Printed Pages :2 **Roll No.** | | | | | | | | | | | **EME602**

B. TECH.
THEORY EXAMINATION (SEM–VI) 2016-17
MACHINE DESIGN- II

Time : 3 Hours ***Max. Marks : 100***

Note : *Be precise in your answer. In case of numerical problem assume data wherever not provided. Use of Design Data book is allowed.*

SECTION – A

1. Attempt all of the following questions: 10 x 2 = 20

(a) Explain wedge film and squeeze film journal bearings.

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

(c) How do you express the life of a bearing? What is an average or median life?

(d) Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures.

(e) What is a herringbone gear? Where they are used?

(f) What are the various forces acting on worm and worm gears ?

(g) Explain the various types of cylinder liners.

(h) Explain the various forces induced in the connecting rod.

(i) What is the function of a connecting rod of an internal combustion engine?

(j) Explain the following terms used in helical gears :
(*a*) Helix angle; (*b*) normal pitch

SECTION – B

2. Attempt any five of the following questions: 5 x 10 = 50

(a) A 80 mm long journal bearing supports a load of 2800 N on a 50 mm diameter shaft. The bearing has a radial clearance of 0.05 mm and the viscosity of the oil is 0.021 kg / m-s at the operating temperature. If the bearing is capable of dissipating 80 J/s, determine the maximum safe speed.

(b) The thrust of propeller shaft is absorbed by 6 collars. The rubbing surfaces of these collars have outer diameter 300 mm and inner diameter 200 mm. If the shaft runs at 120 r.p.m., the bearing pressure amounts to 0.4 N/mm^2. The coefficient of friction may be taken as 0.05. Assuming that the pressure is uniformly distributed, determine the power absorbed by the collars.

(c) A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 kN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the bearing is $20X\ 10^6$ revolutions at 95 per cent reliability, calculate dynamic load rating of the ball bearing.

(d) A bronze spur pinion rotating at 600 r.p.m. drives a cast iron spur gear at a transmission ratio of 4: 1. The allowable static stresses for the bronze pinion and cast iron gear are 84 MPa and 105 MPa respectively. The pinion has 16 standard 20° full depth involute teeth of module 8 mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the standpoint of strength.

(e) A pair of helical gears are to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10 000 r.p.m. and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel

having allowable static strength of 100 MPa; determine a suitable module and face width from static strength considerations and check the gears for wear, given σes = 618 MPa.

(f) 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.

(g) 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.

(h) Derive the following expression as applied to rolling contact bearings subjected to variable load cycle

$$W_e = \sqrt[3]{\frac{N_1 (W_1)^3 + N_2 (W_2)^3 + N_3 (W_3)^3 + ...}{N_1 + N_2 + N_3 + ...}}$$

W_e = Equivalent cubic load,

W_1, W_2 and W_3 = Loads acting respectively for N_1, N_2, N_3 ...

SECTION – C

Attempt any two of the following questions: 2 x 15 = 30

3 A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of 1.4 N/mm^2. The speed of the journal is 900 r.p.m. and the ratio of journal diameter to the diametral clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m-s. The room temperature is 35°C. Find: 1. The amount of artificial cooling required, and 2. The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of the oil as 1850 J / kg / °C.

4 A pair of 20º full depth involute teeth bevel gears connect two shafts at right angles having velocity ratio 3 : 1. The gear is made of cast steel having allowable static stress as 70 MPa and the pinion is of steel with allowable static stress as 100 MPa. The pinion transmits 37.5 kW at 750 r.p.m. Determine: a) Module and face width; b) Pitch diameters; and c) Pinion shaft diameter.
Assume tooth form factor,

$$y = 0.154 - \frac{0.912}{T_E}$$

Where TE is the formative number of teeth, width = 1/3 rd the length of pitch cone, and pinion shaft overhangs by 150 mm.

5 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.