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

Question Paper Code: 55703

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018

Fifth Semester

Mechanical Engineering

15UME503 - DESIGN OF MACHINE ELEMENTS

(Regulation 2015)

(Approved data book are permitted)

Duration: Three hours Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. The toughness of a material _____ when it is heated. CO1 -R

   (a) increases (b) decreases

   (c) does not change (d) may increase or decrease

2. Soderberg relation is based on _____ of the material whereas all other failure relation for dynamic loading are based on ultimate strength of the material. CO1 -R

   (a) elastic strength (b) yield strength

   (c) shear strength (d) Plastic Strength

3. A transmission shaft includes CO2- R

   (a) counter shaft (b) line shaft (c) over head shaft (d) all of these

4. In a flange coupling the weakest element is CO2- R

   (a) thin cylinder (b) thick cylinder (c) solid shaft (d) hollow shaft

5. The length of cotter, in a sleeve and cotter joint, is taken as CO3 -R

   (a) key (b) bolt (c) flange (d) shaft

6. In a steam engine, the valve rod is connected to an eccentric by means of a CO3 -R

(a) knuckle joint (b) universal joint (c) flange coupling (d) cotter joint

7. When spring index increases, the value of Wahl's stress factor CO4- R

(a) increases linearly (b) decreases linearly

(c) remains same (d) increases exponentially

8. The cross-section of the flywheel arms is usually CO4- R

(a) elliptical (b)rectangular (c) I-section (d) L- section

9. A sliding bearing which operates without any lubricant present, is called CO5 -R

(a) zero film bearing (b)boundary lubricated bearing

(c) hydrodynamic lubricated bearing (d) hydrostatic lubricated bearing

10. The metal suitable for bearings subjected to light loads is CO5 -R

(a) silicon bronze (b)white metal

(c) monel metal (d)phosphor bronze

PART – B (5 x 2= 10Marks)

11. Define endurance limit. CO1 -R

12. Why hollow circular shafts are preferred when compared to solid circular shafts. CO2-Ana

13. State why welded joints are preferred over riveted joints? CO3 -Ana

14. When two concentric springs of stiffness 100N/mm and 50N/mm respectively are subjected to an axial load of 750N, what will be the deflection of each spring? CO4 -App

15. Define kinematic viscosity. CO5 -R

PART – C (5 x 16= 80Marks)

16. (a) A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T. If the yield point of the steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to 1. the maximum principal stress; 2. the maximum shear stress; and 3. the maximum distortion strain energy theory of yielding. CO1- App (16)

Or

(b) A 50 mm diameter shaft is made from carbon steel having ultimate tensile strength of 630 MPa. It is subjected to a torque which fluctuates between 2000 N-m to – 800 N-m. Using Soderberg method, calculate the factor of safety. Assume suitable values for any other data needed. CO1 -Eva (16)

17. (a) A hollow shaft is required to transmit 600 kW at 110 r.p.m., the maximum torque being 20% greater than the mean. The shear stress is not to exceed 63 MPa and twist in a length of 3 metres not to exceed 1.4 degrees. Find the external diameter of the shaft, if the internal diameter to the external diameter is 3/8. Take modulus of rigidity as 84 GPa. CO2 -Eva (16)

Or

(b) Design and draw a cast iron flange coupling for a mild steel shaft transmitting 90 kW at 250 r.p.m. The allowable shear stress in the shaft is 40 MPa and the angle of twist is not to exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa. CO2- Eva (16)

18. (a) Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. CO3 -Eva (16)

Or

(b) Design a cotter joint to connect piston rod to the crosshead of a double acting steam engine. The diameter of the cylinder is 300 mm and the steam pressure is 1 N/mm^2. The allowable stresses for the material of cotter and piston rod are as follows :
σ_t = 50 MPa ; τ = 40 MPa ; and σ_c = 84 MPa CO3- Ana (16)

19. (a) A relief valve must blow off at a pressure of 1.25MPa and should lift by 6mm for a 6% increase in pressure. The valve diameter is 65mm. Take the spring index as 8. Maximum allowable shear stress of the spring material is 600MPa, modulus of rigidity is 81370N/mm^2. Consider Wahls correction factor, take inactive number of turns as 1. Design the valve spring. CO4 -U (16)

Or

(b) A single cylinder double acting steam engine develops 150 kW at a mean speed of 80 r.p.m. The coefficient of fluctuation of energy is 0.1 and the fluctuation of speed is ± 2% of mean speed. If the mean diameter of the flywheel rim is 2 metres and the hub and spokes provide 5 percent of the rotational inertia of the wheel, find the mass of the flywheel and cross-sectional area of the rim. Assume the density of the flywheel material (which is cast iron) as 7200 kg / m^3. CO4- Ana (16)

20. (a) Design a journal bearing for a centrifugal pump from the following data :
Load on the journal = 20 000 N; Speed of the journal = 900 r.p.m.; Type of oil is SAE 10, for which the absolute viscosity at 55°C = 0.017 kg / m-s; Ambient temperature of oil = 15.5°C ; Maximum bearing pressure for the pump = 1.5 N / mm^2. Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/m^2/°C. CO5-Eva (16)

Or

(b) Select a suitable roller bearing for a 55mm diameter shaft. The bearing should be capable of withstanding 3000N radial and 1500N axial load at 750rpm. The bearing is to have a desired life of 2000hrs at a reliability of 94%. There is a light shock load and inner ring rotates. CO5 -Eva (16)