

**PRAGATI ENGINEERING COLLEGE: SURAMPALEM**  
**(AUTONOMOUS)**  
**III B. Tech I Semester Supplementary Examinations, May - 2024**

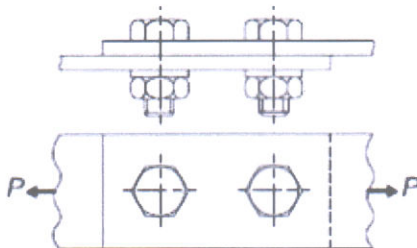
**DESIGN OF MACHINE MEMBERS-I**  
**(Mechanical Engineering)**

Time: 3 hours

Max. Marks: 70 M

Answer ONE Question from each Unit.  
All Questions Carry Equal Marks

Q. No.	Questions	BTL	CO	Marks
<b>UNIT – I</b>				
1.	a) Explain basic procedure of machine design	K2	CO1	7M
	b) Explain about general considerations in the design.	K2	CO1	7M
<b>OR</b>				
2.	a) 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 $E = 2.1 \times 10^5 \text{ N/mm}^2$	K3	CO1	7M
	b) Define the following terms: i) Elasticity ii) Plasticity iii) Toughness of materials using stress-strain curve	K2	CO1	7M
<b>UNIT – II</b>				
3.	a) Determine the thickness of a 120 mm wide uniform plate for safe continuous operation, if the plate is to be subjected to a tensile load that has a maximum value of 250 kN and a minimum value of 100 kN. The properties of the plate material are as follows: Endurance limit stress = 225 MPa, and Yield point stress = 300 MPa. The factor of safety based on yield point may be taken as 1.5.	K4	CO2	7M
	b) Analyze the various factors to be considered in estimation of endurance limit of the Mechanical components	K4	CO2	7M
<b>OR</b>				
4.	a) 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	K4	CO2	7M
	b) A machine component is subjected to a flexural stress which fluctuates between $+ 300 \text{ MN/m}^2$ and $- 150 \text{ MN/m}^2$ . Determine the value of minimum ultimate strength according to 1. Gerber relation and 2. Soderberg relation. Take yield strength = 0.55 Ultimate strength; Endurance strength = 0.5 Ultimate strength; and factor of safety = 2	K4	CO2	7M
<b>UNIT – III</b>				
5.	a) Explain the procedure adopted for designing an eccentrically loaded riveted joint	K2	CO3	7M
	b) Steel plates of 7 mm thickness are connected by a triple riveted lap joint of Zig-zag pattern. Compute the rivet diameter, rivet pitch and distance between rows of rivets for the joint. The permissible working stresses	K4	CO3	7M

		are tensile stress 90 MPa, shear stress 60 MPa and compressive stress 120 MPa			
OR					
6.	a)	What are the advantages of welded joints compared with riveted joints?	K2	CO3	7M
	b)	Two plates are fastened by means of two bolts as shown in Figure below. The bolts are made of plain carbon steel 30C8 ( $S_{yt} = 400 \text{ N/mm}^2$ ) and the factor of safety is 5. Determine the size of the bolts if, $P = 5 \text{ kN}$ . Assume the require data. <div></div>	K4	CO3	7M
UNIT – IV					
7.	a)	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. $\sigma_t = 120 \text{ MPa}$ , $\sigma_c = 160 \text{ MPa}$ and $\tau = 60 \text{ MPa}$	K4	CO4	7M
	b)	A solid circular shaft is subjected to a bending moment of 3000 N-m and a torque of 10000 N-m. The shaft is made of 45C8 steel having ultimate tensile stress of 700 MPa and ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter of the shaft	K4	CO4	7M
OR					
8.	a)	Describe the purpose of gib in cotter joint. What are the applications of cotter joints?	K2	CO4	7M
	b)	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	K4	CO4	7M
UNIT – V					
9.	a)	Design a muff coupling to connect two steel shafts transmitting 25 kW power at 360 rpm. The shafts and key are made of plain carbon steel 30C8 ( $S_{yt} = S_{yc} = 400 \text{ N/mm}^2$ ). The sleeve is made of grey cast iron FG 200 ( $S_{ut} = 200 \text{ N/mm}^2$ ). The factor of safety for the shafts and key is 4. For the sleeve, the factor of safety is 6 based on ultimate strength.	K4	CO5	14M
OR					
10.	a)	Design a typical rigid flange coupling for connecting a motor and a centrifugal pump shaft. The coupling needs to transmit 15 kW at 1000 rpm. The allowable shear stresses of the shaft, key and bolt materials are 60 MPa, 50 MPa and 25 MPa respectively. The shear modulus of the shaft material may be taken as 84GPa. The angle of twist of the shaft should be limited to 1 degree in 20 times the shaft diameter	K4	CO5	10M
	b)	Define shaft coupling? Mention the types of couplings	K2	CO5	4M