QPC: RD20BTECH407 AR 20 Reg. No | | | | | | | | | | |

GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Fifth Semester – Regular) Examinations, December – 2022

BPCME5020– Machine Design-I

(Mechanical Engineering)

Time: 3 hrs Maximum: 70 Marks

Answer ALL Questions

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions) **(1 x 10 = 10 Marks)**

Q.1. Answer ***ALL*** questions [CO#] [PO#]

a. The stress which vary from a minimum value to a maximum value of the same nature (i.e. tensile or compressive) is called CO1 PO1

i. repeated stress ii. yield stress
iii. fluctuating stress iv. alternating stress

b. Guest's theory is used for CO1 PO1

i. brittle materials ii. ductile materials
iii. elastic materials iv. plastic materials

c. According to Indian standards, total number of tolerance grades are CO1 PO1

i. 8 ii. 12
iii. 18 iv. 20

d. The diameter of the rivet hole is usually .... the nominal diameter of the rivet. CO2 PO1

i. Equal to ii. less than
iii. more than iv. Double

e. A double strap butt joint (with equal straps) is CO2 PO1

i. always in single shear ii. always in double shear
iii. either in single shear or double shear iv. any one of these

f. A cotter joint is used to transmit CO2 PO1

i. axial tensile load only ii. axial compressive load only
iii. combined axial and twisting loads iv. axial tensile or compressive loads

g. The sleeve or muff coupling is designed as a CO3 PO1

i. thin cylinder ii. thick cylinder
iii. solid shaft iv. hollow shaft

h. A feather key is generally CO3 PO1

i. loose in shaft and tight in hub ii. tight in shaft and loose in hub
iii. tight in both shaft and hub iv. loose in both shaft and hub.

i. In the levers of first type, the mechanical advantage is ___________ one. CO4 PO1

i. less than ii. equal to
iii. more than iv. none of these

j. The handle of hand pump is of .... type of levers. CO4 PO1

i. First type of Lever ii. Second type of Lever
iii. Third type of Lever iv. None of these

PART – B: (Short Answer Questions) **(2 x 10 = 20 Marks)**

Q.2. Answer ALL questions

	Question	[CO#]	[PO#]
a.	State the importance of interchangeability.	CO1	PO1
b.	What is meant by 'hole basis system' and 'shaft basis system'? Which one is preferred and why?	CO1	PO1
c.	What is meant by ` Endurance limit'?	CO1	PO1
d.	Enumerate the different types of riveted joints.	CO2	PO1
e.	What is an economical joint and where does it find applications?	CO2	PO1
f.	Distinguish between cotter joint and knuckle joint.	CO2	PO1
g.	What is a key ? How are the keys classified?	CO3	PO1
h.	Discuss the function of a coupling. Give at least three practical applications.	CO3	PO1
i.	State the application of hand and foot levers.	CO4	PO1
j.	What do you understand by leverage ?	CO4	PO1

PART – C: (Long Answer Questions) **(10 x 4 = 40 Marks)**

Answer ALL questions

	Question	Marks	[CO#]	[PO#]
3. a.	A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T. If the yield point of the steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to i. the maximum principal stress ii. The maximum shear stress and iii. the maximum distortion strain energy theory of yielding.	10	CO1	PO2
	(OR)			
b.	Illustrate how the stress concentration in a component can be reduced.	5	CO1	PO1
c.	Calculate the tolerances, fundamental deviations and limits of sizes for the fit designated as 50H8f7.	5	CO1	PO2
4. a.	Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm2. Assume joint efficiency as 75%, allowable tensile stress in the plate 90 MPa; compressive stress 140 MPa; and shear stress in the rivet 56 MPa.	10	CO2	PO3
	(OR)			
b.	Design and draw a cotter joint to support a load varying from 50 kN in compression to 50 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 = 60 MPa ; shear stress = 40 MPa and crushing stress = 75 MPa.	10	CO2	PO3
5. a.	Two 35 mm shafts are connected by a flanged coupling. The flanges are fitted with 6 bolts on 125 mm bolt circle. The shafts transmit a torque of 800 N-m at 350 r.p.m. For the safe stresses mentioned below, calculate (i) diameter of bolts; (ii) thickness of flanges (iii) key dimensions (iv) hub length; and (v) power transmitted. Safe shear stress for shaft material = 63 MPa	10	CO3	PO2

Safe stress for bolt material = 56 MPa

Safe stress for cast iron coupling = 10 MPa

Safe stress for key material = 46 MPa

(OR)

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.	5	CO3	PO2
c.	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. A 45 mm diameter shaft is made of steel with a yield strength of 400 MPa.	5	CO3	PO3
6. a.	A Hand lever is 1.5 m from the Centre of shaft to the point of application of 600 N load. Find (i) Diameter of the shaft (ii) Dimensions of the key and (iii) Dimensions of rectangular arm of the Hand lever at 40 mm from the centre of shaft assuming width of the arm as 3 times thickness. The allowable tensile stress may be taken as 65 MPa and allowable shear stress as 60 MPa.	10	CO4	PO3
	(OR)			
b.	In a Hartnell governor, the length of the ball arm is 190 mm, that of the sleeve arm is 140 mm, and the mass of each ball is 2.7 kg. The distance of the pivot of each bell crank lever from the axis of rotation is 170 mm and the speed when the ball arm is vertical, is 300 r.p.m. The speed is to increase 0.6 per cent for a lift of 12 mm of the sleeve. i. Find the necessary stiffness of the spring. ii. Design the bell crank lever. The permissible tensile stress for the material of the lever may be taken as 80 MPa and the allowable bearing pressure at the pins is 8 N/mm2.	10	CO4	PO3

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