

17610

21415

4 Hours / 100 Marks

Seat No.

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- Instructions :** (1) All Questions are *compulsory*.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data, if necessary.
(5) Use of Non-Programmable Electronic Pocket Calculator is permissible.
(6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. (A) Attempt any THREE :

12

- What is factor of safety ? Define it for brittle & ductile loading.
- State with neat diagram about "Failure of cotter in bending."
- Prove that for a square key, permissible crushing stress is always twice the permissible shearing stress.
- Explain about the various types of screw threads used in power screws.

(B) Attempt any ONE :

06

- State and describe in brief about any six ergonomic considerations in the designing of machine elements.
- A shaft of mild steel transmits 100 kW of power at 300 rpm. Supported length of the shaft is 3 meters. It carries two pulleys, each weighing 1500 N, supported at a distance of 1 meter from both ends. Find out the diameter of the shaft. Take $f_s = 60 \text{ N/mm}^2$ and $f_b = 90 \text{ N/mm}^2$.

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- 2. Attempt any TWO :** **16**
- (a) State the design procedure of a cotter joint with neat diagram.
 - (b) Compare the weight, strength and stiffness of a hollow shaft of the same external diameter as that of the solid shaft. Inside diameter of hollow shaft is 0.75 times the external diameter. Both shafts have same material & length.
 - (c) (i) Identify the material & its composition
 - (a) X 10 Cr18Ni9Mo4Si2
 - (b) X 772 W18Cr4V1
 - (ii) Explain with neat diagram about “Failure of knuckle pin in bending.”
- 3. Attempt any FOUR :** **16**
- (a) Write down the names of any four theories of elastic failure.
 - (b) State the three different ways of application of levers in engineering practice.
 - (c) State the classification of shaft couplings.
 - (d) Explain with neat sketch the following terms used in screw threads.
 - (i) Major diameter (ii) Minor diameter
 - (iii) Pitch (iv) Crest
 - (e) Design a rectangular key to be used for a shaft of diameter 50 mm. Both are having the same material. Take $f_s = 42 \text{ MPa}$ & $f_c = 70 \text{ MPa}$.
- 4. (A) Attempt any THREE :** **12**
- (a) Write down the steps involved in a general design procedure in any machine design.
 - (b) State any four areas of application of springs.
 - (c) Which are the four different causes of a gear tooth failure ?
 - (d) Explain with a neat sketch about “Bolts of uniform strength”
- (B) Attempt any ONE :** **06**
- (a) Write down the design procedure of a sleeve or muff coupling with diagram.
 - (b) What is stress concentration ? State its effect on the material in case of static loading and cyclic loading.

5. Attempt any TWO :**16**

- (a) The screw of a shaft straightener exerts a load of 10 kN. Screw is double start with 25 mm nominal diameter & 5 mm pitch. The outer and inner diameters of screw collar are 50 mm & 20 mm respectively. The coefficient of thread friction & collar friction are 0.20 & 0.15 respectively. The screw rotates at 12 rpm. Assuming the uniform wear condition at collar and allowable thread bearing pressure of 5.8 N/mm^2 , find the torque required to rotate the screw, the stress in the screw and the number of threads of nut in engagement with screw.
- (b) At the bottom of a mine shaft, a group of 10 identical close coiled helical springs are set in parallel to absorb the shock caused by the falling of a cage in case of a failure. The loaded cage weighs 75 kN while counter weight weighs 15 kN. If the loaded cage falls through a height of 50 meters from rest, find the maximum stress induced in each spring ? Each spring is made up of 50 mm diameter steel rod having spring index of 6 and number of active turns in each spring is 20. Modulus of rigidity, $G = 80 \text{ kN/mm}^2$. Comment whether the spring design is safe or not if permissible shearing stress is 2800 N/mm^2 .
- (c) (i) Define the following terms related to bearings :
- (a) Bearing characteristics number
 - (b) Bearing modulus
 - (c) Critical pressure
 - (d) Sommerfeld number
- (ii) State the meaning of "Overhauling & self-locking" of power screws.

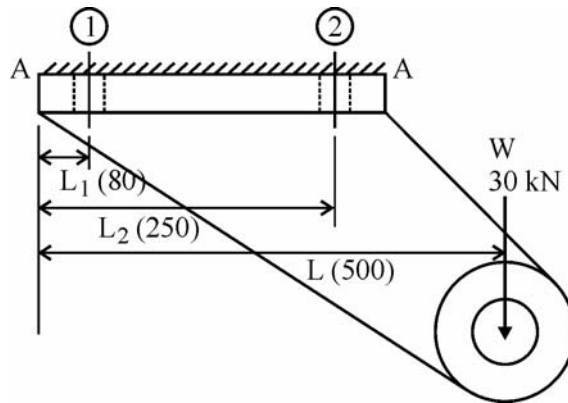
6. Attempt any FOUR :**16**

- (a) Derive the strength of a single transverse double parallel fillet weld with neat sketch.
- (b) A close coiled helical compression spring of 12 active coils has a spring stiffness k . It is cut into two springs having 5 and 7 turns. Determine the spring stiffness of resulting springs.

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- (c) A bracket as shown in fig. No. 1, supports a load of 30 kN. Determine the size of the bolts, if the maximum allowable tensile stress in the bolt material is 60 MPa. The distances are $L_1 = 80$ mm, $L_2 = 250$ mm & $L = 500$ mm.



(All distances are in mm)

Fig. No. 1

- (d) List out & explain in brief any four properties of a good journal bearing.
- (e) What procedure is followed, step-by-step in designing a journal bearing ?
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