QP Code: RN22BTECH255 | Reg. No | | | | | | | | | | | AR 22

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

B. Tech (Fifth Semester - Regular) Examinations, November – 2024

22BMEPC35002 – Machine Design-I

(Mechanical Engg.)

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. Explain Endurance limit stress.	CO1	K1
b. State the usual taper provided to cotter pin, explain why?	CO2	K1
c. Differentiate between rigid coupling and flexible coupling.	CO3	K1
d. Classify type of levers.	CO4	K1
e. Explain efficiency of a riveted joint.	CO2	K1

PART – B **(15 x 4 = 60 Marks)**

Answer ***All*** the questions	Marks	CO #	Blooms Level
2. a. 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 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.	10	CO1	K5
b. Calculate the tolerances, fundamental deviations and limits of sizes for the fit designated as 50H8f7 and state the type of fit. (IT7 = 16i, IT8 = 25i, where i $=0.45\sqrt[3]{D}+0.001D$, upper deviation in shaft = $-5.5D^{0.44}$)	5	CO1	K4
(OR)			
c. 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 factor of safety = 2	10	CO1	K4
d. The dimensions of the mating parts, according to basic hole system, are given as follows : Hole : 25.00 mm , 25.02 mm Shaft : 24.97 mm , 24.95 mm Find the hole tolerance, shaft tolerance and allowance.	5	CO1	K4
3.a. Design a cotter joint to connect two mild steel rods for a pull of 30 kN. The maximum permissible stresses are 55 MPa in tension; 40 MPa in shear and 70 MPa in crushing. Draw a neat sketch of the joint designed.	5	CO2	K4
b. Design the longitudinal joint for a 1.25 m diameter steam boiler to carry a steam pressure of 2.5 N/mm^2. The ultimate strength of the boiler plate may be assumed as 420 MPa, crushing strength as 650 MPa and shear strength as 300 MPa. Take the joint efficiency as 80%.	10	CO2	K5
(OR)			
c. With neat sketch classify the types of types of riveted joint.	5	CO2	K3

d.	Design a knuckle joint to connect two mild steel bars under a tensile load of 25 kN. The allowable stresses are 65 MPa in tension, 50 MPa in shear and 83 MPa in crushing.	10	CO2	K4
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.	10	CO3	K3
b.	A parallel key of size 14 mm wide and 9 mm thick made of steel with a 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.	5	CO3	K6
	(OR)			
c.	It is required to design a rigid type of flange coupling to connect two shafts. The input shaft transmits 37.5 kW power at 180 rpm to the output shaft through the coupling. The surface factor for the application is 1.5. i.e., the design torque is 1.5 times of the rated torque. Select suitable materials for the various parts of the coupling.	10	CO3	K5
d.	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 an ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter of the shaft.	5	CO3	K4
5.a.	An electric motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 300 mm / min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at screw threads is 0.1. Estimate power of the motor.	7	CO4	K4
b.	The cutter of a broaching machine is pulled by square threaded screw of 55 mm external diameter and 10 mm pitch. The operating nut takes the axial load of 400 N on a flat surface of 60 mm and 90 mm internal and external diameters respectively. If the coefficient of friction is 0.15 for all contact surfaces on the nut, determine the power required to rotate the operating nut when the cutting speed is 6 m/min. Also find the efficiency of the screw.	8	CO4	K4
	(OR)			
c.	The lead screw of a lathe has square threads of 24 mm outside diameter and 5 mm pitch. In order to drive the tool carriage, the screw exerts an axial pressure of 2.5 kN. Find the efficiency of the screw and the power required to drive the screw, if it is to rotate at 30 r.p.m. Neglect bearing friction. Assume coefficient of friction of screw threads as 0.12.	5	CO4	K4
d.	Design a cranked lever for the following dimensions : Length of the handle = 320 mm Length of the lever arm = 450 mm Overhang of the journal = 120 mm The lever is operated by a single person exerting a maximum force of 400 N at a distance of $1/3^{rd}$ length of the handle from its free end. The permissible stresses may be taken as 50 MPa for lever material and 40 MPa for shaft material.	10	CO4	K4

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