U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 19IM4DCMCD **Max Marks: 100**
Course: Machine Design **Date: 15.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) What is stress concentration? Explain any one method of reducing the same **05**

b) A mild steel shaft of 6 cm diameter is subjected to a bending moment of 2500 kN mm and a torque M_t. If the yield point of steel in tension is 230 N/mm^2, find maximum value of this torque without causing yielding of the shaft according to i) Max principal stress theory of failure ii) Max shear stress theory of failure iii) Max distortion energy theory of failure. Adopt FOS of 1.5. **15**

OR

2 a) Derive Soderberg relationship for fatigue failure **05**

b) A round rolled rod of diameter 1.2d is reduced to a diameter d with a fillet radius of 0.1d. The stepped rod is to sustain a twisting moment that fluctuates between +2.5 kNm and +1.5 kNm together with a bending moment that fluctuates between +1 kNm and -1 kNm. The rod is made of carbon steel C40 (σ_y = 328.6 N/mm^2, σ_u = 620 N/mm^2). Determine a suitable value for d. Adopt FOS of 2. **15**

UNIT - II

3 a) Design a flange coupling to connect the shafts of a motor and centrifugal pump for the following specifications: pump output is 50 liters/sec, total head is 20 m, pump speed is 600 rpm, pump efficiency is 70%. Select C40 steel (σ_y = 328.6 N/mm^2) for shaft and C35 steel (σ_y = 304 N/mm^2) for bolts with FOS is 2. Use allowable shear stress in cast iron flanges equal to 15 N/mm^2. **12**

b) Design a sleeve type cotter joint to connect two tie rods subjected to an axial pull of 60 kN. The allowable stress of C30 material used for the rods and cotters are σ_t = 65 N/mm^2, σ_c = 75 N/mm^2, τ = 35 N/mm^2. Cast steel used for the sleeve has the allowable stresses σ_t = 70 N/mm^2, σ_c = 110 N/mm^2, τ = 45 N/mm^2 **08**

OR

4 a) In an axial flow rotary compressor the shaft is subjected to a maximum torque of 1.5 kNm and a maximum bending moment of 3 kNm. Neglecting the axial load on the compressor shaft, determine the diameter of the compressor shaft. **10**

The shear stress in the shaft material is limited to 50 N/mm^2. Also design a hollow shaft for the above compressor taking inner diameter as 0.6 times the outer diameter. What percentage of material is saved in the hollow shaft, assume minor shock condition.

b) A shaft is mounted between bearings located 950 cm apart and transmits 10000 kW at 90 rpm. The shaft weighs 66 kN, has outside diameter is 45 cm and inner diameter is 30 cm. Determine the stress induced in the shaft and the angular deflection between the bearings. Consider the weight of shaft. **10**

UNIT - III

5 Design a pair of spur gears to transmit 18 kW from shaft running at 1000 rpm to a parallel shaft to be run at 250 rpm maintaining a distance of 16 cm between the shaft centers. Suggest suitable surface hardness for the gear pair. Assume class III precision gears, pressure angle of 20^o full depth involute and medium shock for 8 to 10 hours duty per day having service factor of 1.5. Select Pinion material as SAE 3245 (Cr – Ni steel). **20**

UNIT - IV

6 a) A plate of 8 cm wide and 1.5 cm thick is joined to another plate by single transverse weld and double parallel weld. Determine length of parallel fillet weld if it is subjected to both static and fatigue loading. Take σ_t = 90 N/mm^2, τ = 55 N/mm^2 as allowable stresses and stress concentration factor as 1.5 for transverse and 2.7 for parallel weld. **10**

b) A double riveted lap joint is to be made between 9 mm plates. If the safe working stresses in tension, crushing and shear are 80 N/mm^2, 120 N/mm^2 and 60 N/mm^2 respectively. Design the riveted joint **10**

UNIT - V

7 a) Determine the dimensions of bearing and journal to support a load of 1 kN at 450 rpm using hardened steel journal and bronze backed babbitt bearing. The oil used has a specific gravity of 0.9 at 15.5^{o}C and a viscosity of 9 centistokes at 82^{o}C which may be taken as the limiting temperature for the oil. Allows a clearance of 0.03 mm per cm diameter. Also find the rate of heat generated. **10**

b) Design a multi collar thrust bearing for a propeller shaft of a 400 kW marine oil engine. The engine makes 300 rpm. The propeller has a pitch of 250 cm and slip is 30 %. The permissible bearing pressure is 0.5 N/mm^2. Assume uniform pressure theory. **10**

****