CBCS SCHEME

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18ME52

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Design of Machine Elements – I

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of design data hand book is permitted.
3. Assume missing data.

Module-1

1 a. Discuss about the Design Process. **(05 Marks)**

b. List different standards and design code. **(05 Marks)**

c. The state of stress at a point in a strained material is as shown in Fig.1(c). Determine:
i) Direction of the principal planes
ii) The magnitude of principal stresses
iii) The magnitude of the maximum shear stresses its direction. **(10 Marks)**

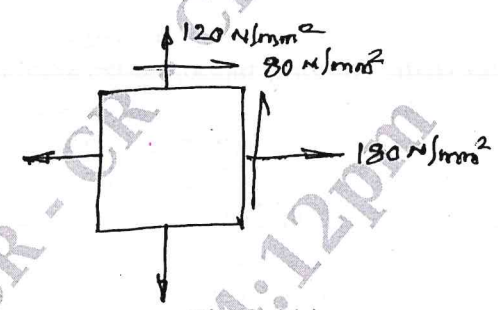

Fig.Q.1(c)

OR

2 a. Define stress concentration factor and discuss about the methods to reduce stress concentration factors. **(08 Marks)**

b. Discuss about the following theories of failure:
i) Maximum shear stress theory
ii) Distortion energy theory. **(04 Marks)**

c. A flat bar, shown in Fig.Q.2(c) is subjected to an axial load of 5×10^5N. Assuming the stress in the bar limited to 400N/mm^2, determine the thickness of the bar. **(08 Marks)**

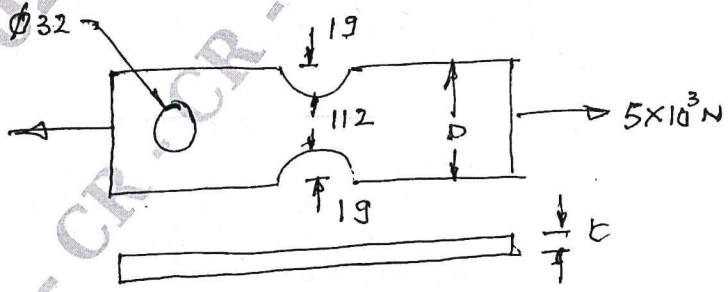

Fig.Q.2(c)

Module-2

3 a. Derive an equation for impact stress. When component is subjected to an axial load? **(06 Marks)**

b. A beam of 300mm depth "I" section is resting on two supports 5m apart. It is loaded by a weight of 5000N falling through a height "h" and striking the beam at midpoint. Moment of inertia of the section is 9.6×10^7mm, assuming $E = 21 \times 10^4$ N/mm^2. Investigate and suggest the permissible value "h" if the stress is limited to 130N/mm^2. **(10 Marks)**

c. With a neat sketch, explain different types of varying stresses. **(04 Marks)**

OR

4 a. Discuss about the Solderberg equation for designing member subjected to fatigue loading. **(06 Marks)**

b. A cold drawn steel rod of circular cross section is subjected to a variable bending moment of 565Nm to 1130Nm as the axial load varies from 430-ON to 13500N. The maximum bending moment occurs at the same instant as that of axial load is maximum. Determine the required diameter of the rod for FOS is 2. Neglect stress concentration and column effect. Take $\sigma u = 550$MPa, $\sigma y = 470$MPa endurance limit as 50% of the ultimate strength and size. Load and surface correction co-efficients as 0.85, 1 and 0.85 respectively. **(14 Marks)**

Module-3

5 A steel solid shaft. 1m long supported between two bearings has two gears keyed to it. The pinion having 40 teeth of 5mm module is located 200mm to the right of the left hand side bearing and receiver 20kW power at 1000rpm from a gear mounted directly below it. The another gear having 50 teeth of 8mm module is located at a distance of 400mm to the left of the right hand bearing and delivers power to another gear mounted directly behind it. The gears are 14½° involute tooth form. The shaft rotates clockwise as seen from the left bearing. If the shaft material selected has an ultimate strength of 500MPa and yield point of 310MPa, determine the necessary diameter of the shaft using combined shock and fatigue factor for bending and twisting as 2 and 1.5 respectively. Neglect the weight of gears. **(20 Marks)**

OR

6 a. With neat sketch, explain different types of keys. **(04 Marks)**

b. A shaft is required to transmit 16kW at 500rpm. Select a suitable key of rectangular cross-section, if the hub length is 60mm. Take allowable shear and crushing stresses for material used as 72MPa and 140MPa respectively. **(06 Marks)**

c. Design a rigid flange coupling to transmit 18kW at 1440rpm the allowable shear stress for CI flange is 4MPa. The shaft, key and Bolts are made of annealed steel having allowable shear stress of 93MPa. Allowable crushing stress for key is 186MPa. **(10 Marks)**

Module-4

7 a. Explain with neat sketch about the failures in rivets. **(06 Marks)**

b. An air vessel of 1m diameter has longitudinal triple riveted lap-joint [zig-zag type), the maximum air pressure in the vessel is 2MPa. Design the riveted joint if the safe working stress in tension, shear and crushing are 125MPa, 90MPa and 165MPa. **(14 Marks)**

OR

8 a. A shaft of rectangular cross section is welded to a support by means of fillet welds, as shown in Fig.Q.8(a). Determine the size of the welds, if the permissible shear stress in the weld is limited to $75N/mm^2$. **(10 Marks)**

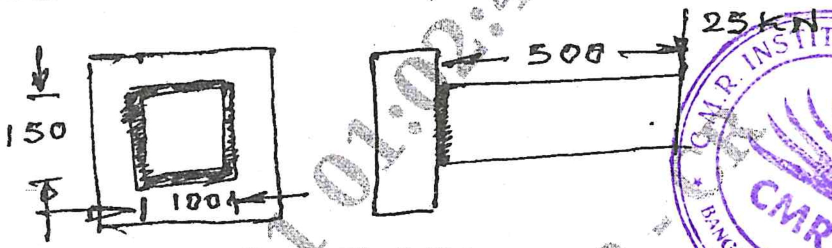

Fig.Q.8(a)

b. A plate of 80mm wide and 10mm thick is to be welded to another plate by means of parallel fillet welds. The plates are subjected to a load of 50kN. Find the length of weld so that maximum stress does not exceed $50N/mm^2$. Consider the joint under static loading and then under dynamic loading. **(10 Marks)**

Module-5

9 a. Explain self locking and over hauling in power screws. **(06 Marks)**

b. Design a sleeve type cotter joint. Connected to a two tie rod, subjected to an axial pull of 60kN. The allowable stress of c-30 material used for the rod are $\sigma t = 65N/mm^2$, $\sigma c = 75N/mm^2$ and $t = 65N/mm^2$. Cast steel for the sleeve has the allowable stresses of $\sigma t = 70N/mm^2$, $\sigma c = 110N/mm^2$ and $t = 45N/mm^2$. **(14 Marks)**

OR

10 Design a screw jack with a lift of 300mm to lift a load of 50kN. **(20 Marks)**

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