**Reg. No. :** | | | | | | | | | | |

## Question Paper Code: 31374

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2016

Third Semester

Mechanical Engineering

01UME304 – FLUID MECHANICS AND MACHINERY

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. State the Newton's law of viscosity.
2. Define uniform flow.
3. Define laminar flow.
4. Define boundary layer thickness.
5. State Buckingham's $\pi$ theorem.
6. What do you mean by kinematic similarity?
7. What is specific speed of a turbine?
8. What is the major difference between a Kaplan turbine and Propeller turbine?
9. What do you mean by 'Net positive suction head' (NPSH)?
10. Can the slip of the reciprocating pump be negative? Explain.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) Calculate the specific weight, specific mass, specific volume and specific gravity of a liquid having a volume of 6 $m^3$ and weight of 44 $N$. (6)

(ii) A 120 *mm* disc rotates on a table separated by an oil film of 1.8 *mm* thickness. Find the viscosity of oil if the torque required to rotate the disc at 60 *rpm* is $3.6 \times 10^{-4}$ *Nm*. Assume the velocity gradient in the oil film to be linear. (10)

Or

(b) (i) A pipe 450 *mm* in diameter branches into two pipes of 300 *mm* and 200 *mm* diameter respectively. If the average velocity in 450 *mm* diameter pipe is 3 *m/s*, find (a) Discharge through the 450 *mm* diameter pipe and (b) Velocity in 200 *mm* diameter pipe if the average velocity in 300 *mm* pipe is 2.5 *m/s*. (8)

(ii) For an incompressible fluid, the velocity components are:

$u = x^3 - y^3 - z^3x$, $v = y^3 - z^3$, $w = -3x^2z - 3y^2z + z^3/3$ .

Determine whether the continuity equation is satisfied. (8)

12. (a) (i) Derive the Bernoulli's energy equation. (8)

(ii) In a pipe of 300 *mm* diameter and 800 *mm* length, an oil of specific gravity 0.8 is flowing at the rate of 0.45 $m^3/s$. Find (a) Head lost due to friction (b) Power required to maintain the flow. Take kinematic viscosity of oil as $0.3 \times 10^{-4}$ $m^2/s$. (8)

Or

(b) (i) List the various minor losses in pipe flow. (4)

(ii) A horizontal venturimeter with inlet diameter 200 *mm* and throat diameter 100 *mm* is used to measure the flow of water. The pressure at inlet is 0.18 $N/mm^2$ and the vaccum pressure at the throat is 280 *mm* of mercury. Find the rate of flow. The value of $C_d$ may be taken as 0.98. (12)

13. (a) The discharge $Q$ of a centrifugal pump depends upon the mass density of fluid ($\rho$), the speed of the pump ($N$), the diameter of the impeller ($D$), the monomeric head ($H$) and the viscosity of fluid ($\mu$). Show that $Q = ND^3\phi\left(\frac{gH}{N^2D^2}, \frac{\mu}{\rho ND^2}\right)$. (16)

Or

(b) (i) Define the various dimensionless numbers and briefly discuss their significance and applications. (8)

(ii) An oil of specific gravity 0.92 and viscosity 0.003 $Ns/m^2$ is to be transported at the rate of 2500 *litres/sec* through a 1.2 *m* diameter pipe. Tests were conducted on a 12 *cm* diameter pipe using water at $20^0$ *C*. If the viscosity of water at $20^0$ *C*

is 0.001 $Ns/m^2$, find (a) Velocity of flow in the model (b) Rate of flow in the model. (8)

14. (a) (i) Discuss the construction and working of a centrifugal pump. (8)

(ii) A centrifugal pump running at 900 *rpm* is working against a head of 16 *m*. The external diameter of the impeller is 360 *mm* and the outlet width is 40 *mm*. If the vane angle at outlet is $30^0$ and the manometric efficiency is 80%, find the discharge of the pump. (8)

Or

(b) (i) A Pelton wheel having wheel diameter of 1.2 *m* rotates at 600 rpm. Water is supplied at the rate of 0.6 $m^3/s$ under a head of 450 *m*. If the buckets deflect the jet through an angle of $160^0$, find the power developed and hydraulic efficiency of the turbine. Assume coefficient of velocity as 0.97 and neglect the frictional losses in the bucket. (8)

(ii) Explain the construction and working of Kaplan Turbine. (8)

15. (a) (i) Explain the construction and working of a single acting reciprocating pump with air vessels fitted. (8)

(ii) Sketch the various types of indicator diagrams of a reciprocating pump. (8)

Or

(b) (i) Discuss the working of fluid coupling with a neat sketch. (8)

(ii) Explain the working of gear pump with the help of a neat sketch. (8)

———————