Fluid Power- Introduction – Basic law – Applications of fluid power – properties of hydraulic oils such as viscosity index- Oxidation stability- Demulsibility- Lubricity- Rust prevention- Pour point- Flash and fire point- Neutralisation number. and specifications -Hydraulic systems- Basic elements of hydraulic system – Oil reservoir- pump- filter unit – Principles of working of Positive displacement pump – Classifications – Gear pumps- Screw Pump- Vane pumps- Lobe pump- Simple piston pumps. Hydraulic actuators – Classifications – Rotary– Linear motion type – Hydraulic motors –Types of Hydraulic cylinders - single acting- double acting - Hydraulic control elements and components

Control valves – Functions – classifications – Describe the working of pressure control valves such as relief valves - poppet valve – Direction control valves – types – sliding spool type- poppet valves – check valves – 1 way- 2 way- 3 way directional control valves- solenoid control valve. Flow control valves – types – gate- globe- butterfly valves- non return valve- application circuits of control valves- Intensifier & accumulators – purpose – types – weight loaded- spring loaded- gas loaded- standard Hydraulic symbols .Hydraulic Circuits-circuit symbols -Describe with diagram of automatic cylinder reciprocating circuit – hydraulic circuit for robotic arm - Introduction to electro hydraulics – Practical applications of hydraulics

MODULE – IV.

Pneumatic System- Comparison of pneumatic system with hydraulic system – identification of standard pneumatic symbols – basic pneumatic system – Reservoir- air filter- pressure regulator- lubricator- FRL unit- mufflers. Pneumatic control elements and components- Pneumatic control valves – operation of manually operated 2 way- 3 way- 4way directional control valves - solenoid valves – operation of manually and cam operated flow control valves. Air cylinders – types - light- medium- heavy- tandem-duplex- double end types - Basic pneumatic circuits – principle of working of power operated holding devices – chuck and clamping device .- Comparison of hydraulic- pneumatic and hydro-pneumatic system –Application-circuits-Acceleration/retraction circuits-a study on design of hydraulic/pneumatics circuits and its simulation - Introduction to electro pneumatics - Practical applications of pneumatics

TEXT BOOKS:

1. Hydraulics and Fluid mechanics - R.S.Khurmi.(S.Chand &Co)
2. Basic fluid power - John Oster
3. Fluid mechanics – Kapoor-Baljith.s.(new age international)
4. Hydraulic & Pneumatic circuits K Shanmughasundaram(S Chand & Co)
5. Industrial automation & Robotics A K Guptha & SK Arora (Laxmi Publications)
6. Pneumatic controls -JOJI –Wiley India Ltd

REFERENCE BOOKS

1. Support materials in pneumatics - NITTTR- Chennai
2. Pneumatic Systems Principles and maintenance - Majumdar (Tata Mc Graw Hill)
3. Fluid Mechanics - Joseph H. Spurk. (Springer)
4. Fluid Mechanics and Pneumatics -M.R.Thomas &C.K.M.Sagir(M&C Publishers)
5. Festo Hydraulics and Pneumatics Manual