Code No: 56019

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, July/August - 2021
DESIGN OF MACHINE MEMBERS – II
(Mechanical Engineering)

Time: 3 hours

Max. Marks: 75

Answer any five questions
All questions carry equal marks

1.a) Explain the operation of a hydrodynamic bearing and sketch the pressure distribution in it when the journal is at full speed.

  b) Design a full hydrodynamic journal bearing with the following specification for machine tool application:
  Journal diameter = 75 mm; radial load = 12 kN; journal speed = 1440 rpm;
  minimum oil film thickness = 22 microns; inlet temperature = 38^0C;
  bearing material – babbit.
  Determine the length of the bearing and select suitable oil for this application. [5+10]

2. A single row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust force of 3 kN. The shaft rotates at 1200 rpm. The expected life L_{10h} of the bearing is 18000 h. The minimum acceptable diameter of the shaft is 70 mm. Select a suitable ball bearing for this application. [15]

3. Design a cast iron piston for a single acting four-stroke diesel engine with the following data:
  Cylinder bore = 200 mm; length of stroke = 250 mm; speed = 500 rpm;
  Break mean effective pressure = 0.5 MPa; Maximum gas pressure = 4 MPa
  Fuel consumption = 0.25 kg per BP per hr
  (l/d) ratio for bush in small end of connecting rod = 1.5
  Assume suitable data if required and state the assumptions made. [15]

4. It is required to select a flat-belt drive to connect two transmission shafts rotating at 800 and 400 rpm respectively. The centre to centre distance between the shafts is approximately 3 m and the belt drive is open-type. The power transmitted by the belt is 30 kW and the load correction factor is 1.3. The belt should operate at a velocity between 17.8 to 22.9 m/s. The power transmitting capacity of the belt per mm width per ply at 180^0 arc of contact and at a belt velocity of 5.08 m/s is 0.0147 kW. Select preferred pulley diameters and specify the belt. [15]

5. A pair of spur gears consists of a 24 teeth pinion, rotating at 1000 rpm and transmitting power to a 48 teeth gear. The module is 6 mm, while the face width is 60 mm. Both gears are made of steel with an ultimate tensile strength of 450 N/mm^2. They are heat treated to a surface hardness of 250 BHN. Assume that velocity factor accounts for the dynamic load. Find the rated power that the gears can transmit, if service factor and the factor of safety are 1.5 and 2 respectively. [15]

6. A pair of helical gears consists of an 18 teeth pinion meshing with a 45 teeth gear. 7.5 kW power at 2000 rpm is supplied to the pinion through its shaft. The normal module is 6 mm, while the normal pressure angle is 20^0. The helix angle is 23^0. Determine the tangential, radial and axial components of the resultant tooth force between the meshing teeth. [15]

7. A double-threaded power screw is used to raise a load of 5 kN. The nominal diameter is 60 mm and the pitch is 9 mm. The threads are Acme type ($2\theta = 29^0$) and the coefficient of friction at the screw threads is 0.15. Neglecting collar friction, calculate
   a) The torque required to raise the load
   b) The torque required to lower the load and
   c) The efficiency of the screw for lifting load. [5+5+5]

8. A pair of worm gears is designated as 1/40/10/4. The input speed of the worm shaft is 1000 rpm. The worm wheel is made of phosphor bronze (sand cast), while the worm of case hardened steel 10C4. Determine the power transmitting capacity based on beam strength. [15]

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