Course Code: 18ME0313 **R18**

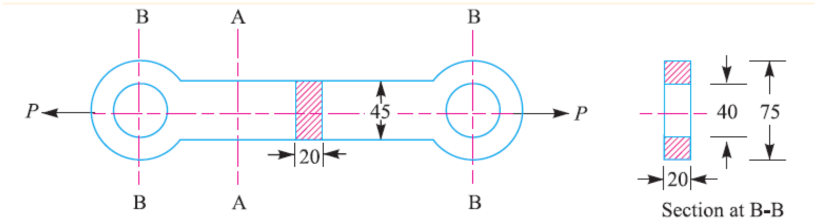
SIDDHARTH GROUP OF INSTITUTIONS:: PUTTUR
(AUTONOMOUS)
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

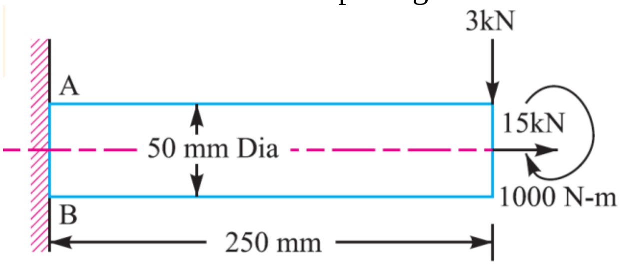
Subject with Code: DME - I (18ME0313) **Course & Branch**: B.Tech -ME
Year & Sem: III-B.Tech & I-Sem **Regulation:** R18

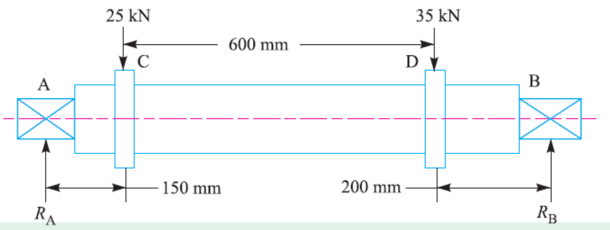
UNIT –I
INTRODUCTION & STRESS IN MACHINE MEMBERS

1	**a**	Define Factor of safety	[L1][CO1]	**[2M]**
	b	What is impact load?	[L1][CO1]	**[2M]**
	c	Distinguish between brittle fracture and ductile fracture.	[L4][CO1]	**[2M]**
	d	Write the bending and torsion equations.	[L2][CO1]	**[2M]**
	e	What are various theories of failure?	[L1][CO1]	**[2M]**
2		**a.** Describe materials classification for engineering use?	[L1][CO1]	**[05M]**
		b. Draw and explain the stress–strain diagram for mild steel.	[L2][CO1]	**[05M]**
3		**a.** How do you classify the machine design? Explain	[L4][CO1]	**[05M]**
		b. Explain the general design procedure while designing a machine element	[L2][CO1]	**[05M]**
4		**a.** What are the general design consideration should be followed while designing a machine element	[L1][CO1]	**[05M]**
		b. Classify the manufacturing consideration that is followed while designing a machine element	[L2][CO1]	**[05M]**
5		**a.** What do you mean by preferred numbers and explain the applications?	[L2][CO1]	**[05M]**
		b. What is meant by factor of safety? Explain how it can be used in design applications.	[L1][CO1]	**[05M]**
6		**a.** A cast iron link, as shown in Fig., is required to transmit a steady tensile load of 45 kN. Find the tensile stress induced in the link material at sections A-A and B-B.	[L3][CO1]	**[05M]**

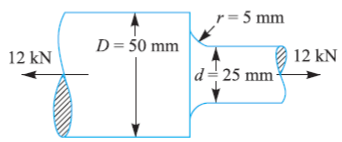


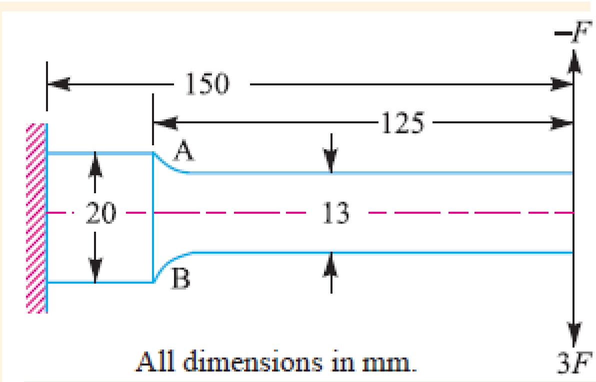
		b. A hydraulic press exerts a total load of 3.5 MN. This load is carried by two steel rods, supporting the upper head of the press. If the safe stress is 85 MPa and E = 210 kN/mm^2, find : 1. diameter of the rods, and 2. extension in each rod in a length of 2.5m.	[L3][CO1]	**[05M]**
7		A shaft, as shown in Fig. is subjected to a bending load of 3 kN, pure torque of 1000 N-m and an axial pulling force of 15 kN. Calculate the stresses at A and B.	[L3][CO1]	**[10M]**



8	**a.** Derive an expression for the impact stress induced due to a falling load	[L4][CO1]	**[05M]**
	b. An unknown weight falls through 10 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 600 mm^2 in section. If the maximum instantaneous extension is known to be 2 mm, what is the corresponding stress and the value of unknown weight? Take E = 200 kN/mm^2.	[L3][CO1]	**[05M]**
9	**a.** Discuss the bending stress relation and draw the diagram.	[L2][CO1]	**[05M]**
	b. A pump lever rocking shaft is shown in Fig. The pump lever exerts forces of 25 kN and 35 kN concentrated at 150 mm and 200 mm from the left and right hand bearing respectively. Find the diameter of the central portion of the shaft, if the stress is not to exceed 100 MPa 	[L4][CO1]	**[05M]**
10	The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to 1. Maximum principal stress theory; 2. Maximum shear stress theory; 3. Maximum principal strain theory; 4. Maximum strain energy theory; and 5. Maximum distortion energy theory.	[L3][CO1]	**[10M]**

UNIT –II
DESIGN FOR FATIGUE LOADS & CONCEPT OF FRACTURE MECHANICS

1	**a**	Define endurance limit.	[L1][CO2]	**[2M]**
	b	Differentiate between repeated stress and reversed stress.	[L2][CO2]	**[2M]**
	c	Define stress concentration and stress concentration factor.	[L1][CO2]	**[2M]**
	d	What is brittle fracture and What is ductile fracture?	[L1][CO2]	**[2M]**
	e	Explain notch sensitivity.	[L2][CO2]	**[2M]**
2		**a.** Describe Goodman's and Soderberg's equation for combination stresses.	[L1][CO2]	**[05M]**
		b. Find the maximum stress induced in the following cases taking stress concentration into account: A rectangular plate 60 mm × 10 mm with a hole 12 diameter as shown in Fig. and subjected to a tensile load of 12 kN.	[L3][CO2]	**[05M]**
3		Explain stress concentration in detail and various methods to reduce stress concentration in machine members?	[L2][CO2]	**[10M]**
4		Define the following terms i) Theoretical Stress concentration factor ii) Fatigue Stress concentration factor iii) Endurance limit with the effect of size, load and surface factors iv) Fatigue failure	[L1][CO2]	**[10M]**
5		**a.** What is the notch sensitivity? And write the expression for it?	[L3][CO2]	**[05M]**
		b. Find the maximum stress induced in the following case taking stress concentration into account: A stepped shaft as shown in Fig. (b) and carrying a tensile load of 12 KN  (b)	[L3][CO2]	**[05M]**
6		**a.** Describe the fluctuating stress, repeated stress and reversed stress? Draw the Stress – Time sinusoidal curves	[L1][CO2]	**[05M]**
		b. Determine the diameter of a circular rod made of ductile material with a fatigue strength (complete reversal), σ_e= 265 MPa and tensile yield strength of 350 MPa. The member is subjected to a varying axial load from W_{min} = -300 KN to W_{max} = 700 KN	[L3][CO2]	**[05M]**

	and has a stress concentration factor is 1.8. Use factor of safety as 2.		
7	**a.** Define the term "stress concentration" with suitable diagram and "stress concentration factor" also.	[L1][CO2]	**[05M]**
	b. A machine component is subjected to a fluctuating stress that varies from 40 N/mm^2 to 100 N/mm^2. The corrected endurance limit of the machine component is 270 N/mm^2. The ultimate stress and yield point stress of the material are 600 and 400 N/mm^2 respectively. Find the factor of safety using: (i) Gerber formula. (ii) Solderberg line. (iii) Goodman line.	[L3][CO2]	**[05M]**
8	A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish factor 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.	[L3][CO2]	**[10M]**
9	Cantilever beam made of cold drawn carbon steel of circular cross-section as shown in Fig. Is subjected to a load which varies from – F to 3 F. Determine the maximum load that this member can withstand for an indefinite life using a factor of safety as 2. The theoretical stress concentration factor is 1.42 and the notch sensitivity is 0.9. Assume the following values : Ultimate stress = 550 MPa Yield stress = 470 MPa Endurance limit = 275 MPa Size factor = 0.85 Surface finish factor= 0.89  	[L3][CO2]	**[10M]**
10	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. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. Take yield strength = 0.55 Ultimate strength; Endurance strength = 0.5 Ultimate strength; and actor of safety = 2.	[L3][CO2]	**[10M]**

UNIT –III
DESIGN OF BOLTED JOINTS & DESIGN OF RIVETED JOINTS

1	**a**	How is a bolt designated?	[L1][CO3]	**[2M]**
	b	What is bolt of uniform strength?	[L1][CO3]	**[2M]**
	c	What is the material used for rivets?	[L1][CO3]	**[2M]**
	d	Classify the rivet heads according to Indian standard specifications.	[L2][CO3]	**[2M]**
	e	Define the terms caulking and fullering.	[L1][CO3]	**[2M]**
2		Find the efficiency of the following riveted joints : **1.** Single riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 50 mm. **2.** Double riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 65 mm. Assume:	[L3][CO3]	**[10M]**

	Permissible tensile stress in plate = 120 MPa Permissible shearing stress in rivets = 90 MPa Permissible crushing stress in rivets = 180 MPa		
3	**a.** What do you understand by the term riveted joint? Explain the necessity of such a joint?	[L2][CO3]	**[05M]**
	b. What do you understand by the term 'efficiency of a riveted joint'?	[L1][CO3]	**[05M]**
4	**a.** What is the difference between caulking and fullering? Explain with the help of neat sketches?	[L1][CO3]	**[05M]**
	b. Explain briefly the method of riveting?	[L2][CO3]	**[05M]**
5	**a.** Explain the various ways in which a riveted joint may fail with neat sketch?	[L4][CO3]	**[07M]**
	b. Classify the rivet heads for general purposes	[L2][CO3]	**[03M]**
6	A double riveted lap joint with zig-zag riveting is to be designed for 13 mm thick plates. Assume σ_t = 80 MPa ; τ = 60 MPa ; and σ_c = 120 MPa State how the joint will fail and find the efficiency of the joint	[L3][CO3]	**[10M]**
7	**a.** Discuss the important terms used in screw threads with a neat sketch.	[L2][CO3]	**[05M]**
	b. Describe the initial stresses in screw fasteners due to screwing up forces	[L1][CO3]	**[05M]**
8	**a.** Explain Stress in screw fasteners due to Combined Forces?	[L2][CO3]	**[05M]**
	b. Two machine parts are fastened together tightly by means of a 24 mm tap bolt. If the load tending to separate these parts is neglected, find the stress that is set up in the bolt by the initial tightening.	[L3][CO3]	**[05M]**
9	**a.** Explain the term "bolts of uniform strength" with suitable examples of such bolts for practical applications.	[L4][CO3]	**[05M]**
	b. A lever loaded safety valve has a diameter of 100 mm and the blow off pressure is 1.6 N/mm^2. The fulcrum of the lever is screwed into the cast iron body of the cover. Find the diameter of the threaded part of the fulcrum if the permissible tensile stress is limited to 50 MPa and the leverage ratio is 8.	[L3][CO3]	**[05M]**
10	Derive the expression for eccentric load acting parallel to the axis of bolts	[L2][CO3]	**[10M]**

UNIT –IV

DESIGN OF MECHANICAL (COTTERS AND KNUCKLE) JOINT & DESIGN OF SHAFTS

1	**a**	What are the main functions of the knuckle joints?	[L1][CO4]	**[2M]**
	b	What are the applications of a cottered joint?	[L1][CO4]	**[2M]**
	c	What is a shaft and What are the types of shafts?	[L1][CO4]	**[2M]**
	d	Define the term critical speed.	[L1][CO4]	**[2M]**
	e	List the various failures occurred in sunk keys.	[L1][CO4]	**[2M]**
2		**a.** Distinguish between cotter joint and knuckle joint.	[L4][CO4]	**[05M]**
		b. What is a cotter joint? Explain with the help of a neat sketch, how a cotter joint is made?	[L1][CO4]	**[05M]**
3		**a.**What are the applications of a cottered joint?	[L1][CO4]	**[05M]**
		b. A knuckle joint is required to withstand a tensile load of 25 kN. Design the joint if the permissible stresses are :σ_t = 56 MPa ; τ = 40 MPa and σ_c = 70 MPa.	[L2][CO4]	**[05M]**
4		Design and draw a spigot and socket cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically. Tensile stress = compressive stress = 50 MPa; shear stress = 35 MPa and crushing stress = 90 MPa.	[L2][CO4]	**[10M]**
5		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: Tensile stress = 60 MPa; shear stress = 70 MPa; and compressive stress = 125 MPa.	[L3][CO4]	**[10M]**
6		The big end of a connecting rod, as shown in Fig. is subjected to a maximum load of 50 kN. The diameter of the circular part of the rod adjacent to the strap end is 75 mm. Design the joint, assuming permissible tensile stress for the material of the strap as 25 MPa and permissible shear stress for the material of cotter and gib as 20 MPa.	[L3][CO4]	**[10M]**
7		Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75	[L3][CO4]	**[10M]**

	MPa in tension, 60 MPa in shear and 150 MPa in compression.		
8	A hollow shaft has greater strength and stiffness than solid shaft of equal weight. Explain.	[L2][CO4]	**[10M]**
9	**a.** Find the diameter of a solid steel shaft to transmit 20 kW at 200 r.p.m. The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 8. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5.	[L3][CO4]	**[05M]**
	b. What type of stresses are induced in shafts?	[L1][CO4]	**[05M]**
10	A shaft made of mild steel is required to transmit 100 kW at 300 r.p.m. The Supported length of the shaft is 3 meters. It carries two pulleys each weighing 1500 N supported at a distance of 1 meter from the ends respectively. Assuming the safe value of stress, determine the diameter of the shaft.	[L3][CO4]	**[10M]**

UNIT –V

DESIGN OF KEYS & DESIGN OF COUPLINGS

1	**a**	What are the types of keys?	[L1][CO5]	**[2M]**
	b	What is the main use of woodruff keys?	[L2][CO5]	**[2M]**
	c	What are the types of Rigid coupling?	[L1][CO5]	**[2M]**
	d	What is the function of a coupling between two shafts?	[L1][CO5]	**[2M]**
	e	Under what circumstances flexible couplings are used?	[L2][CO5]	**[2M]**
2		**a.** What is a key? State its function with neat sketch.	[L2][CO5]	**[05M]**
		b. Design the rectangular key for a shaft of 50 mm diameter. The shearing and crushing stresses for the key material are 42 MPa and 70 MPa.	[L1][CO4]	**[05M]**
3		How are the keys classified? Draw neat sketches of different types of keys and state their applications.	[L1][CO5]	**[10M]**
4		**a.** What is the effect of keyway cut into the shaft?	[L2][CO5]	**[05M]**
		b. A 45 mm diameter shaft is made of steel with yield strength of 400 MPa. A parallel key of size 14 mm wide and 9 mm thick made of steel with yield strength of 340 MPa is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2.	[L2][CO4]	**[05M]**
5		**a.**Discuss the function of a coupling. Give at least three practical applications.	[L2][CO5]	**[05M]**
		b. Design and make a neat dimensioned sketch of a muff coupling which is used to connect two steel shafts transmitting 40 kW at 350 r.p.m. The material for the shafts and key is plain carbon steel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15 MPa.	[L1][CO4]	**[05M]**
6		Describe, with the help of neat sketches, the types of various shaft couplings mentioning the uses of each type.	[L1][CO5]	**[10M]**
7		Design a clamp coupling to transmit 30 kW at 100 r.p.m. The allowable shear stress for the shaft and key is 40 MPa and the number of bolts connecting the two halves are six. The permissible tensile stress for the bolts is 70 MPa. The coefficient of friction between the muff and the shaft surface may be taken as 0.3	[L1][CO5]	**[10M]**
8		Design a cast iron protective type flange coupling to transmit 15 kW at 900 r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used : Shear stress for shaft, bolt and key material = 40 MPa Crushing stress for bolt and key = 80 MPa Shear stress for cast iron = 8 MPa Draw a neat sketch of the coupling.	[L3][CO5]	**[10M]**
9		Design and draw a cast iron flange coupling for a mild steel shaft transmitting 90 kW at 250 r.p.m. The allowable shear stress in the shaft is 40 MPa 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 30 MPa.	[L3][CO5]	**[10M]**
10		Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft	[L3][CO5]	**[10M]**

	transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. The material properties are as follows : (a) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively. (b) The allowable shear stress for cast iron is 15 MPa. (c) The allowable bearing pressure for rubber bush is 0.8 N/mm^2. (d) The material of the pin is same as that of shaft and key. Draw neat sketch of the coupling.		

Prepared by:
Dr. Subhankar Das
Dept. of Mechanical Engineering,
SISTK, PUTTUR.