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BTS – VI – 04.13 – 0228

B.Tech. Degree VI Semester Examination April 2013

ME 603 MACHINE DESIGN I

(*2006 Scheme*)

Time : 3 Hours | Maximum Marks : 100

(*Use of approved design data handbook permitted*)

PART A

(Answer *ALL* questions)

(8 × 5 = 40)

I. (a) List out the mechanical properties of materials and explain the importance of considering the same for the design of components of a machine.

(b) What is meant by stress concentration? Explain the causes of stress concentration.

(c) What is self locking of power screw? What is the condition of self locking?

(d) Compare flexible type and rigid type couplings and explain the suitability of each type based on the application requirements.

(e) Explain the modes of failure of a riveted joint.

(f) Explain A.M. Wahl's factor and its relevance in the design of helical springs.

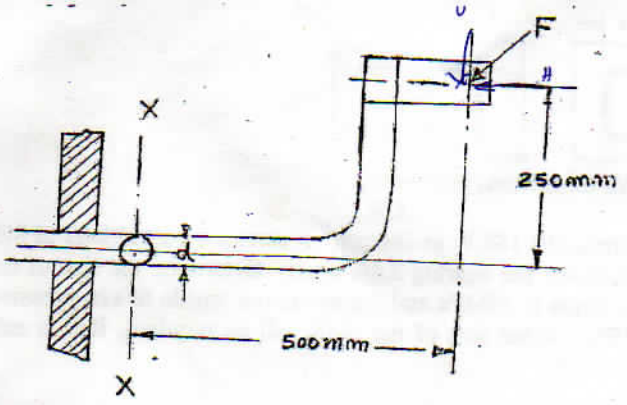
(g) Discuss the advantages and disadvantages of welded joints in comparison to riveted joints.

(h) Explain the term 'critical speed' of shaft.

PART B

(4 × 15 = 60)

II. A hand cranking lever as shown in the figure is used to start a truck engine by applying a force F = 500N. The material of the cranking lever is steel for which yield strength = 320MPa; ultimate tensile strength = 500 MPa; Young's modulus = 205 GPa; modulus of rigidity = 84 GPa and Poisson's ratio = 0.3.



Assuming factor of safety to be 4 based on yield strength, design the diameter 'd' of the lever at X – X near the guide bush using (i) Maximum shear stress theory (ii) Maximum distortion energy theory.

OR

III. A circular bar 400mm long is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having minimum value of 40KN and a maximum value of 100KN. Determine the diameter of bar by taking a factor of safety = 1.5. Take size factor = 0.85 and surface finish factor = 0.9. The material properties of bar given are: ultimate strength = 650 MPa, yield strength = 500 MPa and endurance strength = 350 MPa.

(P.T.O)

IV. The lead screw of a lathe has single start ISO metric trapezoidal threads of 52mm nominal diameter and 8mm pitch. The screw is required to exert an axial force of 2400N in order to drive the tool carriage during turning operation. The thrust is carried on a collar of 102mm outer diameter and 58mm inner diameter. The values of coefficient of friction at the screw threads and the collar are 0.15 and 0.12 respectively. The lead screw rotates at 36 rpm. Calculate:

(i) the power required to drive the screw
(ii) the efficiency of the screw

OR

V. Two mild steel rods are connected by a knuckle joint to transmit axial tensile load of 100KN. Design the joint. The ultimate strength of mild steel in tension is 380 MPa. Assume shearing strength and crushing strength as 50% and 125% respectively of the tensile strength. Take factor of safety as 4.

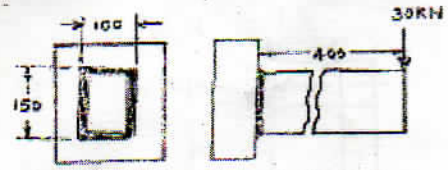
VI. Design the longitudinal joint for a 1.25m diameter steam boiler to carry a steam pressure of 2.5N/mm^2. The ultimate strength of the boiler plate may be assumed as 420 MPa, crushing strength as 650 MPa and shear strength as 300MPa. Take the joint efficiency as 80%. Assume factor of safety as 5. Sketch the joint with all dimensions.

OR

VII. A helical compression spring is used to absorb energy from sudden loading. The initial compression of the spring is 30mm and it is further compressed by 40mm while absorbing energy from the sudden load. The spring is to absorb 180 Joules of energy during the process. The spring index can be taken as 6. The spring is made of cold drawn steel wire with ultimate tensile strength of 1500N/mm^2 and modulus of rigidity 81000 N/mm^2. The permissible shear stress for the spring wire should be taken as 30% of the ultimate tensile strength. Assume a gap of 2mm between the adjacent turns when the spring is subjected to maximum force. Design the spring and calculate:

(i) wire diameter (ii) mean coil diameter (iii) number of active turns
(iv) free length (v) pitch of turns

VIII. A shaft of rectangular cross section is welded to a support by means of fillet welds as shown in figure. Determine the size of the welds, if the permissible shear stress in the weld is limited to 70N/mm^2.



(All dimensions are in mm)

OR

IX. A mild steel shaft transmits 18KW at 180rpm. It carries a central load of 800N and is simply supported between the bearing 2.4m apart. Determine the size of the shaft, if the allowable shear stress is 40MPa and the maximum tensile or compressive stress is not to exceed 56MPa. What size of the shaft will be required, if it is subjected to gradually applied loads?

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