PAPER ID-410437

Subject Code: KME602

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

BTECH

(SEM VI) THEORY EXAMINATION 2023-24

MACHINE DESIGN

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

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

2. Use of the Design Data handbook is allowed.

SECTION A

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

Q no.	Question	Marks	CO
a.	What are the advantages of cast iron form design considerations?	02	CO1
b.	Distinguish between design synthesis and design analysis.	02	CO1
c.	What is caulking? What is its objective?	02	CO2
d.	What is reinforcement in weld? What are its advantages and disadvantages?	02	CO2
e.	What are the advantages of cycloidal teeth gears?	02	CO3
f.	Define lead in worm gear.	02	CO3
g.	Define dynamic load capacity of the rolling bearing.	02	CO4
h.	What is significance of bearing characteristics numbers?	02	CO4
i.	Why is heat-dissipation necessary in clutches?	02	CO5
j.	What are the cooling systems for engine cylinders? Where do you use them?	02	CO5

SECTION B

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

a.	Consider a hypothetical need and discuss the procedure to design a machine to for this need.	10	CO1
b.	Discuss the different types of key and their applications.	10	CO2
c.	A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 40 teeth gear. The helix angle is 25° and the normal pressure angle is 20°. The normal module is 3 mm. Calculate (i) the transverse module; (ii) the transverse pressure angle; (iii) the axial pitch; (iv) the pitch circle diameters of the pinion and the gear; (v) the centre distance; and (vi) the addendum and dedendum circle diameters of the pinion.	10	CO3
d.	Discuss the operating principle of hydrodynamic bearing along with McKee investigation.	10	CO4
e.	Discuss the design consideration for piston.	10	CO5

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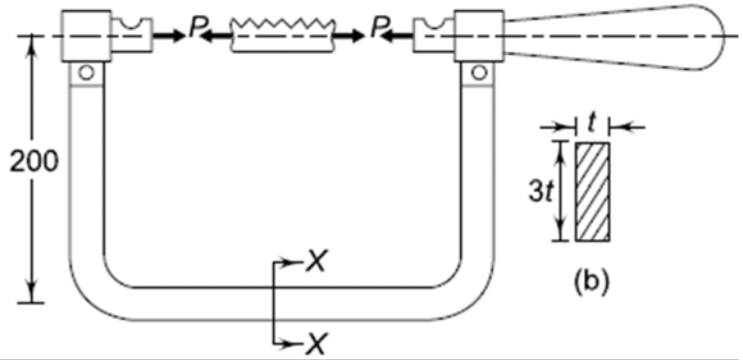
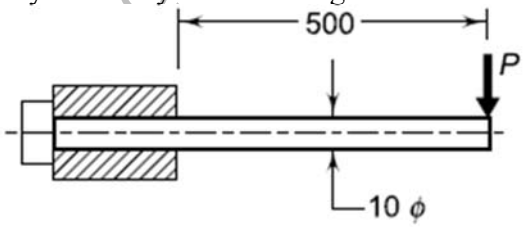
SECTION C

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

a.	The frame of a hacksaw is shown in Figure. The initial tension P in the blade should be 300 N. The frame is made of plain carbon steel 30C8 with a tensile yield strength of 400 N/mm^2 and the factor of safety is 2.5. The cross-section of the frame is rectangular with a ratio of depth to width as 3. Determine the dimensions of the cross-section. 	10	
b.	A cantilever spring made of 10 mm diameter wire is shown in Figure. The wire is made of stainless steel 4Cr18Ni10 (Sut = 860 N/mm^2 and S_{yt} = 690 N/mm^2). The force P acting at the free end varies from 75 N to 150 N. The surface finish of the wire is equivalent to the machined surface. There is no stress concentration, and the expected reliability is 50%. Calculate the number of stress cycles likely to cause fatigue failure. 	10	

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

a.	A cylindrical pressure vessel with 1 m inner diameter is subjected to internal steam pressure of 1.5 MPa. The permissible stresses for the cylinder plate and the rivets in tension, shear and compression are 80, 60 and 120 N/mm^2 respectively. The efficiency of longitudinal joint can be taken as 80% for the purpose of calculating the plate thickness. The efficiency of circumferential lap joint should be at least 62%. Design the circumferential lap joint and calculate: (i) thickness of the plate; (ii) diameter of the rivets; (iii) number of rivets; (iv) pitch of rivets; (v) number of rows of rivets; and (vi) overlap of the plates.	10	

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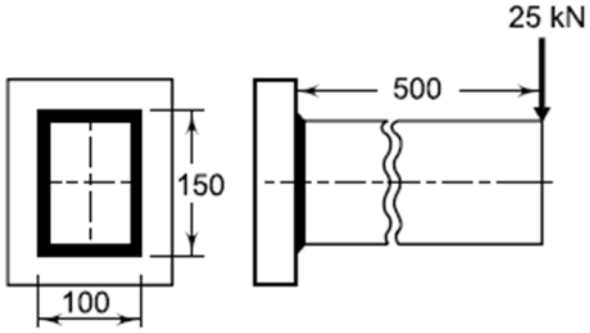
b.	A beam of rectangular cross section is welded to a support by means of fillet welds as shown in Figure. Determine the size of the welds, if the permissible shear stress in the weld is limited to 75 N/mm^2. 	10	

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

a.	A pair of spur gears with 20° full-depth involute teeth consists of a 20 teeth pinion meshing with a 41 teeth gear. The module is 3 mm while the face width is 40 mm. The material for pinion as well as gear is steel with an ultimate tensile strength of 600 N/mm^2. The gears are heat treated to a surface hardness of 400 BHN. The pinion rotates at 1450 rpm and the service factor for the application is 1.75. Assume that velocity factor accounts for the dynamic load and the factor of safety is 1.5. Determine the rated power that the gears can transmit.	10	
b.	Discuss the application and materials for worm-worm gear assembly.	10	

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

a.	Design a full hydrodynamic journal bearing with the following specification for machine tool application: journal diameter = 75 mm radial load = 10 kN journal speed = 1440 rpm minimum oil film thickness = 22.5 microns inlet temperature = 40°C bearing material = babbitt Determine the length of the bearing and select a suitable oil for this application.	10	
b.	A single-row deep groove ball bearing is subjected to a pure radial force of 3 kN from a shaft that rotates at 600 rpm. The expected life L_{10h} of the bearing is 30000 h. The minimum acceptable diameter of the shaft is 40 mm. Select a suitable ball bearing for this application.	10	

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

a.	A four-stroke diesel engine has the following specifications : Brake power = 5 kW ; Speed = 1200 r.p.m. ; Indicated mean effective pressure = 0.35 N / mm 2 ; Mechanical efficiency = 80 %. Determine : 1. bore and length of the cylinder ; 2. thickness of the cylinder head ; and 3. size of studs for the cylinder head.	10	
b.	An automotive plate clutch consists of two pairs of contacting surfaces with asbestos friction lining. The maximum engine torque is 250 N-m. The coefficient of friction is 0.35. The inner and outer diameters of friction lining are 175 and 250 mm respectively. The clamping force is provided by nine springs, each compressed by 5 mm to give a force of 800 N, when the clutch is new. (i) What is the factor of safety with respect to slippage when the clutch is brand new? (ii) What is the factor of safety with respect to slippage after initial wear has occurred? (iii) How much wear of friction lining can take place before the clutch will slip?	10	