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

II B. Tech II Semester Regular/ Supplementary Examinations, April/May - 2019
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) List out at least 6-important mechanical properties of engineering materials. (3M)
   b) Define the term endurance limit? Show diagrammatically. (2M)
   c) Identify different rivets configurations or systems? (2M)
   d) What is a Gib? What is the uniqueness of Gib headed cotter joint. (3M)
   e) What is a shaft coupling? What are its principal functions? (2M)
   f) Write the statement of leaf spring of uniform strength. (2M)

PART -B

2. a) Select a suitable materials for the manufacture of the following: (4M)
      i) Machine tool spindle ii) Valve spring
      iii) Condenser tubes iv) Connecting rod
   b) Define the term 'factor of safety'. Explain the influence of stress raiser on impact strength. (10M)

3. a) Draw the stress strain diagrams of (4M)
      i) Ductile materials and
      ii) Brittle materials
   b) A shaft is made of steel, ultimate tensile strength 700 MPa and yield point 420 MPa is subjected to a torque varying from 200N m anti-clockwise to 600 N m clockwise. Calculate the diameter of the shaft if the factor of safety is 2 and it is based on the yield point and the endurance strength in shear. (10M)

4. a) What do you understand by the term riveted joint? Explain the necessity of such a joint. (4M)
   b) The head of an air compressor cylinder is attached by eight bolts. The cylinder bore diameter is 80 mm and the maximum working pressure is limited to 3 MPa. Determine the diameter of bolt, when a copper-asbestos is used between the head and the cylinder and an initial compressive load of 5 KN is required on the gasket for a leak proof joint. Ultimate tensile strength, Yield strength and endurance limit for material are 400 MPa, 340 MPa and 200 MPa respectively. A factor of safety of three is desired and the stress-concentration factor of 2.84 may be assumed. (10M)

5. a) Discuss the effect of keys on the strength of the shaft. (4M)
   b) Design a socket and spigot type of cotter joint to sustain an axial load of 100kN. The material selected for the joint has the following design stresses. σ_t = 120 MPa, σ_c = 160 MPa and σ_{pb} = 60 MPa (10M)

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6. Design a bushed-pin type flexible coupling for connecting a motor shaft to a pump shaft, with the following service conditions: (14M)
   Power to be transmitted =40kW
   Speed of the motor shaft =1000rpm
   Diameter of motor and pump shafts =45mm
   Bearing pressure on the rubber bush =0.7N/mm^2
   Allowable stress in the pins =60MPa

7. Design the spring for an elevator at the bottom of which 8 identical springs are set in parallel to absorb the shock of the elevator in case of failure. The weight of the elevator is 20 kN and has a free fall of 1.2 m from rest. The spring is made of 20 mm dia wire and has a spring index of 5.5. Each spring has 12 active turns. Neglect the effect of counter weight. (14M)

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(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
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PART –A

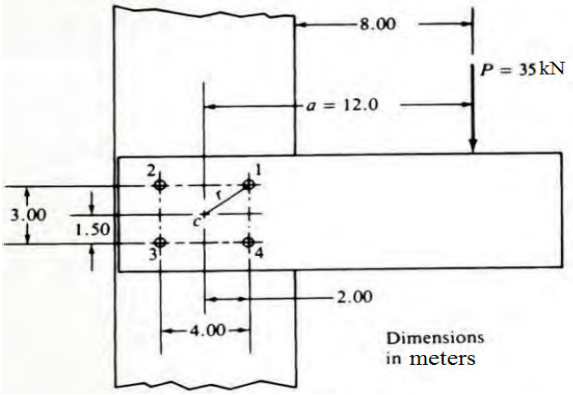
1. a) What is the relation between tolerances and fits? (3M)
   b) Define the term fatigue? (2M)
   c) Classify various welded joints? (2M)
   d) Distinguish the Keyed and Cotter joins? (3M)
   e) Classify the shaft couplings. (2M)
   f) Distinguish helical and torsional springs. (2M)

PART -B

2. a) What are alloy steels? Discuss the effect of adding different alloying elements in steel? (4M)
   b) A weight of 1400 N is dropped on to a collar at the lower end of a vertical steel shaft of 3m long and 25 mm. diameter, calculate the height of drop if the maximum instantaneous stress produced is not to exceed 120 MPa. Take E = 2.1×10^5 MPa. (10M)

3. a) Explain the effect of the following factors on the type of fatigue failure. (4M)
   i) Strain rate ii) Type of material iii) Manner of loading
   b) A steel connecting rod is subjected to a completely reversed axial load of 1,600 MPa. Suggest the suitable diameter of the rod using a factor of safety 2. The ultimate tensile strength of the material is 1,100 MPa and yield strength 930 MPa. Neglect column action and the effect of stress concentration. (10M)

4. a) What do you understand by the term riveted joint? Explain the necessity of such a joint. (4M)
   b) For the bracket in Figure assume that the total force P is 35kN and the distance a is 12 m. Design the bolted joint, including the location and number of bolts, the material, and the diameter. (10M)



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5. a) Describe the purpose of gib in cotter joint? What are the applications of cotter joints? (4M)

   b) Design and draw a sleeve and cotter joint to connect two rods to transmit maximum tensile load of 82 kN. Assume sleeve cotter and rods are made of same material and design stresses in the material are 65 Mpa in tension; 130 in crushing and 50 Mpa in shear. (10M)

6. a) Write a short note on universal coupling. (4M)

   b) In a flange shaft coupling having 37.5mm bore it is desired that torsional stress in the shaft will not exceed 25 N/mm^2. The outside diameter of the coupling limited by space is 200mm. There are three 15mm bolts on a bolt circle diameter of 140mm. The radial flange thickness is 18mm. Determine the following: (10M)
   i) The power that may be transmitted at 600 rev/min.
   ii) The shearing stress in the bolts.
   iii) The bearing pressure on the bolts.

7. A lift system is provided with cushion springs at the bottom of lift. The lift is free to fall. Springs are set in parallel. Specify the required number of springs if the lift has free fall of 1.5m from rest. (14M)
   Weight of lift = 30kN
   Allowable deflection per spring= 370 mm
   Number of active turns =15
   Spring mean coil diameter =30 mm
   Spring wire diameter = 30mm
   Modulus of rigidity for spring =80Gpa

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Code No: R1622034 **R16** SET - 3

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(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
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PART –A

1. a) List standard fundamental equations for Axial, bending and torsional loading. (3M)
   b) Define the term notch sensitivity? What is fatigue stress concentration factor and notch sensitivity? (3M)
   c) List different types of riveted joints. (2M)
   d) How do you classify keys for mechanical systems? (2M)
   e) How do you define rigid shaft couplings? Name them. (2M)
   f) What is energy storage capacity of a spring? (2M)

PART -B

2. a) State the alloying elements added to steel and the effects they produce in steel. (4M)
   b) A copper bar 50 mm in diameter is placed with a steel tube 75 mm external diameter and 50 mm internal diameter of exactly the same length. The two pieces are rigidly fixed together by two pins 18 mm in diameter, one at each end passing through the bar and tube. Calculate the stress induced in the copper bar, steel tube and pins if the temperature of the combination is raised by 50%. Take Es = 210GN/m^2; Ec = 105GN/m^2 $\alpha s = 11.5 \times 10{-}6/^oC$ and $\alpha c = 17 \times 10{-}6/^oC$. (10M)

3. a) Explain the Soderberg method for combination of stresses. (4M)
   b) A steel rod is subjected to a reversed axial load of 180 kN. Find the diameter of the rod for a factor of safty of 2. Neglect column action. The material has an ultimate tensile strength of 1070 Mpa and yield strength of 910 Mpa. The endurance limit is reversed bending may be assumed to be one half of the ultimate tensile strength. The correction factors are as follows. (10M)
   Load factor = 0.7; Surface finish factor = 0.8
   Size factor = 0.85; Stress concentration factor = 1.

4. a) Explain the method of determining the size of the bolt when the bracket carries an eccentric load parallel to the axis of the bolt. (4M)
   b) Determine the safe tensile load for bolts of M 20 and M 36. Assume that the bolts are not initially stressed and take the safe tensile stress as 200 MPa. (10M)

5. a) Design a cotter joint to withstand an axial load varying from 45kN in tension to 45 kN in compression. The allowable for the steel used in the joint are 60Mpa in tension; 70 Mpa in crushing; 45 Mpa in shear. (4M)
   b) A shaft running at 400rpm transmits 10kW. Assuming allowable shear stress in shaft is 40Mpa, find the diameter of the shaft. (10M)

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6. a) The bolt in the flange coupling should be made weaker than the other components of coupling, Why? (4M)

   b) Design a bushed pin type flexible coupling for connecting two shafts when Hp to be transmitted = 50Hp
   Speed of the shaft = 100rpm
   Diameter of the shaft = 50mm.
   The bearing pressure in the rubber bush and allowable stress in the pins are to be limited to $0.45N/mm^2$ and $25N/mm^2$ respectively. Sketch the coupling. (10M)

7. A railway car weighing 20 kN and moving with a velocity of 15 kmph is to be stopped by a buffer consisting of 4 helical compression springs in which the maximum compression allowed is 0.3 m. Find the no. of active turns required if the spring is made of 20 mm diameter wire and 160 mm mean coil diameter. Also find the maximum shear stress induced in the coils. (14M)

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Code No: R1622034 **R16** SET - 4

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(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
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PART –A

1. a) Write the statement of Rankine's theory of failure. (3M)
   b) Define the term stress concentration and draw some critical regions to stress concentration. (3M)
   c) What are locking devices in bolted joints? (2M)
   d) What is a Key? Mention various functions of the keys. (2M)
   e) How do you define flexible shaft couplings? Name them. (2M)
   f) Write the formula for deflection of a helical spring. (2M)

PART -B

2. a) Enumerate the most commonly used engineering materials? Briefly explain shear stress and shear strain? (4M)
   b) A steel saw blade 1 mm thick is bent into an arc of a circle of 50 cm radius. Determine the flexural stresses induced and the bending moment required to bend the blade which is 15 mm wide. Take E = $2.1X10^5$ N/mm^2 (10M)
3. a) A load on a bolt consists of an axial pull of 10 k N together with a transverse shear force of 5 kN. Find the diameter of bolt required according to (14M)
   i) Maximum principal stress theory
   ii) Maximum shear stress theory
   iii) Max-principal strain theory
   iv) Maximum strain energy theory.
   Take permissible tensile stress at elastic limit=100 Mpa and Poisson's ratio=0.3.
4. a) Discuss on bolts of uniform strength giving examples of practical applications of such bolts. (4M)
   b) 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 400 MPa in tension, 320 MPa in shear and 640 MPa 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 two, find out the actual stresses developed in the plates and the rivets. (10M)
5. a) Derive suitable equations in terms of torque, cross section of key for same shaft and key material. (4M)
   b) A feather key is 12mm wide and is to transmit 700N-m torque from a 400mm diameter shaft. The steel key has an allowable stress in tension and compression of 120Mpa and an allowable shear stress of 575Mpa. Determine the required length of key. If the key dimensions are reversed as 9mm wide and 12mm deep, what would have been the required length of key for same load and material? (10M)

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6. a) Discuss the function of coupling. Give at least three practical applications? (4M)

   b) Design a solid muff coupling made of cast iron to connect two shafts transmitting 35KW at 150rpm with a capability of 25% maximum torque greater than the mean torque. The shaft and key are made of mild steel for which permissible shear and crushing stress are $30MN/m^2$ and $80MN/m^2$ respectively. Permissible shear stress in CI is $15MN/m^2$. (10M)

7. A semi elliptical laminated spring is to carry of load of 5000N and consists 8 leaves 46mm wide, two of the leaves being of full length. The spring is to be made 1000mm between the eyes and is held at the center by a 60mm wide band. Assume that the spring is initially stressed so as to induce an equal stress of $500N/mm^2$ when fully loaded. Design the spring (14M)
   i) Thickness of leaves
   ii) Eye diameter
   iii) Length of leaves
   iv) Maximum deflection and camber. Assume $E = 2.1\times10^5$ N/mm^2

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