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**B.E. DEGREE EXAMINATIONS, MAY 2023**  
 Fifth Semester  
**ME16503 – DESIGN OF MACHINE ELEMENTS**  
*(Common to Mechanical and Automobile Branches)*  
**(Regulation 2016)**  
 (Use of Approved Design Data Book is permitted)

TIME:3 HOURS

MAX. MARKS: 100

**PART- A(10x2=20Marks)**  
 (Answer all Questions)

1. What is stress concentration factor? Give an example.
2. What are the factors affecting the endurance strength.
3. What is the effect of keyway cut into the shaft?
4. What are flexible couplings and what are their applications?
5. How is a bolt designated? Give examples.
6. What are the types of stresses induced in eccentric loaded welded joint?
7. What is buckling of springs? state one method of avoiding the tendency of a compression spring to buckle.
8. What is the advantage of leaf spring over helical spring?
9. For a journal bearing the maximum operating temperature must be about less than 80°C. Why?
10. What is meant by life of anti-friction bearings? List the components of anti-friction bearing.

**PART- B (5x 16=80Marks)**

**11. (a)** A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9. The material properties of bar are given by: ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa. (16)

**(OR)**

**(b)** A 60 mm diameter shaft as shown in Figure.11(b) is subjected to a bending load of 5 kN, pure torque of 1 kN-m and axial pulling force of 20 KN. Determine the stresses at A & B. (16)

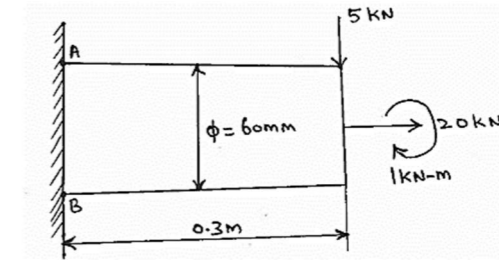


Figure.11(b)

**12. (a)** A mild steel shaft transmits 15 kW at 210 rpm. It is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 24 teeth of 6 mm module is located 100 mm to the left of the right hand bearing and delivers the power horizontally to the right. The gear having 80 teeth of 6 mm module is located 15 mm to the right of the left hand bearing and receives power in a vertical direction from below. Assuming an allowable working shear stress as 53 MPa, and a combined shock and fatigue factor of 1.5 in bending as well as in torsion, determine the diameter of the shaft. (16)

**(OR)**

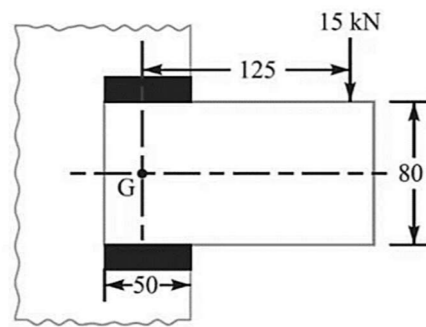
**(b)** Design a cast iron protective flange coupling to connect two shafts in order to transmit 7.5 kW at 720 rpm. The following permissible stresses may be used:  
 Permissible shear stress for shaft, bolt and key material = 33 MPa  
 Permissible crushing stress for bolt and key material = 60 MPa  
 Permissible shear stress for the cast iron = 15 MPa  
 After designing the various elements, make a neat sketch of the assembly indicating the important dimensions. (16)

**13. (a)** A Double riveted double cover butt joint in plates 10 mm thick is made with 20 mm diameter rivets at 80 mm pitch. The permissible stresses are  
 Permissible tensile stress in plate  $\sigma_t = 120$  MPa  
 Permissible shearing stress in rivets  $\tau = 90$  MPa  
 Permissible crushing stress in rivets  $\sigma_c = 170$  MPa  
 Find the efficiency of joint, taking the strength of the rivet in double shear as twice than that of single shear. (16)

**(OR)**

- (b) A bracket is welded to its support and is subjected to an eccentric load of 15 kN as shown in Figure 13(b). Calculate the size of the weld if the allowable stress in the weld is 80 MPa.

Figure.13(b)



(16)

14. (a) Design a close coiled helical compression spring for machine tool applications and its service load ranging from 2000 N to 3000 N. The axial deflection of the spring for the load range is 15 mm. Consider a spring index of 5. Consider Wahl's stress factor effect. The permissible shear stress intensity is 420 MPa and Modulus of rigidity,  $G = 80 \text{ kN/mm}^2$ . Draw a neat sketch of the spring and indicate the main dimensions

(16)

(OR)

- (b) A single cylinder double acting steam engine delivers 185 kW at 100 rpm. The maximum fluctuation of energy per revolution is 15 per cent of the energy developed per revolution. The speed variation is limited to 1 per cent either way from the mean. The mean diameter of the rim is 2.4 m. Design the flywheel.

(16)

15. (a) Design a journal bearing for the following data:

load on the journal = 150 kN, used in Turbine application

Speed of the journal = 1800 rpm

shaft diameter = 300 mm

(i) Length of the journal if the allowable pressure is 1.6 MPa.

(ii) Amount of heat to be removed by the lubricant per minute, if the bearing temperature is  $60^\circ\text{C}$  and viscosity of the oil at  $60^\circ\text{C}$  is  $0.02 \text{ Kg/m-s}$  and the bearing clearance is 0.25 mm.

(16)

(OR)

- (b) A single row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust force of 3 kN. The shaft rotates at 1200 rpm. The expected life of the bearings is 20000 hours. The minimum acceptable diameter of the shaft is 75 mm. select a suitable ball bearing for this application.

(16)

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