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Question Paper Code : 51624

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2014.

Third Semester

Mechanical Engineering

ME 2204/CE 3213/ME 34/CE 1208/10122 ME 305/080180007/IE 41 – FLUID MECHANICS AND MACHINERY

(Common to Aeronautical Engineering, Automobile Engineering, Production Engineering, Mechatronics Engineering, Mechanical and Automation Engineering and Fourth Semester Manufacturing Engineering, Industrial Engineering and Industrial Engineering and Management)

(Regulation 2008/2010)

(Common to PTCE 3213/PTME 2204 – Fluid Mechanics and Machinery for B.E. (Part-Time) Third Semester – Manufacturing Engineering Regulation 2009)

Time : Three hours Maximum : 100 marks

Any missing data can be suitably assumed with justification.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is kinematics viscosity? State its units.
2. What is the moment of momentum equation?
3. What are the characteristics of laminar flow?
4. Differentiate hydraulic gradient line and energy gradient line.
5. Define the Froud's dimensionless number.
6. What are distorted models? State its merits and demerits.
7. How are hydraulic turbines classified?
8. What do you mean by 'Net positive suction head' (NPSH)?
9. Define slip, negative slip in reciprocating pump.
10. What are the uses of air vessels?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A 400 mm diameter shaft is rotating at 200 r.p.m. in a bearing of length 120 mm. If the thickness of film is 1.5 mm and the dynamic viscosity of the oil is 0.7 N.s/m^2, determine

(1) Torque required to overcome friction in bearing

(2) Power utilized to overcoming viscous friction. Assume linear velocity profile. (8)

(ii) Gasoline of specific gravity of 0.8 is flowing upward a verticle pipeline which tapers from 300 mm to 150 mm diameter. A gasoline mercury differential manometer is connected between 300 mm 150 mm pipe section to measure the rate of flow. The distance between the manometer tapings is 1 m and gauge readings is 500 mm of mercury. Find (1) Differential gauge reading in terms of gasoline head and (2) Rate of flow. (8)

Or

(b) (i) Derive an expression for the capillary rise of a liquid having surface tension σ and contact angle θ between two verticle parallel plates at a distance W apart. If the plates are of glass, what will be the capillary rise of water? Assume $\sigma = 0.773 N/m, \theta = 0°$ Take W=1mm. (6)

(ii) Derive Euler's equation of motion. (10)

12. (a) (i) A crude oil of viscosity 0.9 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 120 mm and length 12 m. Calculate the difference of pressure at the two ends of the pipe, if 785 N of the oil is collected in a tank in 25 seconds. (10)

(ii) Briefly explain the following terms

(1) Displacement thickness

(2) Momentum thickness

(3) Energy thickness. (3 × 2 = 6)

Or

(b) (i) The main pipe is divided into two parallel pipes which again forms one pipe, the first parallel pipe has length of 1000 m and diameter of 0.8 m. The second parallel pipe has length of 1000 m and diameter of 0.6 m. The coefficient friction for each parallel pipe is 0.005. If the total rate of flow in the main pipe is 2 m^3 /sec, find the rate of flow in each parallel pipe. (10)

(ii) Briefly explain Moody's diagram regarding pipe friction. (6)

13. (a) (i) The pressure difference Δp in a pipe of diameter D and length L due to viscos flow depends on the velocity V, viscosity μ and density ρ. Using Buckingham's π theorem, obtain an expression for Δp. (10)

(ii) A geometrically similar model of an air duct is built to $1/25^{th}$ scale and tested with water which is 50 times more viscous and 800 times more density than air. When tested under dynamically similar conditions, the pressure drop is 2 bar in the model, find the corresponding pressure drop in the full scale prototype. (6)

Or

(b) (i) Define the following dimensionless numbers and state their significance for fluid flow problems.

(1) Reynold's number

(2) Mach's number (4)

(ii) What is meant by geometric, kinematic and dynamic similarities? (6)

(iii) In a geometrically similar model of spillway the discharge per meter length is $0.2m^3/sec$. if the scale of the model is 1/36, find the discharge per meter run of the prototype. (6)

14. (a) (i) Draw a schematic diagram of a Kaplan turbine and explain its construction and Working. (8)

(ii) Define cavitation. What are the effects of cavitation? (4)

(iii) Explain briefly the following efficiencies of a centrifugal pump

(1) Manometric efficiency

(2) Volumetric efficiency (4)

Or

(b) (i) A pelton wheel which is receiving water from a penstock with a gross head of 510 m. one – third of Gross head is lost in the penstock. The rate of flow through the nozzle fitted at the end of the penstock is 2.2 m^3/sec. The angle of deflection of the jet is 165°. Determine

(1) The power given by the water to the runner

(2) Hydraulic efficiency of the Pelton wheel. Take C_v=1 and speed ratio =0.45 (8)

(ii) (1) Describe multi-stage pump with impeller in series

(2) impellers in parallel. (8)

15. (a) (i) Define indicator diagram. Prove that the work done by the pump is proportional to the area of indicator diagram. (6)

(ii) The plunger diameter and stroke length of a single acting reciprocating pump are 300 mm and 500 mm respectively. The speed of the pump is 50 r.p.m . The diameter and length of delivery pipe are 150 mm and 55 mm respectively If the pump is equipped with an air vessel on the delivery side at the center line of the pump, find the power saved in overcoming friction in the delivery pipe. Take friction co-efficient f=0.01 (10)

Or

(b) Describe the working principal of gear pump and vane pumps. (16)