CBCS SCHEME

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18AU63

Sixth Semester B.E. Degree Examination, Jan./Feb. 2023
Design of Machine Elements – II

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Design Data Handbook is permitted.
3. Missing data may be suitably assumed.

Module-1

1 a. Derive an expression for stress in helical spring of circular wire. **(10 Marks)**

b. Design a helical compression spring to support on axial load of 3000 N. The deflection under load is limited to 60 mm. The spring index is 6. The spring is made of chrome-vanadium steel and factor safety is equal to 2. **(10 Marks)**

OR

2 a. A car engine develops maximum power of 15 kW at 1000 rpm. The clutch used is single plate type of both sides effective having external diameter 1.25 times internal diameter $\mu = 0.3$. Mean axial pressure is not to exceed 0.085 N/mm^2. Determine the dimensions of the friction surface and the force necessary to engage the plates. Assume uniform pressure condition. **(10 Marks)**

b. Derive a relation to compute the torque developed on block brake. **(10 Marks)**

Module-2

3 a. Explain the spur gear terminology. **(05 Marks)**

b. Derive an expression for law of gearing. **(05 Marks)**

c. A pair of mating helical gears have 20° pressure angle in the normal plane. The normal module is 5 mm and the module in the diametral plane is 5.7735 mm. The pitch diameter of the smaller gear is 115.47 mm. If the transmission ratio is 4 : 1. Calculate :

(i) Helix angle (ii) Normal pitch (iii) Transverse pitch
(iv) Number of teeth for each gear (v) Addendum (vi) Dedendum
(vii) Whole depth (viii) Clearance (ix) Tooth thickness
(x) Working depth **(10 Marks)**

OR

4 A pair of carefully cut spur gears with 20° full depth involute profile is used to transmit 12 kW at 1200 revolutions per minute of pinion. The gear has to rotate at 300 revolutions per minute. The materials used for both pinion and gear is medium carbon steel whose allowable bending stress may be taken as 230 MPa. Determine the module and face width of the spur pinion and gear. Suggest suitable hardness. Take 24 teeth on pinion. Modulus of elasticity may be taken as 210 GPa. **(20 Marks)**

Module-3

5 a. Define bearing and classify them. **(06 Marks)**

b. A 75 mm long full journal bearing of diameter 75 mm supports a radial load of 12 kN at the shaft speed of 1800 rev/min. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of oil is 0.01 PaS at the operating temperature.
Determine the following :
(i) Summerfeld number (ii) The coefficient of friction based on McKee's equation
(iii) Amount of heat generated. **(06 Marks)**

c. SAE 20 oil is used to lubricate a hydrodynamic journal bearing of diameter 75 mm and length 75 mm, oil enters at 40°C. The journal rotates at 1200 rpm. The diametral clearance is 75 μm (0.075 mm). Assume operating temperature of the oil as 53°C and determine
(i) Magnitude and location of the minimum film thickness.
(ii) Power loss. (iii) Oil flow through the bearing.
(iv) Side leakage **(08 Marks)**

OR

6 a. Derive an Petroff's equation. **(10 Marks)**
b. Mention the advantages and disadvantages of ball and roller bearings. **(10 Marks)**

Module-4

7 a. Explain Piston materials. **(04 Marks)**
b. Design a suitable aluminium alloy piston with two compression rings and one oil ring for a petrol engine of following particulars :
Cylinder diameter = 0.10 m ; Peak gas pressure = 3.2 MPa ;
Mean effective pressure = 0.8 MPa ; Average side thrust = 2400 N ;
Skirt bearing pressure = 0.22 MPa ; Bending stress in piston crown = 36 MPa ;
Crown temperature difference = 70°C ; Heat dissipated through crown = 157 kW/m^2
Allowable radial pressure = 0.04 MPa ; Bending piston in rings = 90 MPa ;
Heat conductivity K = 160 W/m/°C ;
Assume any further data required for the design. **(16 Marks)**

OR

8 a. Explain the following : (i) Valve rotators (ii) Valve seats (iii) Valve guider **(12 Marks)**
b. Write a short note on operating conditions and operating temperatures. **(08 Marks)**

Module-5

9 Design a connecting rod for a petrol engine from the following data:
Cylinder bore or diameter of piston = 100 mm ; Length of connecting rod = 350 mm
Maximum gas pressure or explosion pressure = 3 N/mm^2; Length of stroke = 150 mm
Engine speed = 1500 rpm ; Weight of reciprocating parts = 25 N
Compression ratio = 4 : 1
Assume any further data required for the design. **(20 Marks)**

OR

10 Design a centre crankshaft for a single acting four stroke single cylinder engine to operate at 200 rpm. The particulars of the engine are as given below :
Cylinder bore = 250 mm ; Maximum gas pressure = 2.5 MPa ;
Length of stroke = 300 mm ; Ratio of length of connecting rod to crank radius = 4.5 ;
Weight of flywheel cum belt pulley = 2 kN ; Total belt pull = 4 kN ;
Mean effective pressure = 0.5 MPa Width of hub for flywheel cum belt pulley = 400 mm
The torque on the crank shaft is maximum when the crank turns through 25° from top dead centre and at this position the gas pressure inside the cylinder is 2 MPa. The belts are in the horizontal position. The crank shaft main bearings are 500 mm center to centre. (i.e. twice the diameter of piston or cylinder bore) Assume any further data required for the design.
(20 Marks)

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