B.E. Seventh Semester (Aeronautical Engineering) (C.B.S.)

Design of Machine Elements

P. Pages : 2 **NKT/KS/17/7524**

Time : Three Hours Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Due credit will be given to neatness and adequate dimensions.
7. Assume suitable data whenever necessary.
8. Illustrate your answers whenever necessary with the help of neat sketches.
9. Use of non programmable calculator is permitted.
10. Use of data book by B.D. Shiwalkar or PSG design data book is permitted.

1. a) Define factor of safety. State the parameters governs the selection of factor of safety. **6**

b) A steel spindle transmit 5 kw at 800 rpm. The angular defection should not exceeds 0.25º per meter of spindle. If the modulus of rigidity for material of the spindle is $84 \times 10^3 \, N/mm^2$. Find the diameter of spindle and shear stress induced in spindle. **14**

OR

2. a) What is couplings? State the requirements of good coupling. List the types of coupling. **6**

b) Find the efficiency of the following riveted joints : **14**

1) Single riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 50 mm.
2) Double riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 65 mm.

Assume :

Permissible tensile stress in plate = $120 \, N/mm^2$

Permissible shear stress in rivets = $90 \, N/mm^2$

Permissible crushing stress in rivets = $180 \, N/mm^2$

3. a) Compare riveted, welded and bolted joint. **5**

b) Design a square key for fixing a gear on a shaft of 25 mm. diameter. The shaft is transmitting 15 kw power at 720 rpm to gear. The key is made of steel $50C_4 (Syt = 460 \, N/mm^2)$ and factor of safety is 3. For key material, the yield strength in compression can be assumed to be equal to the yield strength in tension. **15**

Determine the dimensions of the key.

OR

4. a) Explain buckling of a compression spring with neat sketch. **4**

b) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5. **16**

The maximum permissible shear stress for spring wire is $420 \, N/mm^2$ and modulus of rigidity is $84 \, KN/mm^2$. Take Wahl's factor $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$.

5. a) What is journal bearings? Give a classification of these bearings. **4**

b) Explain the terms used in Hydrodynamic Journal bearing. **4**

c) The load on the journal bearing is 150 KN due to turbine shaft of 300 mm diameter running at 1800 rpm. **12**
Determine the following:

1) Length of the bearing if the allowable bearing pressure is $1.6\,N/mm^2$.
2) Amount of neat to be removed by the lubricant per minute if the bearing temperature is 60ºC and viscosity of the oil at 60ºC is 0.02 kg/m-s and the bearing clearance is 0.25 mm.

OR

6. a) Explain centrifugal tension in belt with neat sketch. **4**

b) Explain the gear terminology with neat sketch. **4**

c) A bronze spur pinion rotating at 600 rpm drives a cast iron spur gear at a transmission ratio of 4 : 1. The allowable static stresses for the bronze pinion and cast iron gear are $84\,N/mm^2$ and $105\,N/mm^2$ respectively. **12**
Pinion has 16 standard 20º full involute teeth of module 8 mm. The face width of both gears is 90 mm.
Find the power that can be transmitted from the standpoint of strength.

7. a) Sketch the cross - section of a V-belt and label its important parts. State merits and demerits of V - belt over flat belt drives. **5**

b) A flat belt is required to transmit 30 KW from a pulley of 1.5 m effective diameter running at 300 rpm. The angle of contact is spread over $\frac{11}{24}$ of the circumference. The coefficient of friction between the belt and pulley surface is 0.3. Determine, taking centrifugal tension into account, width of the belt required. It is given that the belt thickness is 9.5 mm, density of its material is $1100\,kg/m^3$ and the related permissible working stress is $2.5\times10^6\,N/m^2$ **15**

OR

8. a) Discuss the various types of stresses induced in a flywheel rim. **4**

b) Design a cast iron piston for a engine for the following data. **16**
Cylinder bore = 100 mm, Stroke = 125 mm,
Max. gas pressure = $5\,N/mm^2$
Indicated mean effective pressure = $0.75\,N/mm^2$
Mechanical efficiency = 80%
Fuel consumption = 0.15 kg per break power per hour,
Higher calorific value of fuel = $42\times10^3\,KJ/kg$
Speed = 2000 rpm.
Any other data required for the design may be assumed.

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