Design of Machine Elements

Time: 4 Hrs.] Prelim Question Paper Solution **[Marks : 100**

Instructions : (1) All questions are compulsory.
(2) Illustrate your answer with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.

1. (a) Attempt any **THREE** of the following **[12]**
   (i)   What are the steps involved in General Design Procedure ? Explain.
   (ii) Explain reason for taper provided on cotter?
   (iii) Give classification of shafts?
   (iv) Explain different types of threads with their advantages, disadvantages and application with neat sketch.

1. (b) Attempt any **ONE** of the following **[6]**
   (i)   Explain creep and creep curve.
   (ii) A shaft 1000 mm long is supported between two bearings. A pulley of 250 mm diameter is keyed at 400 mm distance away from left hand bearing. The power transmitted by shaft is 10 kW at 800 r.p.m. The pulley gives power to another pulley vertically below it having an angle of contact between pulley and belt as 180°. The weight of pulley is 300 N. The coefficient of friction between belt and pulley is 0.15. Take shear stress material as 60 MPa. Find the diameter of the shaft.

2. Attempt any **TWO** of the following **[16]**
   (a) Explain the design procedure of handlever with neat sketch.
   (b) Explain the design procedure of bush pin type flexible coupling with neat sketch.
   (c) (i) Explain with neat sketch the stress-strain diagram for ductile material.
   (ii) Design "C" clamp frame for a total clamping force of 20 kN. The corss-section of the frame is rectangular and width to thickness ratio is 2. The distance between the load line and natural axis of rectangular cross section is 120 mm and the gap between two faces is 180 mm. The frame is made of cast steel for which maximum permissible tensile stress is 100 N/mm^2.

3. Attempt any **FOUR** of the following **[16]**
   (a) Write down the names of any four theories of elastic failure.
   (b) State the three different ways of applications 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 fS = 42 Mpa and fC = 70 Mpa.

4. (a) Attempt any **THREE** of the following. **[12]**
   (i)   State the meaning of following colour codes aesthetic consideration while designing the product.
      (1) Red   (2) Orange   (3) Green   (4) Blue
   (ii) Define the following terms with respect to springs:
      (1) Spring index   (2) Spring stiffness
      (3) Free length of spring   (4) Solid length of spring
   (iii) State the effect of keyway on the strength of the shaft.

(iv) A cylinder head of steam engine is held in position by M20 bolts. The effective diameter of cylinder is 350 mm and the steam pressure is 0.75 N/mm². If the bolts are not initially stressed, find the number of bolts required. Take working stress for bolt material as 20 N/mm².

4. (b) Attempt any **ONE** of the following [6]
   (i) State the different modes of failure of gear teeth and their possible remedies to avoid the failure.
   (ii) Explain the following types of stresses:
   (1) Transverse shear stress   (2) Compressive stress   (3) Torsional shear stress

5. Attempt any **TWO** of the following [16]
   (a) The screw of a shaft straightener exerts a load of 10 kN. Screw is a double start with 25 mm nominal diameter and 5 mm pitch. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction are 0.20 and 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/mm² 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 failing 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, $G = 80$ kN/mm². Comment whether the spring design is safe or not if permissible shearing stress is 2800 N/mm².
   (c) (i) Define the following terms related to bearings.
      (1) Bearing characteristics number   (2) Bearing modulus
      (3) Critical Pressure   (4) Sommerfeld number
      (ii) State the meaning of "Overhauling and self-locking" of power screws.

6. Attempt any **FOUR** for the following [16]
   (a) State the strength equations of double parallel fillet weld and single transverse fillet weld with neat sketches.
   (b) A semi-elliptical carriage spring of 1200 mm length withstands a load of 60 kN with maximum deflection of 90 mm. Assume breadth to thickness ratio as 8. Design the spring if bending stress of spring material is 540 MPa and $E = 2 \times 10^5$ N/mm².
   (c) A wall bracket is fixed to the wall by means of three bolts, one bolt at a distance of 25 mm from the lower edge and remaining two bolts at a distance of 175 mm from the lower bolts. It supports a load of 7.5 kN at a distance of 250 mm from the wall. The bolts are made from plain carbon steel 45C8 with tensile yield strength of 380 N/mm². If factor of safety is 2.5, estimate the size of the bolts. Sketch the arrangement.
   (d) Explain the selection procedure of bearings from manufacturer's catalogue.
   (e) State the applications of following bearings with suitable reasons:
      (i) Deep grove ball bearing   (ii) Taper roller bearing
      (iii) Thrust coller bearing   (iv) Needle roller bearing

Paper Discussion Schedule for T.Y. Diploma Sem.VI

Date	Day	Timing	Centre
9 April 2017	Sunday	9 a.m. to 11 a.m.	Dadar, Nerul
9 April 2017	Sunday	12 p.m.to 2 p.m.	Thane

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