Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

MAKE UP EXAMINATIONS, JUNE 2018

SUBJECT: DESIGN OF MACHINE ELEMENTS (AAE 2252)

REVISED CREDIT SYSTEM
(19/06/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data **IF ANY**, may be suitably assumed and mentioned clearly
- Usage of design data handbook **provided** is allowed

1A. Two shafts at right angles are connected with a pair of gears having 14.5˚ composite type tooth form. The pinion is made of steel (σ=120 MN/m^2) and the gear is to be of cast iron (σ= 80 MN/m^2). The pinion having 26 teeth is to transmit 10 kW power at 1200 rpm. The velocity ratio, i = 2.5. The gears are heat treated to 200 BHN. Mention which type of gear to be used and why, design the gear pair suitably. **(06)**

1B. For the above gear pair, check the design safety based on strength and wear. **(04)**

2A. A pair of high grade cast iron spur gears with 20º full depth teeth transmit 8 kW at 900 rpm of the pinion. The transmission ratio required is 4 and the pinion has 20 teeth. Design the gear pair. Calculate all the gear parameters and centre distance. Consider suitable BHN. ($\sigma_{01} = \sigma_{02} = 103.005$ N/mm^2) **(06)**

2B. For the above gear pair, check the design for safety and mention remedial measures, if any. **(04)**

3A. A semi-elliptical laminated spring is made of 50 mm wide and 3 mm thick 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. **(05)**

3B. Derive an expression to prove $\tau = K\left\{\frac{8WD}{\pi d^3}\right\}$ and $\delta = \left\{\frac{8WC^3n}{Gd}\right\}$ **(05)**

4A. A single row angular contact ball bearing number 310 is used for an axial flow compressor. The bearing is to carry a radial load of 2500 N and an axial or thrust load of 1500 N. Assuming light shock load, determine the rating life of the bearing. **(03)**

4B. What are the commonly used materials for sliding contact bearings? A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of 1.6 N/mm^2. The speed of the journal is 800 rpm 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 70°C may be taken as 0.012 kg/m-s. The room temperature is 33°C. **(07)**

Find :

1. The amount of artificial cooling required, and
2. The mass of the lubricating oil required for cooling. Take specific heat of the oil as 1800 J / kg / °C.

5A. A belt drive consists of two V-belts in parallel, on grooved pulleys of the same size. The angle of the groove is 28°. The cross-sectional area of each belt is 700 mm^2 and μ = 0.11. The density of the belt material is 1.1 Mg / m^3 and the maximum safe stress in the material is 7 MPa. **(05)**

Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1400 rpm. Find also the shaft speed in rpm at which the power transmitted would be a maximum.

5B. Design a helical compression spring for a safety valve. The valve must blow off at a pressure of 1.2 MPa and should lift by 3mm for 5% increase in pressure. The valve seat diameter is 60mm. Maximum shear stress allowed is 400MPa and modulus of rigidity for the spring material is 82700 N/mm^2. The ends are squared and ground and gap between the adjacent coils is 0.15 times maximum deflection. Take spring index as 6. **(05)**

Determine 1) wire diameter 2) mean coil diameter 3) number of active coils 4) free length 5) pitch of the coil.