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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E. - Industrial and Production Engineering

Semester End Examination; Dec - 2016/Jan - 2017

Design of Machine Elements

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Assume missing data suitably.
iii) Use of Design Data Hand Book Permitted.

UNIT - I

1 a. Derive an expression for TRUE stress-strain in static loading. 8

b. A rectangular plate of 60 mm width is subjected to a tensile load of 9810 N. It has a hole of diameter 12 mm drilled at its centre. Find the thickness, stress concentration factor, if the material of the plate is SAE 1045 Annealed steel. Use factor of safety = 2. 12

2 a. Briefly explain Rankin's theory and Guest theory with reference to theories of failure. 8

b. The load on a bolt consists of an axial pull of 10,000 N and transmits shear load of 5000 N. The permissible tensile stress at the elastic limit is 100 N/mm^2 and $\mu = 0.3$. Find the diameter of the bolt on the basis of ;

i) Maximum principal strain theory

ii) Maximum strain energy theory

iii) Maximum shear stress theory. 12

UNIT - II

3 a. Derive Soderberg's equation considering stress concentration and factor of safety. 8

b. Determine the thickness of a 120 mm wide uniform plate for safe continuous operation, if the plate is to be subjected to a tensile load that has a maximum value of 25,000 N and minimum valve of 10,000 N. The properties of plate material are given to be σ_{en} = 2250 N/mm^2, σ_{up} = 3000 N/mm^2 and Net yield point N = 1.5. 12

4 a. Define fatigue strength and explain the factors affecting fatigue strength. 6

b. A piston rod of a steam engine is subjected to a maximum reversed axial load of 10,000 N. It is to be made of steel having an ultimate stress of 900 N/mm^2. Design the piston rod assuming that there is no stress concentration. Take a factor of safety = 2. The size and surface correction factor can be taken as 0.85 and 0.8 respectively. 14

UNIT - III

5 a. Derive an expression for the shaft subjected to combined bending and twisting moments. 12

b. Compare the torsional strengths of hollow and solid shafts of same length, weight and material. 8

Contd….2

6 a. Show that the length of a square key is approximately 1.5 times the diameter of the shaft, if the torsional strength of the key is same as the torsional strength of the shaft of the same material. 8

b. A rigid coupling is used to transmit 20 kW power at 720 rpm. There are 4 bolts and a pcd of bolts is 125 mm. The bolts are made of steel 45 C8 and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are flange tight in reamed and ground holes. Assume $\sigma_{yt} = 380$ N/mm^2. 12

UNIT - IV

7 a. Derive an expression for the strength of a transverse fillet welded joint. 8

b. An angle ISA 75x75x10 mm is welded to an 8 mm thick plate as shown. The joint is supported to take a load of 100 kN. Determine the lengths the welds l_1 and l_2, if coated mild steel electrodes are used (Refer Fig. 7(b)). 12

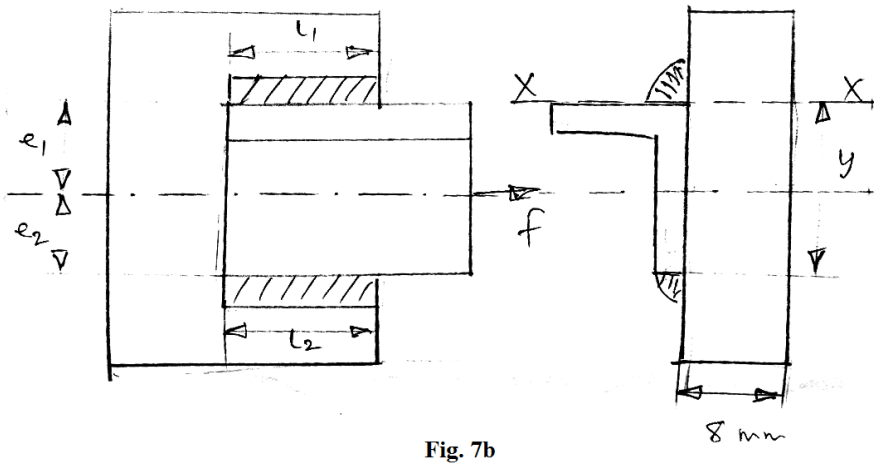

Fig. 7b

UNIT - V

8 a. Briefly explain the types of Rivetted joint and types of Rivetting. 8

b. A lap joint with triple rivet is required for fastening plates of thickness 20 mm each. Design the joint completely and determine the efficiency of the joint. Assume the following safe stress values $\tau = 80$ N/mm^2 and $\sigma_c = 80$ N/mm^2. 12

9. Design a pair of spur gears to transmit 7.36 kW power from a shaft rotating at 1000 rpm to a shaft parallel to it. The required velocity ratio is $3\frac{1}{3}:1$. 20

10 a. Design a compression spring for a load of 490 N. Maximum deflection is to be limited to 20 mm. 10

b. Find the frictional power loss for a petroffs bearing of diameter 80 mm and length 120 mm, radial clearance is 0.05 mm and speed is 900 rpm. Oil used SAE 10 at an operating temperature of 80ºC. 10

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