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B.Tech
PCME4306

6th Semester Regular Examination 2016-17
DESIGN OF MACHINE COMPONENTS

BRANCH: Mechanical
Time: 3 Hours
Max Marks: 70
Q.CODE: Z120

Answer Question No.1 which is compulsory and any five from the rest.
Design Data Handbooks as prescribed in the syllabus can be used in the examination
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** **(2 x 10)**

a) Differentiate between thin cylinder and thick cylinder
b) Define Fatigue failure and Endurance limit
c) Differentiate between clutch and brake
d) State and explain the maximum principal strain theory of failure
e) What is the function of a flywheel in an engine ?
f) Differentiate between block and band brake.
g) What are the advantages of rolling contact bearings over sliding contact bearings ?
h) Differentiate between spur gear and bevel gear
i) What is meant by hydrodynamic lubrication.
j) What is the function of crank shaft in an engine ?

Q2 **a)** What is herringbone gear? Where it is used ? **(2)**

b) Design a journal bearing for a centrifugal pump running at 1440 rpm. The diameter of the journal is 100 mm and load on each bearing is 20 kN. The factor *ZN/p* may be taken as 28 for centrifugal pump bearings. The bearing is running at 75^0 C temperature and the atmospheric temperature is 30^0 C. The energy dissipation coefficient is 875 $W/m^2/^0C$. Take diametral clearance as 0.1 mm. **(8)**

Q3 **a)** The stresses induced at a critical point in a machine component made of steel (σ_{yp}=380 N/mm^2) are as follows: σ_x =100 N/mm^2, σ_y = 40 N/mm^2, τ_{xy} = 80 N/mm^2. Calculate the factor of safety by (i) the maximum principal stress theory, (ii) the maximum shear stress theory. **(5)**

b) A thick cylindrical shell of internal diameter 150 mm has to withstand an internal fluid pressure of 50 N/mm^2. Determine its thickness so that the maximum stress in the section does not exceed 150 MPa. **(5)**

Q4 **a)** A pressure vessel has an internal diameter of 1 m and is to be subjected to an internal pressure of 2.75 N/mm^2 above the atmospheric pressure. Considering it as a thin cylinder and assuming the efficiency of its riveted joint to be 79%, calculate the plate thickness if the tensile stress in the material is not to exceed 88 Mpa. **(5)**

b) With a neat sketch, list and explain the different parts of connecting rods with their functions. **(5)**

Q5 **a)** A single disc clutch with both sides of the disc effective is used to transmit 10 kW power at 900 RPM. The axial pressure is limited to 0.085 N/mm^2. If the external diameter of the friction lining is 1.25 times the internal diameter, find the required dimensions of the friction lining and the axial force exerted by the springs. Assume uniform wear conditions. The co-efficient of friction may be taken as 0.3. **(5)**

b) State the function of the following for an internal combustion engine piston: (i) Ribs; (ii) Piston rings; (c) Piston skirt; and (iv) Piston pin **(5)**

Q6 **a)** A simple band brake operates on a drum of 600 mm in diameter that is running at 200 rpm. The coefficient of friction is 0.25. The brake band has a contact of 270^0, one end is fastened to a fixed pin and the other end to the brake arm 125 mm from the fixed pin. The straight brake arm is 750 mm long and placed perpendicular to the diameter that bisects the angle of contact. (i) What is the pull necessary on the end of the brake arm to stop the wheel if 35 *kW* is being absorbed ? What is the direction of this minimum pull ? (ii) What width of steel band of 2.5 mm thick is required for this brake if the maximum tensile stress is not to exceed 50 MPa ? **(5)**

b) Design a suitable diameter for a circular shaft required to transmit 90 kW at 180 rpm. The shear stress in the shaft is not to exceed 70 MPa and the maximum torque exceeds the mean by 40%. Also find the angle of twist in a length of 2 metres. Take the modulus of rigidity as 90 GPa. **(5)**

Q7 Design a cast iron trunk type piston for a single acting four stroke engine developing 75 kW per cylinder when running at 600 rpm. The other available data is as follows: **(10)**

Maximum gas pressure = 4.8 N/mm^2; Indicated mean effective pressure = 0.65 N/mm^2; Mechanical efficiency = 95%; Radius of crank = 110 mm; Fuel consumption = 0.3 kg/BP/hr; Calorific value of fuel (higher) = 44 x 10^3 kJ/kg; Difference of temperatures at the centre and edges of the piston head = 200^0 C; Allowable stress for the material of the piston = 33.5 MPa; Allowable stress for the material of the piston rings and gudgeon pin = 80 MPa; Allowable bearing pressure on the piston barrel = 0.4 N/mm^2 and allowable bearing pressure on the gudgeon pin = 17 N/mm^2.

Q8 **Write short answer on any TWO:** **(5 x 2)**

a) describe the Goodman and Soderberg Criteria of fatigue failure

b) Explain the following terms as applied to journal bearings:
(i) Bearing characteristic number; (ii) Bearing modulus.

c) Explain the phenomenon of interference in involute gears. What are the conditions to be satisfied in order to avoid interference ?

d) Write short note on classifications and different types of antifriction bearings.