Hall Ticket No | | | | | | | | | | | Question Paper Code:AMEC12

# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

**B.Tech IV SEMESTER END EXAMINATIONS (REGULAR) - JULY 2022**
**Regulation:UG20**
**FLUID MECHANICS AND HYDRAULIC MACHINES**
**Time: 3 Hours** **(MECHANICAL ENGINEERING)** **Max Marks: 70**

**Answer ALL questions in Module I and II**
**Answer ONE out of two questions in Modules III, IV and V**
(NOTE: Provision is given to answer TWO questions from among one of the Modules III / IV / V
**All Questions Carry Equal Marks**
**All parts of the question must be answered in one place only**

## MODULE – I

1. (a) Explain the following terms: i) Mass density, ii) Weight density, iii) Specific volume, iv) Specific gravity, v) Viscosity, vi) Surface tension, vii) Compressibility. [BL: Remember| CO: 1|Marks: 7]

   (b) A 400mm diameter shaft is rotating at 200 RPM in a bearing of length 120 mm.If the thickness of oil film is 1.5mm and the dynamic viscosity of the oil is 0.7 Ns/$m^2$, determine:

   i) Torque required to overcome friction in bearing.

   ii) Power utilized in overcoming viscous resistance.

   Assume a linear velocity profile. [BL: Apply| CO: 1|Marks: 7]

## MODULE – II

2. (a) Illustrate the terms path line, streamline, stream tube and streak line with the help of neat sketches. [BL: Understand| CO: 2|Marks: 7]

   (b) For a three-dimensional flow the velocity distribution is given by u = – x,v = 3 – y and w = 3 – z. What is the equation of a streamline passing through (1,2,2)? [BL: Apply| CO: 2|Marks: 7]

## MODULE – III

3. (a) Discuss the terms – boundary layer thickness, displacement thickness, momentum thickness and energy thickness. [BL: Understand| CO: 3|Marks: 7]

   (b) A plate 450mm × 150mm has been placed longitudinally in a stream of crude oil (specific gravity 0.925 and kinematic viscosity of 0.9 stoke) which flows with velocity of6 m/s. Calculate:

   i) Thickness of the boundary layer at the trailing edge

   ii) Shear stress at the trailing edge. [BL: Apply| CO: 3|Marks: 7]

4. (a) Determine an expression for the theoretical discharge through a venturi meter. Explain the working of a Venturi meter with a neat sketch. [BL: Apply| CO: 4|Marks: 7]

   (b) In a pipe of 300mm diameter and 800m length, an oil of specific gravity 0.8 is flowing at the rate of 0.45 $m^3$/s. Find:

   i) Head lost due to friction

   ii) Power required to maintain the flow

   Take kinematic viscosity of oil as 0.3 stoke. [BL: Apply| CO: 4|Marks: 7]

## MODULE – IV

5. (a) How to govern the impulse turbines? Provide a comparison between impulse turbine and reaction turbine. [BL: Understand| CO: 5|Marks: 7]

   (b) Calculate the diameter and speed of the runner of a Kaplan turbine developing 6000KW under an effective head of 5m. Overall efficiency of the turbine is 90%. The diameter ofthe boss is 0.4 times the external diameter of the runner. The turbine speedratio is 2.0 and flowratio 0.6. What is the specific speed of the turbine? [BL: Apply| CO: 5|Marks: 7]

6. (a) Briefly explain the construction and working of pelton wheel turbine and also draw velocity triangles of it. [BL: Understand| CO: 5|Marks: 7]

   (b) In an inward flow reaction turbine, the head on the turbine is 32m. The external and internal diameters are 1.44m and 0.72m respectively. The velocity of flow through the runner is constant and equal to 3m/s. The guide blade angle is 10° and the runner vanes are rigid at inlet. If the discharge at outlet is radial, determine:

   i) The speed of the turbine

   ii) The vane angle at outlet of the runner

   iii) Hydraulic efficiency. [BL: Apply| CO: 5|Marks: 7]

## MODULE – V

7. (a) Classify centrifugal pumps and explain characteristic curves for centrifugal pumps on the basis of characteristic features. [BL: Understand| CO: 6|Marks: 7]

   (b) The impeller of a centrifugal pump having external and internal diameters 500mm and 250mm respectively, width at outlet 50mm and running at 1200 RPM worksagainst a head of 48m. The velocity of flow through the impeller is constant and equal to3m/s. The vanes are set back at an angle of $40^o$ at outlet. Determine:

   i) Inlet vane angle

   ii) Work done by the impeller on water per second

   iii) Manometric efficiency. [BL: Apply| CO: 6|Marks: 7]

8. (a) How cavitation occurs in centrifugal pumps? Briefly explain the component parts of a centrifugal pump with the help of a neat sketch. [BL: Understand| CO: 6|Marks: 7]

   (b) A single-acting reciprocating pump, running at 50 RPM delivers 0.00736 $m^3$/s of water. The diameter of the piston is 200 mm and stroke length 300 mm. The suction and delivery heads are 3.5 m and 11.5 m respectively. Determine:

   i) Theoretical discharge

   ii) Co-efficient of discharge

   iii) Percentage slip of the pump

   iv) Power required to run the pump. [BL: Apply| CO: 6|Marks: 7]