Code No: R1622034 **R16** SET - 1

II B. Tech II Semester Supplementary Examinations, April - 2021
DESIGN OF MACHINE MEMBERS-I
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) What are preferred numbers? (2M)
   b) What is mean by stress concentration factor and notch sensitivity? (2M)
   c) Explain about strength of transverse fillet welded joints? (3M)
   d) Explain about square thread and acme thread? (3M)
   e) Define a key? What are the types of keys? (2M)
   f) Define the terms used in compression springs? (2M)

PART -B

2. a) Define principal stresses and principal planes? (7M)
   b) A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T. If the yield point of the steel in tension is 200MPa, find the maximum value of this torque without causing yielding of the shaft according to 1. the maximum principal stress; 2. The maximum shear stress; and 3. the maximum distortion strain energy theory of yielding. (7M)

3. a) Explain about Soderberg method for combination of stresses? (7M)
   b) A simply supported beam has a concentrated load at the centre which fluctuates from a value of P to 4 P. The span of the beam is 500 mm and its cross-section is circular with a diameter of 60 mm. Taking for the beam material an ultimate stress of 700MPa, a yield stress of 500MPa, endurance limit of 330MPa for reversed bending, and a factor of safety of 1.3, calculate the maximum value of P. Take a size factor of 0.85 and a surface finish factor of 0.9. (7M)

4. a) A double riveted lap joint is made between 15 mm thick plates. The rivet diameter and pitch are 25 mm and 75 mm respectively. If the ultimate stresses are 400MPa in tension, 320MPa in shear and 640MPa in crushing, find the minimum force per pitch which will rupture the joint.If the above joint is subjected to a load such that the factor of safety is 4, find out the actual stresses developed in the plates and the rivets. (7M)
   b) A plate 100 mm wide and 10 mm thick is to be welded with another plate by means of transverse welds at the ends. If the plates are subjected to a load of 70kN, find the size of weld for static as well as fatigue load. The permissible tensile stress should not exceed 70MPa. (7M)
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5. a) Write the design procedure for knuckle joint with neat sketch? (7M)

   b) Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70kN. The ultimate strength of the material of the rod against tearing is 420MPa. The ultimate tensile and shearing strength of the pin material are 510MPa and 396MPa respectively. (7M)
   Determine the tie rod section and pin section. Take factor of safety = 6.

6. a) Write the design procedure for sleeve or muff coupling? (7M)

   b) Design and draw a cast iron flange coupling for a mild steel shaft transmitting 90 kW at 250r.p.m. The allowable shear stress in the shaft is 40MPa and the angle of twist is not to exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30MPa. (7M)

7. a) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350MPa and modulus of rigidity 84kN/mm^2, find the axial load which the spring can carry and the deflection per active turn. (7M)

   b) A concentric spring for an aircraft engine valve is to exert a maximum force of 5000 N under an axial deflection of 40 mm. Both the springs have same free length, same solid length and are subjected to equal maximum shear stress of 850MPa. If the spring index for both the springs is 6, find (i) the load shared by each spring, (ii) the main dimensions of both the springs, and (iii) the number of active coils in each spring. (7M)
   Assume G = 80kN/mm^2 and diametral clearance to be equal to the difference between the wire diameters

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II B. Tech II Semester Regular/Supplementary Examinations, November - 2020
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(Mechanical Engineering)

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PART –A

1. a) List out the various phases of design process. (2M)
   b) What is modified Goodman's line? (3M)
   c) What do you understand preloading of bolts? (2M)
   d) What is key? State its function. (2M)
   e) Discuss the function of a coupling. (3M)
   f) The extension springs are in considerably less use than the compression springs. Why? (2M)

PART -B

2. a) A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T. If the yield point of the steel in tension is 200 MPa, Calculate the maximum value of this torque without causing yielding of the shaft according to 1. The Maximum principle stress; and 2. The maximum shear stress. (7M)
   b) A circular bar of 500mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20kN and a maximum value of 50kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish of 0.9. The material properties of bar are given by ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 Mpa (7M)

3. a) A machine component is subjected to a flexural stress which fluctuates between +300 MN/m^2 and -150 MN/m^2. Determine the value of minimum ultimate strength according to 1. Modified Goodman relation; and 2. Soderberg relation. Take yield strength = 0.55Ultimate strength; Endurance strength= 0.5 Ultimate strength and factor of safety = 2. (7M)
   b) Determine the diameter of a circular rod made of ductile material with a fatigue strength (complete stress reversal), σ_e = 265 MPa and a tensile yield strength of 350 MPa. The member is subjected to a varying axial load from W_{min} = -300×10^3 N to W_{max} = 700×10^3 N and has a stress concentration factor = 1.8. Use factor of safety as 2.0. (7M)
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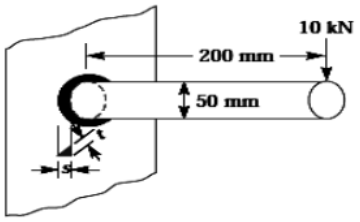
4. a) A mild steel cover plate is to be designed for an inspection hole in the shell of a pressure vessel. The hole is 120mm in diameter and the pressure inside the vessel is 6 N/mm^2.Design the cover plate along with the bolts. Assume allowable tensile stress for mild steel as 60 MPa and for bolt material as 40 MPa. (7M)

   b) A 50mm diameter solid shaft is welded to a flat plate as shown in fig. if the size of the weld is 15 mm; Calculate the maximum normal and shear stress in the weld. (7M)



5. a) Design a sleeve and cotter joint to resist a tensile load of 60 kN. All parts of the joint are made of the same material with the following allowable stresses: σt= 60 MPa; τ=70 MPa; and σc= 125 MPa. (7M)

   b) A hollow shaft of 0.5m outside diameter and 0.3m inside diameter is used to drive a propeller of a marine vessel. The shaft is mounted on bearings6m apart and it transmits 5600kW at 150 rpm. The maximum axial propeller shaft is 500kN and the shaft weighs 70kN. Determine(i).The maximum shear stress developed in the shaft(ii).The angular twist between the bearings. (7M)

6. a) Design a cast iron protective type flange coupling to transmit 15kW at 900 rpm from an electric motor to a compressor. The service factor may be assumed (s) is 1.35. The following permissible stresses may be used. Shear stress for shaft, bolt and key material=40MPa, Crushing stress for bolt and key=80 MPa, Shear stress for cast iron=8 MPa. (7M)

   b) Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15kW at 200 rpm and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for the shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14MPa. (7M)

7. a) At the bottom of a mine shaft, a group of 10 identical close coiled helical springs are set in parallel to absorb. The shock caused by the falling of the cage in case of a failure. The loaded cage weighs 75KN, while the counter weight has a weight of 15KN. If the loaded cage falls through a height of 50 meters from rest, find the maximum stress induced in each spring if it is made of 50mm diameter steel rod. The spring index is 6 and the number of active turn in each spring is 20. Modulus of rigidity G= 80KNmm^2. (7M)

   b) Discuss the materials and practical applications for the various types of springs. (7M)

II B. Tech II Semester Supplementary Examinations, November - 2019
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PART –A

1. a) Define principal stresses and principal planes? (2M)
   b) Define fatigue and endurance limit? (2M)
   c) Explain about methods of riveting? (3M)
   d) What are the elements of a welding symbol? (2M)
   e) Explain about general procedure in machine design? (3M)
   f) Define the terms used in compression springs? (2M)

PART -B

2. a) State and explain theories of failures under static load? (7M)
   b) The load on a bolt consists of an axial pull of 10kN together with a transverse shear force of 5kN. Find the diameter of bolt required according to (7M)
   i). Maximum principal stress theory; ii). Maximum shear stress theory;
   iii). Maximum principal strain theory; iv). Maximum strain energy theory;
   and v). Maximum distortion energy theory.
   Take permissible tensile stress at elastic limit = 100MPa and
   Poisson's ratio = 0.3.

3. a) Write short notes on the influence of various factors of the endurance limit of a ductile material? (7M)
   b) A 50 mm diameter shaft is made from carbon steel having ultimate tensile strength of 630MPa. It is subjected to a torque which fluctuates between 2000 N-m to – 800 Nm. Using Soderberg method, calculate the factor of safety. Assume suitable values for any other data needed. (7M)

4. a) What is an eccentric loaded welded joint? Discuss the procedure for designing such a joint. (7M)
   b) Obtain an expression for total load on a bolt in a bolted joint with gasket. (7M)

5. a) Design a knuckle joint to transmit 150kN. The design stresses may be taken as 75MPa in tension, 60MPa in shear and 150MPa in compression. (7M)
   b) A mild steel shaft transmits 20 kW at 200r.p.m. It carries a central load of 900N and is simply supported between the bearings 2.5metres apart. Determine the size of the shaft, if the allowable shear stress is 42MPa 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? (7M)
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6. a) Write the design procedure for flange coupling with neat sketch? (7M)

   b) Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960r.p.m. The overall torque is 20 percent more than mean torque. (7M)
   The material properties are as follows:
   (i) The allowable shear and crushing stress for shaft and key material is 40MPa and 80MPa respectively.
   (ii) The allowable shear stress for cast iron is 15MPa.
   (iii) The allowable bearing pressure for rubber bush is 0.8 N/mm^2.
   (iv) The material of the pin is same as that of shaft and key

7. a) Explain about composite springs? (7M)

   b) A helical compression spring made of oil tempered carbon steel, is subjected to a load which varies from 400 N to 1000 N. The spring index is 6 and the design factor of safety is 1.25. If the yield stress in shear is 770MPa and endurance stress in shear is 350MPa, find: i). Size of the spring wire, ii). Diameters of the spring, iii). Number of turns of the spring, and 4. Free length of the spring. (7M)
   The compression of the spring at the maximum load is 30 mm. The modulus of rigidity for the spring material may be taken as $80kN/mm^2$.