

B.TECH.
(SEM VI) THEORY EXAMINATION 2018-19
MACHINE DESIGN-II

Time: 3 Hours

Total Marks: 70

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

- (a) What do you understand by Formative spur gear' in helical gears?
- (b) Explain the construction of involute profile.
- (c) A pair of parallel helical gears consists of 18 teeth pinion meshing with a 63 teeth gear. The helix angle is 23 degree while the normal pressure angle is 20 degree. Calculate axial pitch.
- (d) In which gear self-locking is possible? Give the condition for self-locking.
- (e) What do you mean by hydrodynamic lubrication?
- (f) What is L_{10} life?
- (g) What are the desirable properties of piston materials?

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

- (a) Derive the expression for Lewis beam strength equation with proper assumption for spur gear.
- (b) A pair of parallel helical gears consists of an 18 teeth pinion meshing with a 45 teeth gear. A 7.5 kW power at 2000 rpm is supplied to the pinion through its shaft. The normal module is 6mm, while the normal pressure angle is 20°. The helix angle is 23°. Determine the tangential, radial and axial components of the resultant tooth force between the meshing teeth.
- (c) A pair of worm gear is designated as 3/60/8/5. The worm rotates at 720 rpm and normal pressure angle is 20°. Worm is made of case hardened steel, and the gear of phosphor bronze and worm set is well lubricated. Determine the power lost due to friction when power input is 1kW.
- (d) The radial load acting on a ball bearing is 2500N for the first five revolutions and reduces to 1500N for the next ten revolutions; the load variation then repeats itself. The expected life of the bearing is 20 million revolutions. Determine the dynamic load rating capacity of the bearing.
- (e) Determine the amount of artificial cooling, if required for a centrifugal pump running at 1440 rpm, the diameter of the journal is 100mm and the load on each bearing is 20 kN. The bearing characteristics number can be taken as 29.5. the bearing temperature is 75°C, the ambient temperature is 28°C, the energy dissipation coefficient is 900W/m²/°C.

SECTION C

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

- (a) A 20° full depth involute pair of spur gears is to be designed. Driving shaft rotates at 750 rpm and receives a 7.5 kW power, Speed reduction of output shaft is 5 times. The gears are made of steels with $S_{ut}=480\text{MPa}$. Service factor

is 1.5 and face width is 8.5 times of the module. The gears are machined to the accuracy of Grade 8. Assume a pitch line velocity of 3.6 m/s, factor of safety is 2 and deformation factor is 11.4 GPa. Estimate the module of the gear and determine and determine the dynamic load using Buckingham's equation.

- (b) A pair of parallel helical gears consists of 25 teeth pinion meshing with a 120 teeth gear. Normal pressure angle is 20° and helix angle is 25° . The pinion rotates at 800 rpm. Normal module of gear is 5mm and face width is 50 mm. Both pinion and gear are made of steel with allowable bending strength of 330 MPa. Gears are heat treated to a surface hardness of 380 BHN. What power can be transmitted by gears if service factor is 1.3? Assume pitch line velocity factor takes into account for dynamic load.

4. Attempt any one part of the following:

7 x 1 = 7

- (a) A pair of straight bevel gears is mounted on shafts, which are intersecting at right angles. The number of teeth on the pinion and gear are 40 and 65 respectively. The pressure angle is 20° . The pinion shaft is connected to an electric motor developing 16.5kW rated power at 600 rpm. The service factor can be taken as 1.5. The pinion and the gear are made of steel ($S_{ut}=580 \text{ N/mm}^2$) and heat treated to a surface hardness of 350 BHN. The gears are manufactured in such a way that the error between two meshing teeth is limited to 21 microns. The module and face width are 6mm and 50 mm, respectively. Determine the factor of safety against bending and pitting failure.
- (b) Design a worm and worm gear drive for a speed reduction of 30. Worm rotates at 750 rpm and transmits 40kW. Assume double start thread and gear has 65 full depth 20° involute teeth.

5. Attempt any one part of the following:

7 x 1 = 7

- (a) Explain the mechanism of Hydrostatic and Hydrodynamic lubrication. Write five differences between them.
- (b) Following data is given for a full hydrodynamic bearing
 Radial load=25 kN
 Journal speed=1000 rpm
 Unit Bearing pressure= 2.5 MPa
 Viscosity of lubricant= 20cP
 L/D=1
 Ratio of minimum film thickness to radial clearance=0.25.
 Determine:
 (i) dimensions of the bearing
 (ii) minimum film requirements
 (iii) requirements of oil flow

6. Attempt any one part of the following:

7 x 1 = 7

- (a) A system involves four identical ball bearings each subjected to a radial load of 2500 N. the reliability of the system i.e. one out of four bearings failing during the lifetime of 5MR is 82%. Determine the dynamic load carrying capacity of the bearing, so as to select it from the manufacturer's catalogue based on 90% reliability.

- (b) A ball bearing operates on the following work cycle.

S. No.	Radial Load (N)	Speed (rpm)	Element time (%)
1	3000	720	30
2	7000	1440	50
3	5000	900	20

The dynamic load capacity of the bearing is 16.6kN. Calculate:

- (i) average speed of rotation
(ii) equivalent radial load
(iii) the bearing life

7. Attempt any *one* part of the following:

7 x 1 = 7

- (a) The cylinder of a four stroke diesel engine has the following specifications:

Cylinder bore: 150 mm

Maximum pressure: 3.5 MPa

Cylinder material: GCI FG200

Factor of safety:6

Poisson's ratio: 0.25

Determine the thickness of the cylinder wall. Also calculate the apparent and net circumferential stresses in the cylinder wall.

- (b) Design a CI piston for a single acting four stroke diesel engine with following data:

Cylinder bore: 300 mm

Length of stroke: 450 mm

Speed: 300rpm

Indicated mean effective pressure: 0.85 MPa

Maximum gas pressure: 5MPa

Fuel consumption= 0.30 kg/BP/hr

HCV: 44000kJ/kg

Assume suitable if required and state suitable assumptions.