[4858] - 1011

T.E. (Mechanical) (End Semester) (Semester - I)
DESIGN OF MACHINE ELEMENTS - I
(2012 Pattern)

Time : 3 Hours]   *[Max. Marks : 70*

Instructions to the candidates:

1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Use of logarithmic table, slide rule, electronic pocket calculator is allowed.*
5) *Assume suitable data if necessary.*

Q1) a) Two rods are connected by means of a knuckle joint. The axial force 'P' acting on the rods is 25KN. The rods and the pin are made of plain carbon steel 45C8 (S_{yt} = 380N/mm²) and factor of safety is 2.5. The yield strength in shear is 57.7% of the yield strength in tension. **[6]**

Calculate

i) The dia. of rods.
ii) The diameter of the pin.

b) What is the effect of keyway cut into the shaft? How it can be compensated? **[4]**

OR

Q2) a) Fig(1) shows a hanger with rectangular c/s with the proportions indicated. The force p acting on the hanger is 6KN and acts at 30° to the vertical as shown. The permissible stress in the hanger material is 60 MPa. Determine the size of the cross section. **[6]**
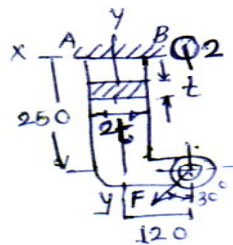
b) i) What is the purpose of rubber bush in bushed pin flexible coupling?**[6]**

    ii) What is the difference between splines and keys? **[4]**

Q3) a) A shaft and key are made of the same material and the key width is $\frac{1}{3}^{rd}$ of the shaft diameter **[8]**
   i) considering shear only, determine the minimum length of key, in terms of the shaft diameter
   ii) Determine thickness of the key, to make the key equally strong in shear and crushing, taking the shear strength of the key material as 40% of its crushing strength.
   b) Prove that a square key is equally strong in shear and crushing. **[2]**

OR

Q4) a) Differentiate between torsional rigidity design and lateral rigidity design of shafts. **[4]**
   b) A 40 mm diameter shaft is made of steel 50 C4 (sut = 660 N/mm^2) and has a machined surface. The expected reliability is 99%. The theoretical stress concentration factor for the shape of the shaft is 1.6 and the notch sensitivity factor is 0.9. Determine the endurance limit of the shaft $k_a = 0.76$, $k_b = 0.85$ $k_c = 0.814$. **[6]**

Q5) a) i) Discuss the salient features of ACME thread for power screws. **[3]**
   ii) Why are V threads not used in power screws? **[3]**
   b) Two railway coaches are coupled by means of a turn buckle using two rods. The rods are having single start square threads. The mean diameter of the rods is 40mm and pitch of the threads is 8mm. Determine the magnitude of the work to be done in bringing the coaches closer, through a distance of 240mm, against a steady load of 2KN. Take co-efficient of friction between the rod threads and nut as 0.15. **[10]**

OR

Q6) a) i) Why is the efficiency of self locking square threaded screw less than 50%. **[3]**
   ii) What are the applications of recirculating ball screw. **[3]**
   b) A power transmission screw of a screw press is required to transmit maximum load of 10 tonnes and rotates at 60 rpm. Trapezodial threads are mention in the table. The screw thread friction coefficient is 012. Torque required for collar friction and journal bearing is about 10% of the torque to drive the load considering screw friction. Determine screw dimensions and its efficiency. Also determine power required to drive the screw. Maximum permissible compressive stress in screw is 100M. **[10]**

Nominal diameter, mm	40	50	60	70
Core diameter, mm	32.5	41.5	50.5	39.5
Mean diameter. mm	36.5	46	55.5	65
Core area, cm^2	8.3	13.53	20.03	27.81
pitch mm.	7	8	9	10

Q7) a) The pull in the tie rod of an iron truss is 50KN. Design a suitable adjustable steel screwed joint. The permissible stresses are 75MPa in tension, 45MPa in shear and 90 MPa in crushing. **[8]**

b) A bracket carrying a load of 15KN is to be welded as shown in fig(2) find the size of weld required if the allowable shear stress is not to exceed 80 N/mm². **[10]**
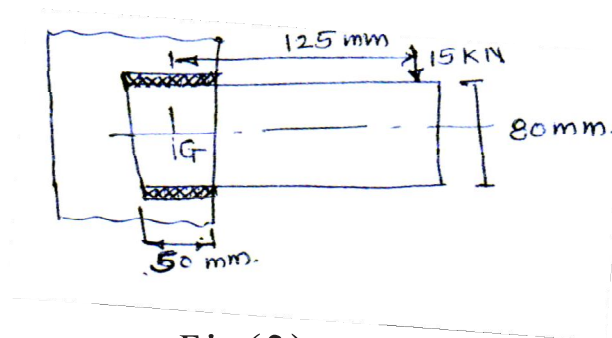
Fig(2)

OR

Q8) a) A steel plate subjected to a force of 3KN and fixed to a vertical channel by means of four identical bolts as shown in fig(3) the bolts are made of plain carbon steel 45C8 (S_{yt} = 380 N/m²) and the factor of safety is 2. Determine the diameter of the shank. **[10]**
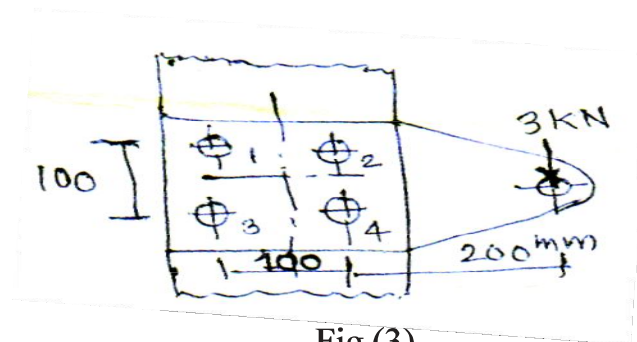
Fig.(3)

b) i) What are the advantages of welded joints compared with riveted joints? **[4]**

ii) Discuss on bolts of uniform strength. **[4]**

Q9) a) What is mean by spring surge and what is its effect. **[4]**

b) A helical spring whose mean diameter of the coils is 8 times that of wire, is to absorb 400 N.m of energy. The initial compression of the spring is 50mm and compress by additional 70mm while absorbing the shock. The maximum allowable stress is 400Mpa. and G = 84×10³GPa. Determine the diameter of wire, and the number of active turns Neglect the effect of stress conectration. **[12]**

*Q10)*a) How will you find whether the given helical spring is a compression spring or tension spring. **[4]**

b) A load of 1KN dropped axially on a closed coiled helical compression spring from a height of 250 mm. The spring has 20 active coils. Take wire diameter as 20mm. Spring index is 8. Determine the deflection and stress induced in the spring. Take $G = 0.84 \times 10^5$ MPa. **[12]**

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