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B.E / B.TECH. DEGREE EXAMINATION, MAY 2023

Fifth Semester

AE18503- DESIGN OF MACHINE ELEMENTS AND TRANSMISSION SYSTEMS

(Automobile Engineering)

(Regulation 2018)

(Use of Approved Design Data book is permitted)

TIME: 3 HOURS

MAX. MARKS: 100

CO 1 Discuss the various types of stresses developing on machine elements

CO 2 Discuss and design the shaft as well as the various types of mechanical coupling

CO 3 Design and examine the various types of mechanical joints and bearings

CO 4 Design and justify the types of gear used in the various mechanical systems

CO 5 Discuss and design the various types of gear boxes and braking systems

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

	CO	RBT LEVEL
1. Discuss the significance of S-N curve.	1	2
2. Identify suitable failure theories in the design of parts made out of brittle materials.	1	2
3. Differentiate keys and splines.	2	2
4. Distinguish between rigid and flexible couplings.	2	2
5. Differentiate between Caulking and fullering in rivets.	3	2
6. Discuss the importance of Bearing characteristic number in the design of journal bearing.	3	3
7. Identify the reason for the surface failure of gears and mention its types.	4	2
8. What are the non-metallic gear materials used in practice?	4	1
9. Write the function of a speed reducer.	5	3
10. What do you understand by self-energizing brakes?	5	1

PART- B (5 x 14 = 70 Marks)

Marks CO RBT
LEVEL

- 11. (a)** A crane hook having an approximate trapezoidal cross-section is shown in Fig. 11.(a). It is made of plain carbon steel 45C8 ($\sigma_y = 380 \text{ N/mm}^2$) and the factor of safety is 3.5. Determine the load-carrying capacity of the hook. **(14)** **1** **3**

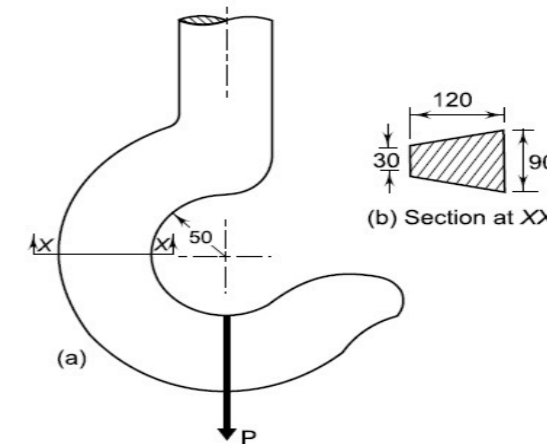


Fig. 11.(a) - All dimensions in mm

(OR)

- (b)** 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 factor = 0.85, surface finish factor = 0.9. Take ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa. **(14)** **1** **3**
- 12. (a)** Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200 N and is located at 300 mm from the centre of the bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 rpm. The angle of lap of the belt is 180° and coefficient of friction between the belt and the pulley is 0.3. The shock and fatigue factors for bending and twisting are 1.5 and 2.0 respectively. The allowable shear stress in the shaft may be taken as 35 MPa. **(14)** **2** **3**

(OR)

- (b) A rigid type of coupling is used to connect two shafts transmitting 15 kW at 200 rpm. The shaft, keys and bolts are made up of C45 steel and the coupling is of cast iron. Design the coupling and make a neat sketch of the assembly indicating the important dimensions. (14) 2 3

13. (a) For supporting the traveling crane in a workshop, the brackets are fixed on steel columns as shown in Fig.13 (a). The maximum load that comes on the bracket is 12 kN acting vertically at a distance of 400 mm from the face of the column. The vertical face of the bracket is secured to a column by four bolts, in two rows (two in each row) at a distance of 50 mm from the lower edge of the bracket. Determine the size of the bolts if the permissible value of the tensile stress for the bolt material is 84 MPa. Also find the cross-section of the arm of the bracket which is rectangular. (14) 3 3

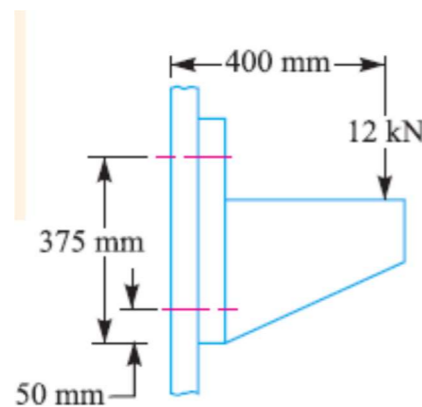


Fig. 13(a) - All dimensions are in mm

(OR)

- (b) Design a journal bearing for a centrifugal pump with the following data: load on the journal = 10 kN (axial and radial), speed of the journal = 900 r.p.m, diameter of the journal = 100 mm. Also calculate the mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Assume any other suitable data. (14) 3 3

14. (a) Design a spur gear drive to transmit 22.5 kW at 900 rpm. Speed reduction is 2.5. Materials for pinion and wheel are C15 steel and cast iron grade 30 respectively. Take pressure angle of 20° and working life of the gears as 10000 hours. (14) 4 3

(OR)

- (b) Design a helical gear to transmit 15 kW at 1400 rpm to the following specifications: Speed reduction is 3, Pressure angle is 20°, Helix angle is 15°, Materials for both the gears is C45 steel. Assume allowable static stress of 180 N/mm², Surface endurance limit of 800 N/mm² and Young's modulus of material 2x10⁵ N/mm². (14) 4 3

15. (a) Draw the kinematic diagram and speed diagram of a headstock gear box of a turret lathe having arrangements for 9 spindle speeds ranging from 31.5 rpm to 1050 rpm. Calculate the number of teeth on each gear. The minimum number of teeth on a gear is 25. Also, calculate the percentage deviation of the obtainable speeds from the calculated ones. (14) 5 3

(OR)

- (b) Explain the step-by-step procedure involved in the design of disc brakes. (14) 5 3

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

- | | Marks | CO | RBT LEVEL |
|--|-------|----|-----------|
| 16. (i) Discuss the role of the factor of safety in the design of machine elements and the significant factors to be considered for its selection. (7) | (7) | 1 | 3 |
| (ii) What is the range of factor of safety and how it will be decided. (3) | (3) | | |
