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

Question Paper Code : Q 2704

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Annual Pattern — First Year

(Regulation 2004)

Electrical and Electronics Engineering

CEIX 11 — SOLID AND FLUID MECHANICS

(Common to Electronics and Instrumentation Engineering/Instrumentation and Control Engineering)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define a 'perfect frame' and state the relationship between the number of joints (j) and the number of members (m).

2. State the relationship between modulus of elasticity (E), Poisson's ratio (μ) and bulk modulus (K).

3. State the relationship between intensity of load (w), shear force (F) and bending moment (M).

4. State : 'torsional equation'.

5. Differentiate between dynamic viscosity and kinematic viscosity.

6. State the condition/(s) for the existence of a 'velocity potential' function.

7. Distinguish, between 'Hydraulic Gradient Line' (HGL) and 'Total Energy Line' (TEL).

8. Define : 'boundary layer'. What is its importance?

9. What are pitot tubes? Mention their functions.

10. Define : 'slip' with respect to a reciprocating pump. Can it be negative? Give reason/(s).

PART B — (5 × 16 = 80 marks)

11. (a) Determine the forces in all the members of the truss shown in Fig. 1. (16)

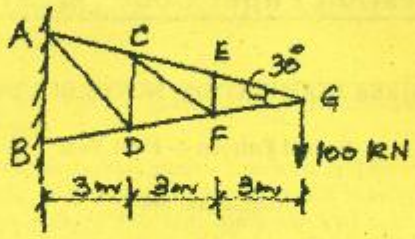

Fig. 1

Or

(b) A compound bar of length 600 mm consists of a strip of aluminium 40 mm wide and 20 mm thick and a steel strip of 60 mm wide × 15 mm thick rigidly jointed at the ends. If the elastic modulus of aluminium and steel are : 1×10^5 N/mm² and 2×10^5 N/mm² determine the stresses developed in each material and the extension of the compound bar, when an axial force of 60 kN is applied. (16)

12. (a) An overhanging beam ABC is supported at A and B, the span AB being 6 m. The overhang BC is 2 m (Fig. 2). It carries a u.d.l. of 30 kN/m over a length of 3 m from A and a concentrated load of 20 kN at free end. Draw SF and BM diagrams. (16)

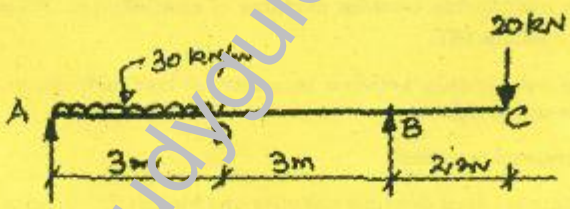

Fig. 2

Or

(b) A shaft is required to transmit 275 kW power at 250 rpm, the maximum torque being 1.5 times the mean torque. If the shear stress is to be limited to 40 N/mm² and the angle of twist to 1° per metre length, determine the diameter required, if : (i) the shaft is solid (ii) the shaft is hollow with external diameter 1.5 times the internal diameter. Assume modulus of rigidity (G) = 80 kN/mm². (16)

13. (a) State Newton's Law of Viscosity. Derive the law. State how fluids are classified based on Newton's law. (16)

Or

(b) (i) Given the velocity components of flow as : $u = (x^2 - y^2)$ and $v = (-)\ 2xy$, determine the stream function and velocity potential for the fluid flow. (8)

(ii) Water flows at the rate of 200 *l*/sec upwards through a tapered vertical pipe. The diameter at the bottom is 240 mm and at the top 200 mm and the length is 5 m. The pressure at the bottom and at the top side are 8 bar and 7.3 bar, respectively. Determine the head loss through the pipe and express it as a function of exit velocity head. (8)

14. (a) (i) Define : displacement thickness, momentum thickness and energy thickness. (6)

(ii) Define : drag and lift forces. (4)

(iii) The total mass of an aircraft is 70 tonnes. The wing area is 160 m². If the aircraft travels at 800 kmph, determine the 'lift coefficient'. Neglect compressibility effect. Assume density of air (at flight conditions) is 0.8 kg/m³. (6)

Or

(b) (i) What are minor losses in pipes. Explain each in detail. (8)

(ii) A 30 cm pipe with friction coefficient, $f = 0.024$ (in $h_f = flv^2/2gd$) carries water to a turbine at the rate of 0.25 m³/sec over a distance of 160 m. The difference in levels between the water inlet and turbine inlet is 36 m. Determine the efficiency of transmission. Assume the turbine outlet delivery is submerged into the tail race and the velocity at the exit is 0.4 times the velocity in the pipe. (8)

15. (a) (i) Define : 'specific speed' of a turbine. (2)

(ii) Explain the reason for higher part load efficiency in the case of Kaplan turbine when compared to Francis or Propeller turbines. (4)

(iii) Explain the working principle of a Francis Turbine. (10)

Or

(b) (i) What are the components of a centrifugal pump? Explain its functions. (8)

(ii) In a reciprocating pump, the bore is 180 mm and the stroke is 280 mm. Water level in the sump is 5 m below the pump level. The suction pipe is 110 mm diameter and 9 m long. Determine the maximum speed, if, the head at suction side of the pipe is not less than 2.5 m of head of water. In case, the suction side pipe diameter is increased to 125 mm and length reduced to 6 m, what will be the speed? Assume 1 atm. pr. = 10.3 m of water column. (8)

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