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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech IV Semester End Examinations (Supplementary) - July, 2018

Regulation: IARE – R16

MECHANICS OF FLUIDS AND HYDRAULIC MACHINES

Time: 3 Hours

(ME)

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

- (a) Explain mass density, specific weight, Specific gravity, vapour pressure. [7M]

(b) Two large fixed parallel planes are 12mm apart. The space between surfaces is filled with oil of viscosity 9.72 poise. A thin flat plate of area $0.25m^2$ moves through the oil at a velocity of 0.3m/s. Calculate drag force (i) When the plate is equidistance from both the planes (ii) When the thin plate is at a distance of 4mm from one of the planes [7M]
- (a) Explain how vacuum pressure is measured with the help of a U-tube manometer. [7M]

(b) An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5m and it rotates at 200 rpm. Calculate the power lost in oil for a sleeve length of 100 mm. The thickness of oil film is 1.0 mm. [7M]

UNIT – II

- (a) Explain stream line, path line, streak line and stream tube. [7M]

(b) Derive Euler's equation of motion along a stream line and hence derive the Bernoulli's equation? State the significance of each term in Bernoulli's equation. [7M]
- (a) Explain impulse momentum principle and its applications [7M]

(b) The discharge of water through a pipe of diameter 40 cm is 400 lit/sec. If the pipe is bend by 135° , find the magnitude and direction of the resultant force on the bend. The pressure of flowing water is 300 KPa . [7M]

UNIT – III

- (a) Explain the phenomenon of boundary layer separation and its influence on the drag of an immersed body. [7M]

(b) A streamlined train is 200 m long with a typical cross section having a perimeter of 9 m above the wheels. determine the power required to run the train moving with a velocity of 90 Km/hr. Kinematic viscosity of air is $1.5 \times 10^{-5} m^2/Sec$. Density of air is $1.24 kg/m^3$. [7M]

6. (a) Explain Reynolds experiment with neat sketch. [7M]
 (b) A piping system consists of three pipes arranged in series; the lengths of the pipes are 1200 m, 750 m and 600 m and diameters 750 mm, 600 mm and 450 mm respectively.
 (i) Determine the equivalent diameter of the pipe.
 (ii) Determine the equivalent length of the pipe for diameter 450mm [7M]

UNIT – IV

7. (a) Prove that the force exerted by a jet of water on a fixed semi-circular plate in the direction of jet when the jet strikes at the centre of the semi-circular plate is two times the force exerted by the jet on a fixed flat vertical plate. [7M]
 (b) A 100 mm diameter jet discharging at $0.40 \text{ m}^3/\text{sec}$ impinges on a series of curved vanes moving at 18 m/sec. The direction of the jet and the direction of motion of vane are same at inlet. Each vane is so shaped that if stationary it would deflect the jet by 170° . Calculate the [7M]
 (i) Force exerted in the direction of motion of the vanes.
 (ii) Power developed and
 (iii) Hydraulic efficiency
8. (a) Explain the terms unit speed, unit discharge, unit power and specific speed of a turbine. [7M]
 (b) A Pelton wheel has to designed for the following data. Power = 6MW, H = 300 m, N = 550 rpm, Jet ratio = 10, $\eta_o = 85\%$, speed ratio (Ku) = 0.45, coefficient of velocity (Kv) = 0.98
 Find (i) Number of jets (ii) Wheel diameter (iii) Quantity of water [7M]

UNIT – V

9. (a) Draw and discuss the performance characteristic curves of a centrifugal pump. [7M]
 (b) Find the number of pumps required to take water from a deep well under a total head of 89 m. All the pumps are identical and are running at 800 rpm. the specific speed of each pump is given as 25 while the rated capacity of each pump is $0.16 \text{ m}^3/\text{s}$. [7M]
10. (a) Explain working of reciprocating pump with the help of neat sketch. [7M]
 (b) A single acting reciprocating pump has a plunger diameter of 100 mm and stroke length of 200 mm. The suction pipe is 50 mm diameter and 6.5 m long with a suction lift of 3.2 m. The separation occurs when pressure in the pump falls below 2.5 m of water absolute and manometer reads 763 mm of mercury. Find the speed at which the crank can operate without separation to occur. [7M]

