

**GIET UNIVERSITY, GUNUPUR – 765022**

B. Tech (Fifth Semester Regular) Examinations, December – 2023

21BMEPC35002 – Machine Design - I

(Mechanical)

Time: 3 hrs

Maximum: 70 Marks

Answer all questions**(The figures in the right hand margin indicate marks)****PART – A****(2 x 5 = 10 Marks)**Q.1. Answer **ALL** questions

	CO #	Blooms Level
a. Summarize the basic requirements for a successful design.	CO1	K1
b. State briefly unilateral system of tolerances covering the points of definition, application and advantages over the bilateral system.	CO1	K2
c. Explain the significance of riveted joint? Explain the necessity of such a joint.	CO2	K2
d. Classify flexible couplings with applications ?	CO3	K1
e. Define self-locking property of threads and where it is necessary?	CO4	K1

PART – B**(15 x 4 = 60 Marks)**Answer **ALL** questions

Marks	CO #	Blooms Level
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2. a. Calculate the tolerances, fundamental deviations and limits of sizes for the fit designated as 25H8d9 fit. (IT8 = 25i, IT9 = 40i, where $i = 0.45\sqrt[3]{D} + 0.001D$, upper deviation in shaft = $-16D^{0.44}$)	8	CO1	K4
b. Write short notes on the following: (i) Tolerance (ii) Allowance (iii) Fits.	7	CO1	K3
(OR)			
c. A 50 mm diameter shaft is made from carbon steel having ultimate tensile strength of 630 MPa. It is subjected to a torque which fluctuates between 2000 N-m to – 800 N-m. Using Soderberg method, calculate the factor of safety. Assume suitable values for any other data needed.	15	CO1	K3
3.a. A single riveted double cover butt joint is made in 10 mm thick plates with 20 mm diameter rivets with a pitch of 60 mm. Calculate the efficiency of the joint, if $\sigma_t = 100$ MPa ; $\tau = 80$ MPa and $\sigma_c = 160$ MPa.	8	CO2	K3
b. Explain the procedure for designing a longitudinal and circumferential joint for a boiler.	7	CO2	K3
(OR)			
c. Two plates of 7 mm thick are connected by a triple riveted lap joint of zig-zag pattern. Calculate the rivet diameter, rivet pitch and distance between rows of	8	CO2	K4

rivets for the joint. Also state the mode of failure of the joint. The safe working stresses are as follows:

$$\sigma_t = 90 \text{ MPa} ; \tau = 60 \text{ MPa} ; \text{ and } \sigma_c = 120 \text{ MPa}.$$

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|------|---|----|-----|----|
| d. | Explain the design procedure for knuckle joint. | 7 | CO2 | K3 |
| 4.a. | Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. 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 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 14 MPa. | 15 | CO3 | K6 |

(OR)

- b. Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque.

The material properties are as follows:

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|------|---|----|-----|----|
| a. | The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively. | 15 | CO3 | K3 |
| 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. | | | |
| 5.a. | A foot lever is 1 m from the centre of shaft to the point of application of 800 N load. Find: | | | |
| (i). | Diameter of the shaft, (ii) Dimensions of the key, and (ii) Dimensions of rectangular arm of the foot lever at 60 mm from the centre of shaft assuming width of the arm as 3 times thickness. The allowable tensile stress may be taken as 73 MPa and allowable shear stress as 70 MPa. | 15 | CO4 | K3 |

(OR)

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| b. | A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 r.p.m. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm ² , find: (i) the torque required to rotate the screw; (ii) the stress in the screw; and (iii) the number of threads of nut in engagement with screw. | 15 | CO4 | K4 |
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