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

II B. Tech II Semester Regular Examinations, April - 2018
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)	Define factor of safety?	(2M)
	b)	Define endurance limit?	(2M)
	c)	What do you understand by the terms riveted joint and welded joints?	(3M)
	d)	List out the various types of stresses induced in shafts.	(3M)
	e)	Write the applications of rigid couplings?	(2M)
	f)	Write about co-axial springs?	(2M)

PART -B

2.	a)	Explain about manufacturing considerations in design, tolerances and fits?	(7M)
	b)	Describe various theories of failure?	(7M)
3.	a)	Write about the design for fluctuating stresses?	(5M)
	b)	An automobile leaf spring is subjected to cyclic stress such that the average stress is 150Mpa, variable stress is 350Mpa; the material properties are; ultimate strength = 400Mpa; yield strength = 350Mpa; endurance limit = 270Mpa; estimate the factor of safety using Goodman method and Soderberg method?	(9M)
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 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 2, find out the actual stresses developed in the plates and the rivets.	(10M)
	b)	Enumerate the list of failures of riveted joints.	(4M)
5.	a)	Design a cotter joint to withstand an axial load varying from 48kN in tension to 48kN in compression. The allowable for the steel used in the joint are 60Mpa in tension; 75Mpa in crushing; 48Mpa in shear	(7M)
	b)	A 350mm diameter solid shaft is used to drive the propeller of a marine vessel. It is necessary to reduce the weight of the shaft by 80%. What would be the dimensions of a hollow shaft made of the same material as the solid shaft?	(7M)
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6. Design and draw a bush type flexible flange coupling to transmit 15Hp at 960 rpm allowable shear stress for the shaft and key may be taken as 53.5N/mm^2. The shear stress in the bolts should not exceed 35N/mm^2.The bearing pressure between the bush and coupling should be 2N/mm^2. (14M)

7. a) A close coiled helical compression spring of 16 active coils has a spring stiffness of 10 N/mm. It is cut into two springs having 7 and 9 turns. Determine the spring stiffness of resulting springs. (8M)

   b) Generally how the springs are classified? Indicate the different types of springs by sketches and give minimum two practical applications of each. (6M)

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PART –A

1.	a)	Write the BIS codes of steels in brief?	(3M)
	b)	Define notch sensitivity?	(2M)
	c)	Write the necessity of riveted and bolted joint?	(2M)
	d)	What are the applications of socket and spigot joints?	(3M)
	e)	Write the applications of flexible couplings?	(2M)
	f)	Write the energy storage capacity of springs?	(2M)

PART -B

2.	a)	Explain the general considerations in the design of engineering materials and their properties?	(7M)
	b)	A shaft is designed based on maximum distortion energy theory with a factor of safety of 2.0. The material used is 30C8 steel with a yield stress of 310MPa. It is subjected to an axial load of 40kN. Determine the maximum torque capacity. Diameter of the shaft is 20 mm.	(7M)
3.	a)	Explain Goodman's method to calculate the safe values of fluctuating stress. For what materials it is applicable?	(7M)
	b)	A simply supported beam has a concentrated load at the center, which fluctuates from a value of P to 4 P. The span of the beam is 0.5 m and its cross-section is circular with a diameter of 0.06 m. Taking for the beam material an ultimate stress of 700 MPa, a yield stress of 500 MPa, endurance limit of 330 MPa 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 triple riveted lap joint with zig-zag riveting is to be designed to connect two plates of 6 mm thickness. Determine the diameter of the rivet, pitch of rivets and distance between the rows of the rivets. Indicate how the joint will fail. Also, find the efficiency of the joint. The permissible stresses are 120MPa in tension, 100MPa in shear and 150MPa in crushing.	(10M)
	b)	What are the advantages and limitations of welding over riveting?	(4M)
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5. a) Design a knuckle joint to transmit 140 kN, with permissible stresses in tension; shear and compression are 75 Mpa; 60 Mpa and 150 Mpa respectively. (10M)
   b) Describe the purpose of gib in cotter joint? Write the applications of knuckle joint? (4M)

6. a) Design a muff coupling to connect two shafts transmitting 40KW at 120rpm. The permissible shear and crushing stress for the shaft and key material (mild steel) are 30Mpa and 80Mpa respectively. The material of muff is cast Iron with permissible shear stress of 15Mpa. Assume that the maximum torque transmitted is 25 percent greater than mean torque. (10M)
   b) Write the applications of split muff couplings? (4M)

7. a) What is nip and explain its importance on leaf springs? (4M)
   b) A bus is provided with four leaf springs each having 9 leaves and supports are 2m a part and section of leaf is 50 mm x 6mm. The full capacity load for springs amounts to 10000N. The rear axle takes 80% of load, breaking strength 12,000. Check the dimensions. (10M)

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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 about types of tolerances? (2M)
   b) Define endurance strength? (2M)
   c) Write the applications of welded joints? (3M)
   d) Write the stresses in cotter joint? (3M)
   e) Write the purpose of flange couplings? (2M)
   f) Write the basic phenomenon of surge in springs. (2M)

PART -B

2. A machine element is loaded so that$\sigma 1$ = 120 Mpa, σ_2 = 70Mpa, σ_3 = −90Mpa the material has a maximum yield strength in tension and compression of 360Mpa. Find the factor of safety for each of the following theories. i) Maximum Normal stress theory ii) Maximum Shear stress theory iii) Distribution energy theory. (14M)

3. a) Determine the size of a piston rod subjected to a total load of having cyclic fluctuations from 150 kN in compression to 25 kN in tension. The endurance limit is 360 MPa and yield strength is 400 MPa. Take impact factor = 1.25, factor of safety = 1.5, surface finish factor = 0.88 and stress concentration factor = 2.25. (10M)
   b) Explain the methods to reduce stress concentrations? (4M)

4. A double riveted, double strap bolt joint is used to join 30mm thick plates. The pitch of the rivets in the outer row is twice that of the inner row. Zigzag riveting is to be employed with the following working stresses; τ = 63Mpa and σ_t = 84Mpa. Calculate rivet diameter, rivet pitches in the inner and outer rows and the thickness of the butt straps. (14M)

5. a) A 10kW power is transmitted at 800 rpm, from a motor shaft, through a key, to a machine shaft by a means of a pulley and a belt. Design the key. Take the allowable shear stress and crushing stress are 45MPa and 100Mpa. (6M)
   b) A shaft and a key are made of the same material and the key width is 1/4 of the shaft diameter. Consider shear only, determine the minimum length of the key in terms of the shaft diameter. The shearing strength of the key material is 60% of its crushing strength. Determine the thickness of the key to make the key equally strong in shear and crushing. (8M)

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6. 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. (14M)

7. Design a spring for an engine indicator of the following specifications: (14M)
Maximum pressure in the engine cylinder 500 N/cm^2
Diameter of the indicator cylinder 20mm
Mean diameter of the indicator spring 15 mm
Height of the indicator drum 60 mm
Mechanical amplification of the linkage 5
Approximate number of turns in the spring 6
Rigidity modulus of the spring material 0.85 x 105 N/mm^2.

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

1. a) Write about types of fits? (3M)
   b) Define theoretical stress concentration factor? (2M)
   c) Write the applications of bolted joint? (2M)
   d) Write the stresses in keys? (3M)
   e) Write the purpose of muff couplings? (2M)
   f) How does surge in springs eliminated? (2M)

PART -B

2. A cylindrical shaft made of steel yield strength 800Mpa is subjected to static loads bending moment 20kN-m and twisting moment 30N-m. Calculate the diameter of the shaft using Normal stress theory and Von Mises theory. Assume factor of safety is 2. (14M)

3. a) Explain the effect of the following factors on the type of fatigue failure. (4M)
      i) Type of material
      ii) Stress distribution

   b) A shaft made of steel having ultimate tensile strength of 700 MPa and yield point 420 MPa is subjected to a torque of 2000 N- m clockwise to 600 N- m anti-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) Two plates 16 mm thick are joined by a double riveted lap joint. The pitch of each row of rivets is 90 mm. The rivets are 25 mm in diameter. The permissible stresses are 140 MPa in tension, 80 MPa in shear and 160 MPa in crushing. Find the efficiency of the joint. (10M)
   b) Enumerate the different types of riveted joints. (4M)

5. Design a sleeve and cotter joint to resist a tensile load of 70kN. All parts of the joints are made of the same material with the following allowable stresses: σ_t = 60Mpa ; τ = 70Mpa ; σ_c = 125Mpa (14M)
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6. Design and draw a cast iron flange coupling for a mild steel shaft transmitting 90KW at 250 rpm. The allowable shear stress in the shaft is 40Mpa and the angle of twist is not to exceed 1^0 in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30Mpa. (14M)

7. A Rail wagon weighing 300kN is moving with a velocity of 2m/sec. It is to be brought to rest by two buffers with springs of 300mm diameter. The maximum deflection of spring is 300mm, allowable shear stress in the spring = 600 N/mm^2. Design the spring. (14M)