ONE TIME EXIT SCHEME

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10ME52

Fifth Semester B.E. Degree Examination, April 2018
Design of Machine Elements – I

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Missing data, if any, may be suitably assumed.
3. Use of approved data hand book is permitted.

PART – A

1 a. Explain with a block diagram, the phases of an engineering design. **(06 Marks)**

b. Sketch free hand and label the Mohr's circles for the following cases:
i) Pure tension
ii) Pure shear
iii) A shaft twisted and pulled axially **(06 Marks)**

c. Explain the considerations to be given in the selection of engineering materials for a given application. Suggest suitable material and justify the selection for the following applications:
i) Piston of a scooter engine
ii) A lathe bed
iii) A machine tool spindle
iv) A high speed gear for power transmission **(08 Marks)**

2 a. The dimensions of an overhung crank are given in Fig.Q2(a). The force 'P' acting at the crank pin is 1 kN. The crank is made of steel 30 C8 and the factor of safety is '2'. Using maximum shear stress theory of failure, determine the diameter 'd' at section XX. Take the yield strength of the material is 400 MPa. **(08 Marks)**

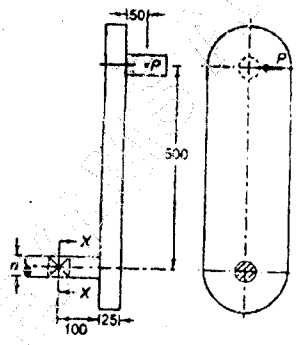

Fig.Q2(a)

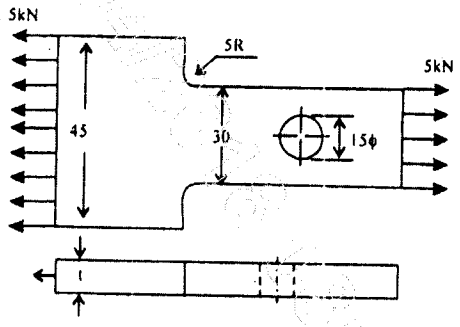

Fig.Q2(b)

b. A flat plate subjected to tensile force of 5 kN is shown in Fig.Q2(b). The plate material is grey cast iron FG 200 with an ultimate tensile strength of 200 MPa. The factor of safety is 2.5. Determine the thickness of the plate. **(08 Marks)**

c. List the design recommendations for members subjected to impact loading. **(04 Marks)**

3 a. Enumerate the factors which influence the endurance limit of a material. Also explain the reasons for using correction factors for modifying the theoretical endurance limit of a material. **(04 Marks)**

b. Explain the following:
i) Low cycle fatigue and high cycle fatigue
ii) Notch sensitivity **(04 Marks)**

c. A hot rolled steel shaft is subjected to a torsional load that varies from 300 N-m clockwise t 100 N-m anticlockwise. The applied bending moment at the critical section varies fro +400 N-m to –200 N-m. The shaft is of uniform cross section and there is no keywa present at the critical section. Determine the required shaft diameter using a factor of safet of 1-5 based on yield strength. The ultimate tensile strength of the material is 560 MPa an the yield strength in tension is 420 MPa. **(12 Mark**

4 a. The external load applied to a bolt fluctuates between zero and 8000 N. The ratio of the m deflection of the bolt per Newton to that for the connected members is 3. The endurand limit of the bolt material in reversed axial loading is 210 MPa and the yield strength 350 MPa. The root area of the thread is 115 mm^2. Assume a stress concentration factor 2.5 and a factor of safety of 1.8 based on yield strength of the material. Determine th minimum initial tightening load that must be applied to prevent separation. Determin whether the bolt is safely loaded by plotting the Soderberg working stress diagram. **(10 Mark**

b. A wall bracket is attached to the wall by means of four identical bolts - two at 'A' and two 'B', as shown in Fig.Q4(b). Assuming that the bracket is held against the wall and prevente from tipping about the point 'O' by the four bolts, determine the size of the bolts on th basis of the maximum shear stress theory. The allowable tensile stress in the material of th bolt is 350 MPa.

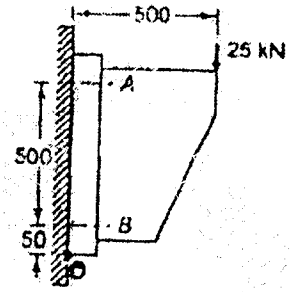

Fig.Q4(b) **(10 Mark**

PART – B

5 a. i) Explain the effect of cutting keyways in shafts from the design point of view.
ii) Design of shafts based on torsional rigidity is more important than the design based o strength. Explain. **(06 Mark**

b. A shaft of uniform diameter as shown in Fig.Q5(b) carries belt pulleys at A and B wit vertical belts. It is supported using ball bearings at C and D. The shaft transmits 7.5 kW 400 r/min. The tension on the tight side of the belt 'A' is 2000 N and that on the tight side the belt 'B' is 900 N. Pulley 'A' weighs 200 N and pulley 'B' 400 N. Estimate a suitab diameter for the shaft adopting a working shear stress of 42 MPa.

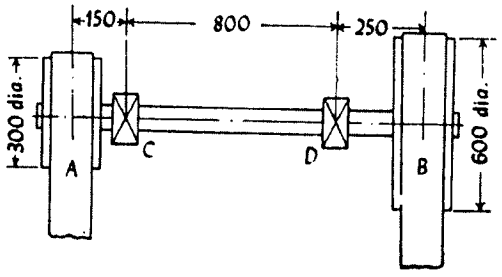

Fig.Q5(b) **(14 Mark**

6 a. Distinguish clearly between rigid and flexible couplings. **(02 Marks)**

b. Sketch the different types of Sunk keys and state their applications. **(04 Marks)**

c. Design a protected type of cast iron flange coupling for connecting steel shaft transmitting 15 kW at 200 r/min. the allowable shear stress for the material of the shaft is 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is shaft and keys and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than full load. Take the shear stress of cast iron as 5 MPa. Design various parts of the coupling and check for possible failures. **(14 Marks)**

7 a. Two mild steel tie bars, for a bridge structure are to be designed by means of a butt joint with double straps. The thickness of the tie bar is 12 mm and carries a tensile load of 400 kN. Design the rivetted joint completely taking into account the following allowable stresses:
Allowable stress in tension : 100 MPa
Allowable stress in shear : 75 MPa
Allowable stress in crushing : 160 MPa
Sketch the joint designed. The joint must be of Lozenge form. **(14 Marks)**

b. A plate 100 mm wide and 12.5 mm thick is to be welded to another plate by means of a single transverse and double parallel fillet welds as shown in Fig.Q7(b). Determine the length of the weld run is each case if the joint is subjected to varying loads (+P to –P). The plates are made of mild steel. The maximum load 'P' carried is limited by an allowable tensile stress of 70 MPa for the joint.

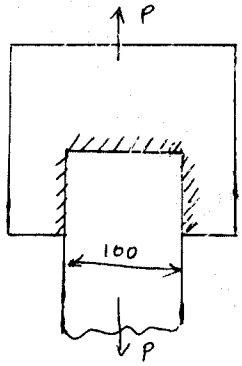

Fig.Q7(b) **(06 Marks)**

8 a. Enumerate the commonly used forms of screw threads used in power transmission. Also state their advantages and disadvantages. **(04 Marks)**

b. Explain the concept of (i) self locking and (ii) collar friction in case of power screws. **(04 Marks)**

c. A machine vice has a single start square threads with 22 mm nominal diameter and 5 mm pitch. The outer and inner diameter of the friction collar are 55 mm ad 45 mm respectively. The machinist can easily exert a force of 125 N on the handle at a mean radius of 150 mm. Assume uniform wear theory for the collar. Calculate:
i) The clamping force developed between the jaws
ii) Overall efficiency of the clamp. **(12 Marks)**

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