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

TIME: 3 HRS

M.MARKS: 70

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

SECTION A

1. Attempt all questions in brief.

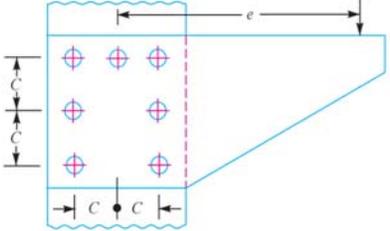
2 x 07 = 14

Q no.	Question	CO	Level
a.	Explain preferred numbers in machine design.	1	K 2
b.	Define the term bearing characteristic number.	2	K 2
c.	Describe the following: (i) Helix angle of helical gear (ii) Addendum circle of gear	3	K 3
d.	What is meant by pitch point in gear design?	4	K 4
e.	What is foot step bearing?	4	K 4
f.	What is function of piston in IC Engine?	5	K 5
g.	What is octane number?	5	K 5

SECTION B

2. Attempt any three of the following:

07 x 3 = 07

a.	Write shorts notes on: i) Notch sensitivity ii) Stress concentration iii) Endurance stress iv) Fatigue failure	1	K 2
b.	An eccentrically loaded lap riveted joint is to be designed for a steel bracket as shown in Fig. The bracket plate is 25 mm thick. All rivets are to be of the same size. Load on the bracket, $P = 50$ kN; rivet spacing, $C = 100$ mm; load arm, $e = 400$ mm. Permissible shear stress is 65 MPa and crushing stress is 120 MPa. Determine the size of the rivets to be used for the joint. 	2	K 2
c.	A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20° , while the helix angle is 25° . The face width is 40 mm and the normal module is 4 mm. The pinion as well as the gear is made of steel 40C8 ($S_{ut} = 600$ N/mm ²) and heat treated to a surface hardness of 300 BHN. The service factor and the factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of gears.	3	K 3
d.	Derive the expression for dynamic load rating capacity of rolling contact bearing under variable load.	4	K 4



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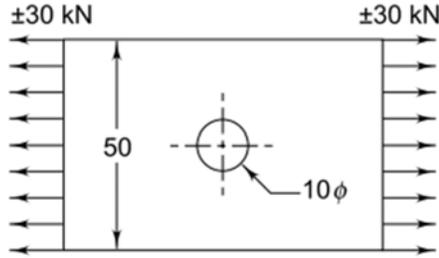
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e.	The cylinder of four stroke diesel engine has a following specifications: Brake power =5KW, Speed=600rpm, indicated mean effective pressure=0.5MPa, make suitable assumption and calculate: i) Bore and length of the cylinder liner ii) Thickness of cylinder liner iii) Thickness of cylinder head iv) Size, number and pitch of studs	5	K 5
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SECTION C

3. Attempt any one part of the following: 07 x 1 = 07

a.	A plate made of steel having ultimate tensile strength 440N/mm ² in hot rolled and normalized condition is shown in fig. It is subjected to a completely reverse axial load of 30 kN. The notch sensitivity factor q can be taken as 0.8 and the expected reliability is 90%. The factor of safety is 2. The size factor can be taken as 0.85. Determine the plate thickness for infinite life. 	1	K 2
b.	What are the reasons for the use of alloy steels in machine design parts? How do you classify materials for engineering use?	1	K 2

4. Attempt any one part of the following: 07 x 1 = 07

a.	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 a ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter of the shaft.	2	K 2
b.	Write down the short notes on: i) Spline ii) Feather key iii) Woodruff key iv) Keyway	2	K 2

5. Attempt any one part of the following: 07 x 1 = 07

a.	It is required to design a spur gear speed reducer for a compressor running at 250 rpm driven by a 7.5 kW, 1000 rpm electric motor. The centre distance between the axes of the gear shafts should be exactly 250 mm. The starting torque of the motor can be assumed to be 150% of the rated torque. The gears are made of carbon steel 50C4 ($S_{ut} = 700$ N/mm ²). The pressure angle is 20°. The factor of safety is 2 for preliminary design based on the use of velocity factor. (i) Design the gears and specify their dimensions. (ii) Assume that the gears are manufactured to meet the requirements of Grade 6 and calculate the dynamic load by using Buckingham's equation.	3	K 3
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b.	A worm drive transmits 15 kW at 2000 r.p.m. to a machine carriage at 75 r.p.m. The worm is triple threaded and has 65 mm pitch diameter. The worm gear has 90 teeth of 6 mm module. The tooth form is to be 20° full depth involute. The coefficient of friction between the mating teeth may be taken as 0.10. Calculate: 1. tangential force acting on the worm; 2. axial thrust and separating force on worm; and 3. efficiency of the worm drive.	3	K 3
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6. Attempt any one part of the following: 07 x 1 = 07

a.	Explain the following term- i) zero film bearing ii) thin film bearing iii) thick film bearing iv) dynamic load rating capacity	4	K 4
b.	A journal bearing is proposed for steam engine. The load on the journal is 3 kN, diameter mm, length 75mm, speed 1600 rpm, diametral clearance 0.1 mm and ambient temperature 15.5°C. Oil used is SAE 10 and oil film temperature is 60°C. Determine the heat generated and heat dissipated. Take absolute viscosity at 60°C of SAE 10 is 0.014kg/m-s.	4	K 4

7. Attempt any one part of the following: 07 x 1 = 07

a.	Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore = 100 mm; Stroke = 125 mm; Maximum gas pressure = 5 N/mm ² ; Indicated mean effective pressure = 0.75 N/mm ² ; Mechanical efficiency = 80%; Fuel consumption = 0.15 kg per brake power per hour; Higher calorific value of fuel = 42 × 10 ³ kJ/kg; Speed = 2000 r.p.m. Any other data required for the design may be assumed.	5	K 5
b.	State the function of the following for an internal combustion engine piston. a) Ribs b) Piston Rings c) Piston skirt d) Piston pin	5	K 5