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**Printed Page:-4** **Subject Code:- BME0404**

**Roll. No:**

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**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA**
**(An Autonomous Institute Affiliated to AKTU, Lucknow)**
**B.Tech**
**SEM: IV - THEORY EXAMINATION (2025 - 2026)**
**Subject: Fluid Mechanics & Machines**

**Time: 3 Hours** **Max. Marks: 100**

**General Instructions:**

**IMP:** *Verify that you have received the question paper with the correct course, code, branch etc.*

***1.*** *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

***2.*** *Maximum marks for each question are indicated on right -hand side of each question.*

***3.*** *Illustrate your answers with neat sketches wherever necessary.*

***4.*** *Assume suitable data if necessary.*

***5.*** *Preferably, write the answers in sequential order.*

***6.*** *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*



## SECTION-A 20

1. Attempt all parts:-

(1.1) The viscous force the relative motion between the adjacent layers of a fluid in motion. Which of the following flowing fits best in the sentence? (CO1,K1) 1

(a) never affects
(b) may effect under certain conditions
(c) facilitates
(d) opposes

(1.2) Which of the following is a type of fluid based on viscosity? (CO1,K1) 1

(a) Real Fluid
(b) Ideal Fluid
(c) Newtonian Fluid
(d) All of the mentioned

(1.3) Which among these forces does not act in a moving fluid? (CO2,k2) 1

(a) Inertial force
(b) Viscous force
(c) Gravity force
(d) Drag

(1.4) What is the nature of streamlines of free vortex flow? (CO2,K1) 1

(a) Concentric
(b) Non-concentric
(c) Linear
(d) None of the mentioned

(1.5) Which among the following is the correct formula for head loss? (CO3,K1) 1

(a) Z1-Z2
(b) C
(c) T2-T1
(d) S2-S1

(1.6) The liquid flowing through a series of pipes can take up.. (CO3,K1) 1

(a) Pipes of different diameters
(b) Pipes of the same diameters only.
(c) Single pipe only
(d) Short pipes only

(1.7) Specific speed of reaction turbine is between? (CO4,K1) 1

(a) 5 and 50
(b) 10 and 100
(c) 100 and 150
(d) 150 and 300

(1.8) Francis and Kaplan turbines are known as (CO4,K1) 1

(a) Impulse turbine
(b) Reaction turbine
(c) Axial flow turbine
(d) Mixed flow turbine

(1.9) Internal cavitation in pump occurs due to (CO5,K1) 1

(a) Drag force
(b) Cyclic stress
(c) Shock waves
(d) Flow speed

(1.10) Reciprocating pumps operate by drawing _____ into the chamber .(CO5,K1) 1

(a) Liquid
(b) Pressure
(c) Heat
(d) Electricity

2. Attempt all parts:-

(2.1) Define viscosity. (CO1,K1) 2

(2.2) What are the various minor losses? (CO2,K1) 2

(2.3) Define Metacentre.(CO3,K1) 2

(2.4) What are the classifications of turbine? (CO4,K2) 2

(2.5) Differentiate pump and turbine. (CO5,K2) 2

**SECTION-B** 30

Answer any one of the following:-

(3.1) The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm, calculate the power lost 6

in the bearing for a sleeve length of 90 mm. The thickness of the film is 1.5 mm. (CO1,K3)

(3.2) What is Surface Tension? Give the mathematical expression of surface tension for a soap bubble and water droplet? (CO1,K2) 6

Answer any one of the following:-

(3.3) Derive the equation of a streamline for a 2-D flow. Prove that the discharge between two streamlines is the difference in their stream function values. (CO2,K3) 6

(3.4) If for a 2-D potential flow, the velocity potential is given by $\Phi = x(2y - 1)$. Determine the velocity at the point P(4, 5). Determine also the value of stream function at the point P. (CO2,K2) 6

Answer any one of the following:-

(3.5) Derive an expression for the velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of the pipe.(CO3,K3) 6

(3.6) Derive an expression for the loss of head due to : ( i) Sudden enlargement and ( ii ) Sudden contraction of a pipe (CO3,K3) 6

Answer any one of the following:-

(3.7) The mean velocity of the buckets of the Pelton wheel is 10 m/s. The jet supplies water at 0.7 m 3 /s at a head of 30 m. The jet is deflected through an angle of 160° by the bucket. Find the hydraulic efficiency. Take Cv = 0.98. (CO4,K3) 6

(3.8) What are the various efficiencies against which turbines are studied? (CO4,K2) 6

Answer any one of the following:-

(3.9) What is the difference between single stage and multistage centrifugal pump? Describe multistage pump with (a) impellers in parallel (b) impellers in series. (CO5,K2) 6

(3.10) A centrifugal pump is to discharge 0.118 $m^3$/ sec at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75% . Determine the vane angle at the outer periphery of the impeller. (CO5,K3) 6

**SECTION-C** 50

4. Answer any one of the following:-

(4.1) Explain hydrostatic law and pascals law. Also Derive the expression for hydrostatic law. (CO1,K2) 10

(4.2) A venturi-meter of D/d = 0.6 fitted in a pipe of 20 cm diameter, the throat being 30 cm above the inlet. Determine (a). Pressure difference recorded by pressure gauges at inlet and throat. (b). Difference in head in terms of Hg when it is measured by using U-tube manometer. The liquid flowing through the pipe is oil of Specific gravity = 0.8, Take Coefficient of discharge = 0.965. (CO1,K3) 10

5. Answer any one of the following:-

(5.1) Using Buckingham's pi theorem, show that the discharge, Q consumed by an oil ring is given by, $Q = Nd^3\ \Phi\ [\mu/(\rho Nd^2), (\sigma/(\rho N^2 d^3), w/(\rho N^2 d)]$
Where, d is internal diameter of ring, N is rotational speed, $\rho$ is density, $\mu$ is viscosity, $\sigma$ is surface tension and w is the specific weight of oil. (CO2,K3) 10

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| (5.2) | Define the term "dimensionless numbers". Discuss some important dimensionless numbers and their significance with applications. (CO2,K2) | 10 |

6. Answer any <u>one</u> of the following:-

| | | |
|---|---|---|
| (6.1) | Derive the expression for head loss in pipe flow due to friction. (CO3,K3) | 10 |
| (6.2) | State Buckingham's π-theorem. The efficiency η of a fan depends on density p, dynamic viscosity p of the fluid, angular velocity w, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters. (CO3,K3) | 10 |

7. Answer any <u>one</u> of the following:-

| | | |
|---|---|---|
| (7.1) | A Pelton wheel has a mean bucket speed of 10 metres per second with a jet of water flowing at the rate of 700 litres/s under a head of 30 metres. The buckets deflect the jet through an angle of 160°. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98.(CO4,K3) | 10 |
| (7.2) | Obtain an expression for the work done per second by water on the runner of a Pelton wheel. Hence derive an expression for maximum efficiency of the Pelton wheel giving the relationship between the jet speed and bucket speed. Draw inlet and outlet velocity triangles for a Pelton turbine and indicate the direction of various velocities (CO4,K3) | 10 |

8. Answer any <u>one</u> of the following:-

| | | |
|---|---|---|
| (8.1) | A centrifugal pump having outer diameter equal to two times of inner diameter and running at 1000 rpm. Works against a head of 40 m, the velocity of flow through the impeller is constant and equal to 2.5 m/s; the vanes are set back at an angle of $40^0$ at outlet. If the outer dia. of the impeller is 500 mm and width at the outlet is 50 mm. Determine, (i) Vane angle at inlet (ii) Work done by impeller on water per second (iii) Mechanical efficiency. (CO5,K3) | 10 |
| (8.2) | What is a reciprocating pump? Describe the principle and working of a reciprocating pump with a neat sketch. Why is a reciprocating pump not coupled directly to the motor? Discuss the reason in detail. (CO5,K2) | 10 |