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RM-7161

B. E. III (Sem. VI) (Mech.) Examination

May / June – 2010

Machine Design - I

Time : **3** 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. 6) (Mech.)**

Name of the Subject :

☛ **Machine Design - 1**

☛Subject Code No. : **7 1 6 1** ☛Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

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

(3) Draw neat sketches wherever **necessary**.

(4) Assume suitable data, if required.

(5) Use of standard design databook is permissible.

SECTION - I

1 (a) Answer the following (any **four**) **10**

(i) How will you estimate the life of a component subjected to fatigue?

(ii) Discuss the alloy steel as materials.

(iii) Explain the design of push rod briefly.

(iv) Explain the factors to be considered while designing castings.

(v) Explain limits, fits and tolerances.

(vi) What do you mean by preloading of bolts? State its advantages.

(b) Design a cotter joint transmit a load of 100 kN in tension/compression. The stresses for socket, spigot and cotter are as below: **10**

Desgisn tensile stress = 90 MPa

Design crushing stress = 170 MPa

Design shear stress = 60 MPa

2 (a) A cantilever I-beam (as shown in figure 1) is subjected a load of 20 kN and fillet welded to a support. Find the weld size, if the design strength of the weld is 85 MPa. **10**

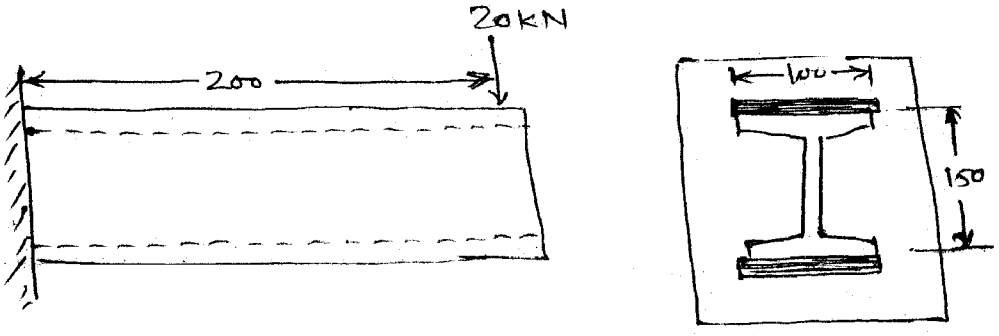

Fig. 1

OR

2 (a) Design a connecting rod for an I.C. engine running at 1800 rpm. for a maximum pressure of 3.15 MPa. The diamater of the piston is 100 mm, mass of reciprocating parts per cylinder 2.25 kg, length of connecting rod 380 mm, piston stroke 190 mm and compression ratio 6:1. The factor of safety is 6 for design. Assume I-section as 5t × 4t × t size. **10**

The connecting rod is made from M.S. material with σ_c = 320 MPa and Rankine constant is $\frac{1}{7500}$.

(b) Draw a neat sketch of valve gear mechanism. Explain its working. **5**

3 (a) The construction of the shaft straightener is used on the shop floor. The screw has single start square threads of 80 mm nominal diameter and 10 mm pitch. The screw is required to exert a maximum axial force of 10 kN. The mean radius of the friction collar is 30 mm. The axial length of the nut is 40 mm. The coefficient of friction at the threads and the collar 0.12. The mean diameter of the rim of the handwheel is 500 mm. Calculate : **12**

(i) the force exerted at the rim to drive the screw

(ii) the efficiency of the straightner

(iii) Bearing pressure on the threads in the nut.

OR

(a) Design a single start square threaded C-clamp to exert a maximum force of 4 kN. The design stress for a screw material 130 MPa in compression and 65 MPa in shear. The permissible shear stress for the nut is 76 MPa. The permissible tensile stress for body is 67 MPa. The permissible bearing pressure between nut and screw is 12 MPa. The coefficient of friction at threads and collar are 0.14 and 0.16 respectively. Mean collar radius is 8 mm. Assume length of handle as 150 mm. Consider section of the body as $4t \times 4t \times t$. **12**

(b) Recommend the type of threads for the following components with stating reasons : **3**

(i) Machine bench vice

(ii) Hexagonal bolts.

SECTION - II

4 (a) Answer the following : (any **four**) 8

(i) Differentiate between closed and open coiled helical springs.

(ii) Explain various types of lever. Why type-III is not used in practice?

(iii) What are the factors to be considered while selecting the types of key?

(iv) Define and explain "Torsional Rigidity" and "Lateral Rigidity"?

(v) Why the keyway weakening factor is considered in shaft design?

(b) (i) Design a helical compression spring for a max. load of 1000 N for a deflection of 25 mm using the value of spring index as 5. The max. permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 kN/mm^2. **7**

(ii) The leaf spring has 12 numbers of leaves, two of which are full length leaves. The spring supports are 1.1 m apart and the central band is 90 mm wide. The central load is to be taken 5.5 kN with a permissible stress of 300 N/mm^2. Determine

(a) The thickness and width of the steel spring leaves. The ratio of the total depth to the width of the spring is 3,

(b) Deflection of the spring. **5**

5 A steel solid shaft transmitting 15 kW at 200 r.p.m. is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located 100 mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of the left hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54 MPa in shear, determine the diameter of the shaft. Also draw the required diagrams. **15**

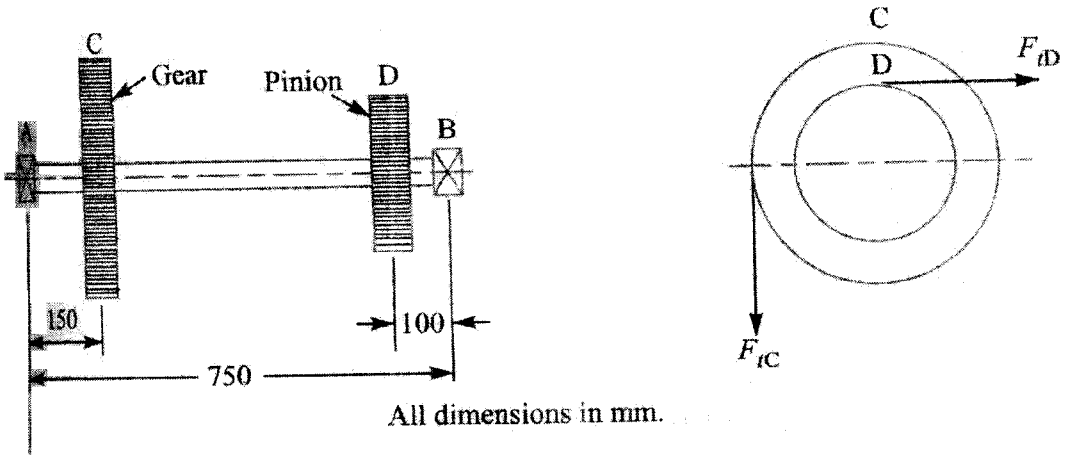

Fig. 2

OR

5 (a) Determine the diameter for a hollow shaft having inside dia. 0.6 times outside dia. The max. shear stress allowed is 85 N/mm^2. The shaft is driven by a 90 cm dia. overhung pulley. The pulley is driven by an electric motor placed vertically below it. The weight of the pulley is 700 N. The tension in the tight and slack sides of the belt are 2700 N and 900 N respectively. The overhung is 250 mm. (Assume the angle of lap = 180°). **6**

(b) For axial flow rotary compressor, design the shaft. The torque coming on shaft = 1×10^6 N-mm, B.M. on shaft = 250×10^3 N-mm, and allowable torsional stress for shaft = 50 N/mm^2. The load is applied gradually. Find: (i) dia of the shaft considering it to be solid, (ii) dia. of hollow shaft when inner dia. is 0.5 times outer dia. Calculate % saving in material in case of hollow shaft, (iii) For hollow shaft, if axial force of 10000 N is considered, calculate shear stress induced. **9**

6 (a) The hand lever is 1000 mm from center of shaft to the point of application of 400 N force. Calculate (i) Diameter of the solid shaft, taking allowable shear stress as 20 N/mm^2, (ii) what is the twist of shaft per meter length?. (iii) Determine the section of the lever near the boss, if the permissible stress is limited to 70 MPa, and (iv) Distance moved by the point of application of the load due to elasticity of the shaft. Modulus of rigidity is 0.84 x 10^5 N/mm^2. The length of the shaft is 3m. **7**

(b) Determine the diameter of the journal, section of lever and the diameter of handle of a cranked lever. The length of the handle, l=300 mm, length of the lever arm, L = 400 mm and overhung of the journal = 100 mm. The lever is operated by a single person exerting a max. force of 400 N at the distance of one-third of the handle from its free end. The permissible bending stress for the lever material may be taken as 50 MPa and shear stress for shaft material as 40 MPa. **8**

OR

6 (a) Solve the following : **3**

The standard cross-section for a flat key, which is fitted on a 50 mm diameter shaft, is 16 × 10 mm. The key is transmitting 475 N-m torque from the shaft to the hub. The key is made of commercial steel ($S_{yt} = S_{yc} = 230$ N/mm^2). Determine the length of the key, if the F.O.S. is 3.

(b) It is required to design a rigid type of flange coupling to connect two shafts. The input shaft transmits 37.5 kW power at 180 r.p.m. to the output shaft through the coupling. The design torque is 1.5 times of rated torque. Select suitable materials for various parts of the coupling, design the coupling and specify the dimensions of its components. **12**
