Paper id: 250679

Roll No: | | | | | | | | | | | | | |

BTECH
(SEM VI) THEORY EXAMINATION 2024-25
MACHINE DESIGN

TIME: 3 HRS **M.MARKS: 100**

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 10 = 20**

Q No.	Question	CO	Level
a.	Define machine design. What is the final outcome of a machine design process?	1	K2
b.	What is the safe endurance strength of a weldment subjected to fatigue loading?	2	K2
c.	Make a neat sketch of spur-gear tooth and show all its parameters.	3	K2
d.	What is hydrostatic bearing? What are its advantages over hydrodynamic bearing?	4	K2
e.	What are the basic differences between uniform pressure theory and uniform wear theory for friction clutches?	5	K2
f.	What do you understand by size of a product? Give examples.	1	K2
g.	Compare the merits and demerits of riveting process over welding process, for making permanent joints in boiler shell structures.	2	K2
h.	Make a neat sketch of forces acting on a helical gear tooth. What are the relationships, between tangential load, axial load and radial load?	3	K2
i.	What is the difference between flat-race and grooved race thrust ball bearings? What are the differences in their basic characteristics?	4	K2
j.	Name and briefly describe the two criteria for calculating the thickness of piston head.	5	K2

SECTION B

2. Attempt any *three* of the following: **10 x 3 = 30**

a.	Distinguish between design synthesis and design analysis. Define ergonomics. Distinguish between sequential design and concurrent engineering.	1	K2
b.	Make simple sketches of snap-head, pan-head and countersunk-head rivets, where these are used? Explain how torsional shear stress is developed in an eccentrically loaded riveted joint.	2	K2
c.	Derive the expression for beam strength of a gear tooth.	3	K2
d.	What do you mean by rotation factor, radial factor and thrust factor for a ball bearing? What are stable and unstable lubrications?	4	K2
e.	Describe the principle of operation of a friction clutch? Derive the expression for frictional torque in the case of a friction clutch using uniform wear theory.	5	K2

SECTION C

3. Attempt any *one* part of the following: **10 x 1 = 10**

a.	The force acting on a bolt consists of two components—an axial pull of 12 kN and a transverse shear force of 6 kN. The bolt is made of steel FeE 310 (tensile yield strength = 310 N/mm2) and the factor of safety is 2.5. Determine the diameter of the bolt using the maximum shear stress theory of failure.	1	K3
b.	A forged steel bar, 50 mm in diameter, is subjected to a reversed bending stress of 250 N/mm2. The bar is made of steel 40C8 (ultimate tensile strength = 600 N/mm2). Calculate the life of the bar for a reliability of 90%.	1	K3

4. Attempt any *one* part of the following: **10 x 1 = 10**

a.	A double-riveted, double-cover butt joint is used to connect two plates of thickness 15 mm each, with the help of rivets with 25 mm diameters. If the strength of the rivets in shear or bearing—whichever is less—is equal to the tearing strength of the plate, then determine the pitch for the rivets. What is the effi ciency of the joint? What is	2	K3

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	thickness of the cover plates Allowable stresses: Tensile = 100MPa, shear = 80MPa, compression (bearing) = 120MPa.		
b.	Two 15 mm plates overlap each other and are welded with two 15 mm fi llet welds, each 30 cm long, and load is applied normal to the welded joint. Determine the total static load that the joint can carry. Take Jennings design stress.	2	K3

5. Attempt any *one* part of the following: 10 x 1 = 10

a.	A pair of spur gears of pinion 30 teeth transmits power at 1200 rpm to a 60 teeth gear. Module of gear tooth is 5 mm and face width is 60 mm. Both the gears are made of steel with ultimate strength of 410 MPa. Gears are heat treated to a surface hardness of 300 BHN. Gears are machined to the accuracy of grade 6. Determine: (a) Beam strength, (b) Wear strength, (c) Dynamic load. If service factor is 1.25 and factor of safety is 1.50, what power can be transmitted by gears?	3	K3
b.	A pair of helical gears with number of pinion tooth=20, number of gear tooth=60, helix angle=25°, normal pressure angle=20°, transmits 7.5 kW when pinion rotates at 800 rpm. If pitch circle diameter of pinion is 80 mm, determine three components of tooth load.	3	K3

6. Attempt any *one* part of the following: 10 x 1 = 10

a.	On a hydrostatic conical thrust bearing, the axial thrust is 600 kN, and the shaft rotates at 1000 rpm. If the shaft diameter is 450 mm, the recess diameter is 350 mm, semi-cone angle is 45°, film thickness is 0.12 mm, viscosity of lubricant is 160 SUS, and specific gravity of lubricant is 0.86. Calculate the supply pressure and flow requirement.	4	K3
b.	A ball bearing is to be selected for 600 million revolutions life at 95% reliability. The bearing designation is SKF 6302. How much radial load can be applied on bearing?	4	K3

7. Attempt any *one* part of the following: 10 x 1 = 10

a.	In a cone clutch, the effective diameter of contacting surfaces is 86 mm. Semi cone angle is 12.5° and coefficient of friction is 0.3. If the axial force on clutch is 240 N, what is the torque required for slipping. An electric motor running at 100 rpm is to be connected to a flywheel of mass 15 kg and radius of gyration 0.2 m. What is the time required for the flywheel to attain the full speed of motor? Calculate also the energy lost in slipping of clutch.	5	K3
b.	The bore of a cylinder of the four-stroke diesel engine is 120 mm. The maximum gas pressure inside the cylinder is limited to 4 MPa. The cylinder head is made of cast iron and allowable tensile stress is 40 N/mm2. Determine the thickness of cylinder head. The studs, which are made of steel, have allowable stress as 50 N/mm2. Calculate (i) number of studs, (ii) nominal diameter of studs, and (iii) pitch of studs.	5	K3