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Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



V SEMESTER B.TECH (AUTOMOBILE ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: MECHANICAL DESIGN-II [AAE 351]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ANY FIVE FULL the questions.
- Missing data, if any, may be suitable assumed and mentioned clearly.
- 1A. A spur gear drive is required to transmit a maximum power of 22.5 kW. (05) The velocity ratio is 1:2 and r.p.m. of the pinion is 200. The approximate center distance between the shafts may be taken as 600 mm. The teeth has 20° stub involute profiles. The static stress for the gear material (cast iron) may be taken as 60 MPa and face width as 10 times the module. Find the module and all gear parameters.
- **1B.** Check the design for static, dynamic and wear loads. The deformation or **(05)** dynamic factor in the Buckingham equation may be taken as 80 and the material combination factor for the wear as 1.4.
- **2A.** Briefly explain the bearing characteristic number. With a neat sketch **(05)** explain the classification of lubrication regimes.
- 2B. A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of 1.4 N/mm2. 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: The amount of artificial cooling required, and 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.
- **3A.** At the bottom of a mine shaft, a group of 10 identical close coiled helical (05) springs are set in parallel to absorb the shock caused by the falling of the cage in case of a failure. The loaded cage weighs 75 kN, while the counter weight has a weight of 15 kN. If the loaded cage falls through a height of 50 metres from rest, find the maximum stress induced in each spring if it is made of 50 mm diameter steel rod. The spring index is 6 and the number of active turns in each spring is 20. Modulus of rigidity, $G = 80 \text{ kN/mm}^2$.

- **3B.** With neat sketches, classify flat belt drives. Briefly enumerate on the **(05)** types of rolling contact bearings with relevant clear representation of ball/roller arrangements.
- 4A. A pair of precision cut parallel helical gears is used to transmit 15 kW at 2000 r.p.m from the pinion shaft with a gear ratio of 5. The gear is made of phosphor bronze of static strength 75 MPa and pinion is made of hardened steel of static strength 100 MPa. The pressure angle is 20° in the normal plane and the helix angle is 35°. Determine the required module and face width with all gear parameters.
- **4B.** For the above gear pair arrangement, check the design for static, **(05)** dynamic and wear loads.
- **5A.** Select a single row deep groove ball bearing with the operating cycle **(05)** listed below, which will have a life of 15,000 hours. Assume radial and axial load factors to be 1.0 and 1.5 respectively and inner race rotates.

Fraction of cycle	Radial load (N)	Thrust load (N)	Speed (r.p.m)	Service Factor
1/10	2000	1200	400	3
1/10	1500	1000	500	1.5
1/5	1000	1500	600	2
3/5	1200	2000	800	1

- **5B.** Explain with neat sketches, the classification and working of available **(05)** brake systems.
- 6A. A semi-elliptical laminated spring is made of 50 mm wide and 3 mm thick (05) plates. The length between the supports is 650 mm and the width of the band is 60 mm. The spring has two full length leaves and five graduated leaves. If the spring carries a central load of 1600 N, find: Maximum stress in full length and graduated leaves for an initial condition of no stress in the leaves, The maximum stress if the initial stress is provided to cause equal stress when loaded and the deflection.
- **6B.** With neat sketch, deduce a relation for ratio of tensions in a flat belt drive **(05)** system.