

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)**

**CLASS: BE
BRANCH: MECHANICAL**

**SEMESTER: VI/ADD
SESSION : SP/2020**

SUBJECT : ME6007 DESIGN OF MECHANICAL SYSTEMS

TIME: 1.5 HOURS

FULL MARKS: 25

INSTRUCTIONS:

1. The total marks of the questions are 30.
 2. Candidates may attempt for all 30 marks.
 3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. The missing data, if any, may be assumed suitably.
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- Q1 (a) Discuss some modes of failure of a gear. [2]
(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 mm. The face width is 45 mm. Assuming the velocity factor accounts for the dynamic load and bending strength is equal to effective load (limiting condition) Calculate
(i) the effective load on the gear tooth; and (ii) the bending stresses in the gear tooth. [3]
- Q2 (a) What are the advantages of helical gears? [2]
(b) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20° , while the helix angle is 25° . The face width is 40 mm and the normal module is 4 mm. The pinion as well as the gear is made of steel 40C8 ($S_{ut} = 600 \text{ N/mm}^2$) and heat treated to a surface hardness of 300 BHN. The service factor and the factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load. Calculate the beam strength and wear strength. [3]
- Q3 (a) Differentiate between a straight and spiral bevel gear. [2]
(b) A pair of straight bevel gears is mounted on shafts, which are intersecting at right angles. The gears are made of steel and the surface hardness is 300 BHN. The number of teeth on the pinion and gear are 40 and 65 respectively. The module at the outside diameter is 3 mm, while the face width of the tooth is 35 mm. Calculate the wear strength of the tooth. [3]
- Q4 (a) What are the major advantages of worm gear? [2]
(b) A pair of worm gears is designated as 1/30/10/8 [3]
Calculate (i) the centre distance; (ii) the speed reduction; (iii) the dimensions of the worm; and (iv) the dimensions of the worm wheel
- Q5 (a) Explain self aligning bearing. [2]
(b) A taper roller bearing has a dynamic load capacity of 26 kN. The desired life for 90% of the bearings is 8000 hours and the speed is 300 rpm. Calculate the equivalent radial load that the bearing can carry. [3]
- Q6 (a) What is hydrostatic and hydrodynamic lubrication? [2]
(b) Describe in brief the principle of hydrodynamic lubrication along with neat sketch. [3]