B. TECH.

Theory Examination (Semester-VI) 2015-16

MACHINE DESIGN-II

Time : 3 Hours   *Max. Marks : 100*

Note :   1.   Assume any missing data suitably.
             2.   Use of design data book is allowed.

Section-A

1.   **Attempt all question :** $(2 \times 10 = 20)$

   (a)   20-tooth, 8 pitch, 2.54-mm-wide, 20° pinion transmits
         5 kw at 1725 rpm to a 60-tooth gear. Determine driving
         force, separating force, and resultant force that would
         act on mounting shafts.

   (b)   What do you understand by beam strength of gear tooth?

   (c)   Define worm gearing with applications?

   (d)   Classify the sliding contact bearing in terms of thickness
         of layer of the lubricant between the bearing and
         journal?

(e) Why is piston made light weight?

(f) What kind of contact occurs between worm and worm wheel? How does it differ from other types of gears?

(g) What is SAE ?

(h) Define L_{10} and L_{50} life for bearings.

(i) What is the purpose of valve spring?

(j) What is herringbone helical gear?

Section-B

2. **Attempt any five questions.** (5×10=50)

(a) A pair of straight teeth spur gears is to transmit 25 kW when pinion rotates at 300 rpm. The velocity ratio is 1 : 3. The allowable static stresses for the pinion and gear materials are 120 Mpa and 100 Mpa respectively. The pinion has 15 teeth and its face width is 15 times the module. Determine the module, face width and pitch circle diameters of both the pinion and the gear from standpoint of strength only, taking into consideration the effect of dynamic loading. Assume 20° full depth involute pairs with ordinary cutting.

(b) A steel pinion with 20° full depth involute teeth is transmitting 7.5 kW power at 1000 rpm from an electric motor. The starting torque of the motor is twice the rated torque. The number of teeth on the pinion is 25, while the module is 4. The face width 45 mm. Assuming that velocity factor accounts for the dynamic load, calculate

(i) Effective load on the gear tooth

(ii) Bending stress in the gear tooth.

(c) A pair of 20° stub teeth spur gears is to transmit 20 kW . The pinion rotates at 500 rpm and the V.R. is 1 : 4. The allowable static stress for gear and pinion are 100 Mpa and 120 Mpa respectively. The pinion has 20 teeth and face width is 10 times the module. Design the gear for static strength

(d) Give the terminology of helical gears with suitable diagram. Also explain the forces on a helical gear tooth.

(e) A journal bearing has a journal diameter of 50 mm and the diameter of bushing is 50.1 mm. The bushing is 50 mm long and has to support a load of 1 KN at a speed of 1200 rpm. Determine the minimum oil film thickness and power loss for SAE 10 oil, assuming the oil film temperature to be 70°C.

(f) A pair of helical gears is used to transmit 15 kW at 3000 rpm of the pinion. The teeth are 20° stub in

diametric plane and the helix angle is 45°. The gear and pinion have a pitch diameter of 320 and 80 mm respectively. Both the gears are made of cast steel with an allowable stress of 100 Mpa. The modulus of elasticity for cast steel is 2×10^5 Mpa and its surface endurance strength is 618 MPa. Suggest a suitable module and face width for gear pair and check the strength of the gear pair in wear.

(g) The bore of a cylinder of 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 (σ_{ut} = 200 N/mm2) and the FOS is 5 .Determine the thickness of the cylinder head .Studs is made of steel FeE 250 (σ_{yt} = 250 N/mm2) and the FOS is 5. Calculate :

(i) Number of studs

(ii) Nominal diameter of studs

(iii) Pitch of studs

(h) Determine the dimensions of cross-sections of the connecting rod (1-section), for a diesel engine with the following data :

(i) Cylinder bore = 100 mm

(ii) Length of connecting rod = 320 mm

(iii) Maximum gas pressure = 2.45 Mpa

(iv) FOS against buckling failure = 5

Section-C

Attempt two question. (2×15=30)

3. The following data is given for a pair of parallel helical gears made of steel :

Power transmitted = 20 kW, n_p = 720 rpm, z_P = 35, zg = 70, centre distance = 285 mm, normal module = 5 mm, b = 50 mm, normal pressure angle = 20°, S_{ut} = 600 N/mm², surface hardness number = 300 BHN, grade of machining = 6, Service factor = 1.25 Calculate :

(i) The helix angle;

(ii) Beam strength,

(iii) Wear strength,

(iv) Static load

(v) The dynamic load by Buckingham's equation.

(vi) Effective factor of safety against bending failure.

4. Design a high efficiency worm gear speed reducer to transmit continuously the rated power output of 15 kW motor running

at 1750 rpm. The steel worm having hardness 250 BHN is integral with the motor shaft. The speed ratio is 10, while the phosphor bronze gear should not have less than 40 mm.

5. Answer following in breif.

    (i)   Virtual no. of teeth is in helical gear.

    (ii)   Hydrostatic versus hydrodynamic bearing.

    (iii) Reliability of antifriction bearings.