GUJARAT TECHNOLOGICAL UNIVERSITY

BE-3 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code:
Fluid Flow Operations (3130502)

Unit 1: Fluid Static and Its Application & Fluid Flow Phenomena

Topics: Properties of fluids, pressure, hydrostatic equilibrium, decanters, Newtonian/non-Newtonian fluids, viscosity, Reynolds number, laminar/turbulent flow, boundary layers.

Repeated Questions:

1. **Define/Explain:**
   - **Ideal fluid, Potential flow, Fully developed flow**
     - Appeared in: **S24 (Q1a, 03 marks)**, **S23 (Q2a, 03 marks)**
2. **Define viscosity and its units.**
   - Appeared in: **S23 (Q1a, 03 marks)**, **S22 (Q4a, 03 marks)**
3. **Explain Newtonian and Non-Newtonian fluids with examples.**
   - Appeared in: **S24 (Q3c, 07 marks)**, **S22 (Q5a, 03 marks)**, **W25 (Q1c, 07 marks)**
4. **Explain laminar and turbulent flow.**
   - Appeared in: **S22 (Q2b, 04 marks)**, **W25 (Q1b, 04 marks)**, **W23 (Q1b, 04 marks)**
5. **Explain boundary layer formation in straight tubes/pipes.**
   - Appeared in: **S24 (Q5b, 04 marks)**, **W25 (Q5b, 04 marks)**, **W24 (Q1b, 04 marks)**
6. **What is cavitation? / Define cavitation in pumps.**
   - Appeared in: **S24 (Q2a, 03 marks)**, **S23 (Q5a, 03 marks)**, **W25 (Q3a, 03 marks)**

Other Important Questions:

1. **Define:**
   - **Dynamic and kinematic viscosity** – W25 (Q1a, 03 marks)
   - **Mass velocity, ideal fluid, real fluid** – S22 (Q1a, 03 marks)
   - **Mach number, Drag coefficient, Reynolds number** – S24 (Q4a, 03 marks)
2. **Explain:**
   - **Continuous gravity decanter** – S24 (Q1b, 04 marks), S22 (Q3b, 04 marks)
   - **Centrifugal decanter** – S22 (Q3b, 04 marks)
   - **Boundary layer separation and wake formation** – S22 (Q1b, 04 marks), W25 (Q5a, 03 marks)
   - **Significance of Reynolds number** – W25 (Q3a, 03 marks)
   - **Significance of Mach number** – S23 (Q4a, 03 marks)
3. **Classify fluids based on externally applied temperature and pressure with examples.**
   - W23 (Q1a, 03 marks)
4. **Define/Explain:**
   - **Compressible and incompressible fluids** – S22 (Q5a, 03 marks)
   - **Stagnation point** – W24 (Q1a, 03 marks), W22 (Q1a, 03 marks)
   - **Pseudoplastic fluids (with example)** – W24 (Q1a, 03 marks), W22 (Q1a, 03 marks)

Unit 2: Basic Equations of Fluid Flow

Topics: Mass/avg. velocity, potential flow, streamlines, continuity eq., Bernoulli's eq., momentum balance, correction factors.

Repeated Questions:

1. **Derive Bernoulli's equation and explain correction factors.**
   - Appeared in: **S23 (Q3c, 07 marks)**, **S24 (Q2c, 07 marks)**, **S22 (Q1c, 07 marks)**
2. **Derive the equation of continuity.**
   - Appeared in: **S23 (Q2c OR, 07 marks)**
3. **Define/Explain:**
   - **Mass velocity and average velocity relation** – S24 (Q3c, 07 marks)
   - **Potential flow, streamline, stream tubes** – S22 (Q3a, 03 marks)
4. **Derive/Explain:**
   - **Kinetic energy correction factor (α)** – W24 (Q3a OR, 03 marks)
   - **Momentum correction factor (β)** – W24 (Q2a, 03 marks), W22 (Q2a, 03 marks)

Other Important Questions:

1. **Derive the working equation of a U-tube manometer.**
   - S23 (Q1c, 07 marks)
2. **Develop equation for pressure difference for inclined tube manometer.**
   - S22 (Q2c, 07 marks)
3. **Derive Bernoulli's equation for flow with friction through inclined stream tube.**
   - S24 (Q2c, 07 marks)
4. **Explain pump work in Bernoulli's equation.**
   - S22 (Q4b, 04 marks)
5. **Describe correction for friction in Bernoulli's equation.**
   - S22 (Q4b OR, 04 marks)
6. **Explain form friction losses in Bernoulli's equation with example.**
   - W25 (Q5a, 03 marks)
7. **Derive angular momentum equation / macroscopic momentum balance.**
   - Mentioned in syllabus; not directly asked but related.

Unit 3: Flow of Incompressible Fluids in Conduits and Thin Layers

Topics: Laminar/turbulent flow in pipes, friction factor, Hagen-Poiseuille eq., roughness effect, non-circular cross-sections, hydraulic radius, sudden expansion/contraction, fittings losses.

Repeated Questions:

1. **Derive Hagen-Poiseuille equation.**
   - Appeared in: **S24 (Q3c OR, 07 marks)**, **S23 (Q2c, 07 marks)**, **W24 (Q2b, 04 marks)**, **W22 (Q2b, 04 marks)**
2. **Define hydraulic radius / equivalent diameter.**
   - Appeared in: **S24 (Q3a, 03 marks)**, **W24 (Q4b, 04 marks)**
3. **Show that avg. velocity = ½ max velocity for laminar flow in circular pipe.**
   - Appeared in: **W25 (Q4c, 07 marks)**
4. **Discuss friction loss in sudden expansion/contraction of pipe.**
   - Appeared in: **W25 (Q5c, 07 marks)**, **S23 (Q5c OR, 07 marks)**
5. **Explain velocity distribution for laminar flow of Newtonian fluid in circular channel.**
   - Appeared in: **W25 (Q5b, 04 marks)**

Other Important Questions:

1. **Discuss friction factor for flow through channels of non-circular cross-section.**
   - W23 (Q3c OR, 07 marks)
2. **Effect of roughness for flow through pipe.**
   - W23 (Q3b OR, 04 marks)
3. **Define friction factor and establish relation between skin friction parameters.**
   - W23 (Q3a, 03 marks)
4. **Explain fully developed flow and transition length for laminar/turbulent flow.**
   - W24 (Q5c, 07 marks), W22 (Q5c, 07 marks)
5. **Explain separation of boundary layers in diverging channel.**
   - W24 (Q3a, 03 marks), W22 (Q3a, 03 marks)
6. **Numerical on friction loss / pressure drop in pipes** – Multiple papers:
   - S22 (Q5b, 04 marks) – Water flow in pipe
   - S22 (Q5c, 07 marks) – Crude oil pumping
   - W24 (Q2c, 07 marks) – Sugar syrup flow
   - W23 (Q3b, 04 marks) – Water flow in pipe

Unit 4: Flow of Compressible Fluids

Topics: Mach number, continuity & energy eq., velocity of sound, isentropic/adiabatic/isothermal flow, nozzles.

Repeated Questions:

1. **Define Mach number and explain its significance.**
   - Appeared in: **S24 (Q4a, 03 marks)**, **S23 (Q4a, 03 marks)**, **S22 (Q3a OR, 03 marks)**
2. **Explain isentropic flow of compressible fluid through nozzles.**
   - Appeared in: **S23 (Q4b, 04 marks)**, **S22 (Q3c OR, 07 marks)**, **W25 (Q4c, 07 marks)**
3. **Derive expression for critical pressure ratio (rc) for isentropic flow.**
   - Appeared in: **W25 (Q4b, 04 marks)**

Other Important Questions:

1. **Derive expression for effect of cross-sectional area on velocity for isentropic flow through nozzle.**
   - W25 (Q4a, 03 marks)
2. **Explain asterisk condition and stagnation condition. Derive stagnation temperature expression.**
   - W24 (Q5b, 04 marks), W22 (Q5b, 04 marks)
3. **Explain concept of isothermal friction flow with diagram.**
   - W24 (Q3b, 04 marks), W22 (Q3b, 04 marks)
4. **Barometric equation with nomenclature.**
   - S22 (Q4a, 03 marks)

Unit 5: Flow Past Immersed Bodies & Dimensional Analysis

Topics: Drag, drag coefficient, dimensional analysis methods.

Repeated Questions:

1. **Define drag and drag coefficient.**
   - Appeared in: **S24 (Q4a, 03 marks)**, **S23 (Q4a OR, 03 marks)**, **W25 (Q4a, 03 marks)**
2. **Explain Rayleigh method / Buckingham Pi method for dimensional analysis.**
   - Appeared in: **S24 (Q1c, 07 marks)**, **S23 (Q4b, 04 marks)**, **W25 (Q3c, 07 marks)**, **W23 (Q5c, 07 marks)**

Other Important Questions:

1. **The efficiency η of a fan depends on ρ, μ, ω, D, Q. Express in dimensionless parameters.**
   - S24 (Q1c, 07 marks)
2. **Power required by agitator: function of D, N, μ, ρ. Obtain relation using Buckingham Pi method.**
   - W25 (Q3c, 07 marks)
3. **Pressure drop per unit length depends on d, v, ρ, μ. Find relation.**
   - W24 (Q4c, 07 marks), W22 (Q4c, 07 marks)

Unit 6: Transportation and Metering of Fluids

Topics: Pipes, tubing, fittings, valves, pumps, fans, blowers, compressors, vacuum pumps, flow meters.

Repeated Questions:

1. **Distinguish between pipe and tube.**
   - Appeared in: **S24 (Q4b, 04 marks)**, **W25 (Q3b, 04 marks)**
2. **Explain working of Gate valve and Globe valve.**
   - Appeared in: **S24 (Q5b, 04 marks)**, **S22 (Q4c, 07 marks)**, **S23 (Q5b, 04 marks)**
3. **Explain construction and working of Venturimeter / Orifice meter / Rotameter.**
   - Appeared in: **S23 (Q5c, 07 marks)**, **W25 (Q2b, 04 marks)**, **W24 (Q5b, 04 marks)**
4. **Define NPSH, priming, cavitation.**
   - Appeared in: **S24 (Q5a, 03 marks)**, **W25 (Q3a, 03 marks)**, **W23 (Q4b, 04 marks)**
5. **Explain construction and working of centrifugal pump / reciprocating pump.**
   - Appeared in: **S23 (Q4c, 07 marks)**, **S23 (Q4c OR, 07 marks)**, **W25 (Q5c, 07 marks)**

Other Important Questions:

1. **Explain Needle valve and Ball valve.**
   - S24 (Q2b, 04 marks)
2. **Explain variable head meter and variable area meter with example.**
   - S24 (Q5a OR, 03 marks)
3. **Explain Target meter.**
   - W25 (Q2a, 03 marks)
4. **Explain insertion meter concept.**
   - W24 (Q5b, 04 marks), W22 (Q5b, 04 marks)
5. **Explain stuffing boxes / prevention of leakage around moving parts.**
   - S24 (Q3b, 04 marks), W25 (Q5b, 04 marks), W24 (Q4a, 03 marks)
6. **Discuss fans, blowers, compressors – differences.**
   - W25 (Q4b, 04 marks)
7. **Explain jet ejector with diagram.**
   - W23 (Q4b, 04 marks)
8. **List check valves and draw labeled diagram.**
   - W23 (Q4a OR, 03 marks)
9. **Define Schedule number & BWG.**
   - W23 (Q5a, 03 marks)
10. **Distinguish between notch and weir.**
    - S24 (Q3b, 04 marks), W24 (Q5a, 03 marks), W22 (Q5a, 03 marks), W23 (Q5b, 04 marks)
11. **Numerical on Venturimeter / Orifice meter / Pitot tube** – Multiple:
    - S24 (Q5c, 07 marks) – Pitot tube flow rate calculation
    - W25 (Q2c, 07 marks) – Orifice meter mass flow rate
    - S22 (Q5c OR, 07 marks) – Venturimeter throat diameter
    - W23 (Q4c OR, 07 marks) – Orifice meter mass flow rate
12. **Numerical on pump power / head / efficiency** – Multiple:
    - S22 (Q5c, 07 marks) – Crude oil pump power
    - W24 (Q3c OR, 07 marks) – Centrifugal pump motor power
    - W23 (Q5c OR, 07 marks) – Centrifugal fan power

Unit 7: Measurement of Flowing Fluids

Topics: Full-bore meters, area meters, insertion meters.

Repeated Questions:

1. **Derive flow equation for Venturimeter starting from Bernoulli's theorem.**
   - Appeared in: **S23 (Q5c, 07 marks)**, **W25 (Q3c, 07 marks)**, **W23 (Q4c, 07 marks)**
2. **Why coefficient of discharge of Venturimeter > Orifice meter?**
   - Appeared in: **S23 (Q5a OR, 03 marks)**
3. **Explain Pitot tube / insertion meters.**
   - Appeared in: **W24 (Q5b, 04 marks)**, **W22 (Q5b, 04 marks)**

Other Important Questions:

1. **Discuss different types of flow measuring devices with utility and application.**
   - S24 (Q4c, 07 marks)
2. **Discuss various types of flow observed in two-phase flow.**
   - W24 (Q5c, 07 marks), W22 (Q5c, 07 marks)
3. **Distinguish between area meters and insertion meters.**
   - W23 (Q5a OR, 03 marks)

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