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SE-8302

B. E. - III (Sem. - V) (Mech.) Examination

May / June – 2011

Machine Design - I

(New Course)

Time : Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ B. E. - 3 (SEM. - 5) (MECH.)

Name of the Subject :

☛ MACHINE DESIGN - 1 (NEW)

☛ Subject Code No. : 8 3 0 2 ☛ Section No. (1, 2,.....) : Nil

Seat No. :

Student's Signature

(2) Attempt **all** questions.

(3) Use of Standard design data book is permissible.

(4) Assume suitable data, if necessary.

(5) Figures to the **right** indicate full marks.

1 (a) Answer the following : **10**

(i) What is S-N diagram ? Write its application.

(ii) Write the advantages of 'standardization'.

(iii) Explain the phenomena of fatigue failure.

(iv) What is a thin cylinder ? Which are the stresses generated in it ?

(b) A cantilever beam made of cold drawn steel 40C8 **10**
(σut = 600 N/mm^2 and σyi = 380 N/mm^2 is shown in figure 1. The force P acting at the free end varies from –50 N to +150 N. The expected reliability is 90%

and the factor of safety is 2. The notch sensitivity factor at the fillet is 0.9. Determine the diameterd of the beam at the fillet cross section.

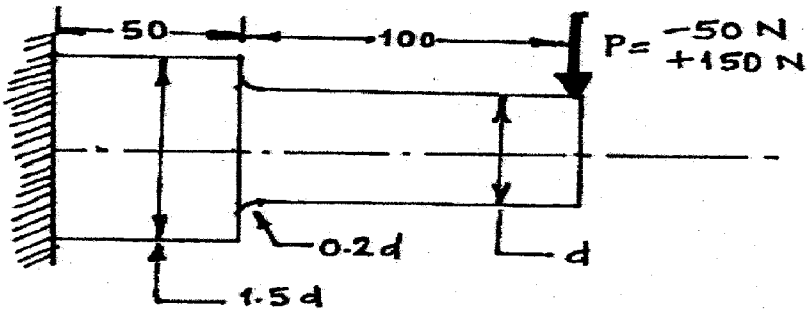

Fig.1

OR

(b) A cantilever spring made of 10 mm diameter wire is shown in Figure 2. The wire is made of stainless steel having σut = 860 N/mm^2 and σyi = 690 N/mm^2. The force P acting at the free end varies from 75 N to 150 N. The surface finish of the wire is equivalent to the machined surface. There is no stress concentration and expected reliability is 50%. Calculate the number of stress cycles likely to cause fatigue failure. **10**

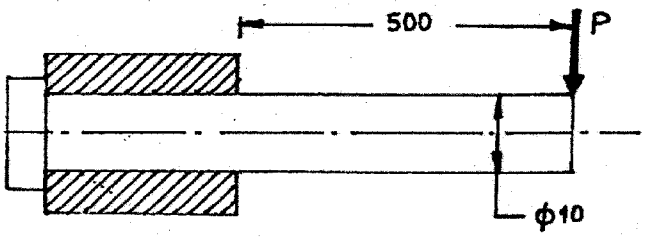

Fig.2

2 (a) A compound cylinder consists of an inner steel tube with inner and outer diameter 40 mm and 60 mm respectively. It is reinforced by shrinking a steel jacket of outer diameter 80 mm. The compound cylinder is subjected to an internal pressure of 60 MPa. The shrinkage allowance is such that the maximum circumferential stresses in inner tube and jacket are same. Calculate : **9**

(i) the interference pressure; and

(ii) the original dimensions of inner tube and jacket. Assume : E = 207000 N/mm^2.

(b) Explain design considerations for casting in detail. **6**

OR

(b) A seamless cylinder of storage capacity 0.0245 m^3 and made of alloy steel 20 Mo55 (σ_{ut} =450 N/mm^2) is to be used for storing a fluid at 14 MPa gauge pressure. The length of the cylinder is twice its diameter. If the factor of safety is 3, determine the cylinder dimensions. **6**

3 (a) It is required to design a helical compression spring subjected to a maximum force of 1250 N. The deflection of the spring corresponding to the maximum force should be approximately 30 mm. The spring index can be taken as 6. The spring is made of patented and cold drawn steel wire. The ultimate tensile strength and modulus of rigidity of the spring material are 1090 and 81370 N/mm^2 respectively. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design **9**

the spring and calculate

(i) Wire diameter

(ii) mean coil diameter

(iii) number of active coils

(iv) total number of coils;

(v) free length of the spring and

(vi) Pitch of the coil

Draw a neat sketch of the spring showing various dimensions.

(b) A semi-elliptic multi-leaf spring is used for the suspension of the rear axle of a truck. It consists of two extra full-length leaves and ten graduated length leaves including the master leaf. The centre to centre distance between the spring eyes is 1.2 m. The leaves are made of steel 55Si2Mo90 (σ_{yt} =1500 N/mm^2 and E =207000 N/mm^2) and the factor of safety is 2.5. The spring is to be designed for a maximum force of 30 kN. The leaves are pre-stressed so as to equalize stresses in all leaves. Determine : **6**

(i) the cross-section of leaves and

(ii) the deflection at the end of the spring

OR

(b) Explain design considerations for forging in detail. **6**

4 (a) Attempt the following : **10**

(i) Which wire rope is more flexible out of 6 x 19 and 6 x 37 ? Why ?

(ii) Which materials are used for making flat-belt pulley ?

(iii) What is arc of contact factor for flat-belt ?

(iv) When do you prefer V-belt to a flat-belt ?

(v) Why is semi-cone angle of cone clutch 12.5^{o} ?

(vi) Why clutches are usually designed on the basis of uniform wear ?

(vii) How will you classify brakes ?

(viii) When do you say a journal bearing is square ?

(ix) Write down Petroff's equation.

(x) Write one disadvantage of angular contact ball bearing.

(b) Derive Stribeck's equation for static load capacity of ball bearing. Write assumptions used in the derivation. **10**

5 (a) Select a flat-belt drive for a compressor running at 720 rpm, which is driven by a 25 kW, 1440 rpm motor. Space is available for a centre distance of 3m. The belt is open type. **9**

(b) Explain the cross-section of a wire rope. What is lay of a rope ? What are different constructions of wire ropes according to rope-lay ? **6**

OR

(a) Give brief description about types of rolling contact bearings with figure. (any five) **10**

(b) A pulley transmits 10 kW power at 720 rpm. The diameter of the pulley is 500 mm. The pulley has four arms of elliptical cross-section, in which the major axis is twice the minor axis. Determine the dimensions of the cross-section of the arm, if permissible stress is 30 N/mm^2. **5**

6 (a) A single-row deep-groove ball bearing is subjected to a pure radial load of 3 kN from a shift that rotates at 500 rpm. The expected life L_{10h} of the bearing is 30000 hr. The minimum acceptable diameter of the shaft is 40 mm. Select a suitable ball bearing for this application. **5**

(b) A single-row deep-groove ball bearing No. 6002 is subjected to an axial thrust of 1000 N and a radial load of 2200 N. Find the expected life that 50% of the bearings will complete under this condition. **6**

(c) Write the load-life relationship equation and tell how the rated life in million revolution can be converted into life in working hours. **4**

OR

6 (a) Following data are given for a hydrostatic thrust bearing : **9**

Thrust load = 500 kN

Shaft speed = 720 rpm

Shaft diameter = 500 mm

Recess diameter = 300 mm

Film thickness = 0.15 mm

Viscosity of lubricant = 160 SUS

Specific gravity = 0.86

Calculate :

(i) supply pressure

(ii) flow requirement in litre/min;

(iii) power loss in pumping; and

(iv) frictional power loss

(b) A cone clutch with asbestos friction lining transmits 30 kW at 500 rpm. The coefficient of friction is 0.2 and the permissible intensity of pressure is 0.35 N/mm^2. The semi-cone angle α is 12.5^o. The outer diameter is fixed as 300 mm. Assuming uniform wear theory, determine : **6**

(i) inner diameter

(ii) face width of the friction lining; and

(iii) force required to engage the clutch.
