PAPER ID-420707

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

BTECH
(SEM VI) THEORY EXAMINATION 2021-22
MACHINE DESIGN

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If you require any missing data, then choose suitably.

Design data book is allowed in the exam hall

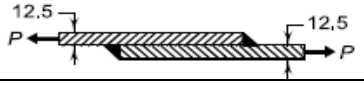
SECTION A

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

Qno	Questions	CO
(a)	Describe the preferred numbers.	1
(b)	Define Endurance limit.	1
(c)	Enlist the various type of riveted joint.	2
(d)	Write any four types of keys.	2
(e)	Describe pressure angle in gear.	3
(f)	Compare between spur gear and helical gear.	3
(g)	Define Bearing modulus.	4
(h)	Differentiate between sliding contact and rolling contact bearing.	4
(i)	Explain the various types of cylinder liners.	5
(j)	Difference between coupling and clutch	5

SECTION B

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

Qno	Questions	CO
(a)	A manufacturer is interested in starting a business with five different models of tractors ranging from 7.5 to 75 kW capacities. Specify power capacities of the models. There is an expansion plan to further increase the number of models from five to nine to fulfill the requirement of farmers. Specify the power capacities of the additional models.	1
(b)	Two steel plates, 120 mm wide and 12.5 mm thick, are joined together by means of double transverse fillet welds as shown in Fig.The maximum tensile stress for the plates and the welding material should not exceed 110 N/mm2. Find the required length of the weld, if the strength of weld is equal to the strength of the plates. 	2
(c)	(i) Obtain expression of Lewis equation for static strength of gear tooth. (ii) Derive the expression used to obtain formative number of teeth on a helical gear.	3
(d)	Define Basic Static load capacity, Basic Dynamic load capacity, Equivalent Static Load, Equivalent dynamic load and Rating Life.	4
(e)	The bore of a cylinder the four-stroke diesel engine is 150 mm. The maximum gas pressure inside the cylinder is limited to 3.5 MPa. The cylinder head is made of Grey cast iron FG 200 (S_{ut}= 200 N/mm^2) and the factor of safety is 5. Four studs are used to fix the cylinder head to cylinder and obtain leak proof joint. They are made of steel (S_{ut} 250 N/mm^2) and the factor of safety is 5. Design cylinder, cylinder head and studs	5

SECTION C

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

Qno	Questions	CO
(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 tensile	1

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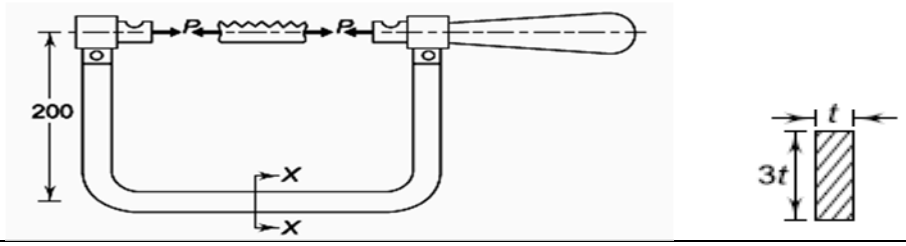
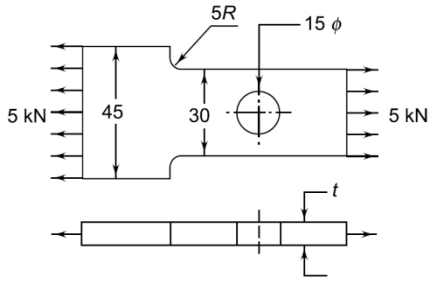
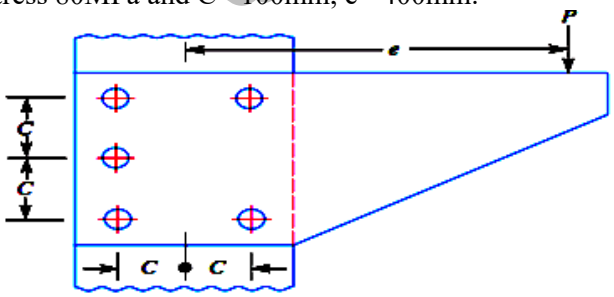
	yield strength of 400 N/mm2 and the factor of safety is 2.5. The cross section of the frame is rectangular with a ratio of depth to width as 3, as shown in Fig. Determine the dimensions of the cross-section. 	
(b)	A flat plate subjected to a tensile force of 5KN as shown in fig. the plate material is grey cast iron FG 200 and FOS= 2.5. determine the thickness of the plate. 	1

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

Qno	Questions	CO
(a)	Determine the diameter of the rivet which is to be used to join to bracket plate as shown in fig. to sustain the load of 50kN. Take maximum permissible shear stress 80MPa and C= 100mm, e= 400mm. 	2
(b)	A shaft is supported on bearings A and B, 800 mm between centers. A 20° straight tooth spur gear having 600 mm pitch diameter, is located 200 mm to the right of the left-hand bearing A, and a 700 mm diameter pulley is mounted 250 mm towards the left of bearing B. The gear is driven by a pinion with a downward tangential force while the pulley drives a horizontal belt having 180° angle of wrap. The pulley also serves as a flywheel and weighs 2000 N. The maximum belt tension is 3000 N and the tension ratio is 3:1. Determine the maximum bending moment and the necessary shaft diameter if the allowable shear stress of the material is 40 MPa.	2

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

Qno	Questions	CO
(a)	Compressor running at 300 rpm is driven by 15 kW 1200 rpm motor through a 14 ½ ° full depth gears. The centre distance is 0.375m. The motor pinion is to be C-30 forged steel hardened and tempered, and the driven gear is to be cast steel. Assuming medium shock condition and 8 hrs per day for service condition. Determine module, face width, & number of teeth on each gear. Take face	3

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	width= 10 times of module.	
(b)	Two steel helical gears are used in a speed reducer which is to be driven by an I.C. engine. The rated power is 75kW at a pinion speed of 1200 rpm. The diameter of pinion is160mm and speed ratio 3:1. Assume medium shock condition and 24 hr operation. Find module, face width, number of teeth on each gear if tooth are 20º full depth in normal plane. Take Design stress for pinion material =175MPa, with 280BHN Design stress for gear material =140MPa, with 320 BHN	3

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

Qno	Questions	CO
(a)	Design a journal bearing for centrifugal pump from following data Load on journal = 15000 N Speed of journal = 1050 rpm Type of oil = SAE 30 Operating temperature of oil = 55^0C Ambient temperature = 16^0C	4
(b)	75 mm dia shaft of machine operates continuously for 2400 hrs, because of an over running, each one of the shaft bearing will be subjected to varying load and varying speed cycle as follows **Fraction of cycle** / **Radial Load (N)** / **Thrust Load (N)** / **Speed (R.P.M.)** / **Service factor** 1/10 / 4000 / 2000 / 1000 / 1.0 1/10 / 2000 / 2000 / 500 / 1.5 5/10 / 5000 / 2000 / 400 / 1.5 3/10 / 2500 / 2000 / 150 / 1.0 Assume radial and axial load factors to be 1.0 and 1.5 respectively and inner race rotates.	4

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

Qno	Questions	CO
(a)	Find the thickness of piston crown for four stroke engine developing power at 1500 rpm. Other relevant data for the engine are given as Piston dia = 87mm, Length of stroke = 100mm, Brake Mean effective pressure = 0.7MPa, bsfc = 0.26kg/kW-h, Maximum pressure = 4 MPa, Calorific value = 42MJ/kg Heat conducted through crown = 10% of heat generated during combustion, Assume piston is made of aluminum alloy with thermal conductivity 175 W/m ºC and allowable temperature difference is 111ºC.	5
(b)	A dry single plate clutch is to be designed for an automotive vehicle whose engine is rated to give 100 kW at 2400 r.p.m. and maximum torque 500 N-m. The outer radius of friction plate is 25% more than the inner radius. The intensity of pressure between the plate is not to exceed 0.07 N/mm2. The coefficient of friction may be assumed equal to 0.3. The helical springs required by this clutch to provide axial force necessary to engage the clutch are eight. If each spring has stiffness equal to 40 N /mm, determine the initial compression in the springs and dimensions of the friction plate.	5