Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL 2018

SUBJECT: DESIGN OF MACHINE ELEMENTS (AAE 2252)

REVISED CREDIT SYSTEM
(23/04/2018)

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. A pair of straight tooth bevel gears at acute angles are used to transmit 5 kW at 900 rpm of the pinion. The shaft angle is 60° and the speed reduction is 3:1. The teeth are 20° full depth form and the number of teeth on pinion is 20. The pinion is to be made of steel and the gear is to be made of phosphor bronze. The load is steady and service is continuous. Design the gear pair and find the gear parameters. **(05)**

1B. For the above gear pair, check the design safety based on strength and wear, considering suitable BHN. **(05)**

2A. It is required to transmit 15 kW power from a shaft running at 1200 rpm to a parallel shaft with a velocity ratio of 3. The centre distance of shafts is to be 300 mm. The material used for pinion is steel (σ= 200 MPa) and for gear is cast iron (σ= 140 MPa). The service factor is 1.25 and the tooth profile is 20° full depth involute. Design the spur gear and calculate the gear parameters. **(05)**

2B. For the above gear pair, check the design for safety and mention remedial measures, if any. **(05)**

3A. A locomotive semi-elliptical laminated spring has an overall length of 1 m and sustains a load of 70 kN at its center. The spring has 3 full length leaves and 15 graduated leaves with a central band of 100 mm width. All the leaves are to be stressed to 400 MPa, when fully loaded. The ratio of the total spring depth to that of width is 2 and E = 210 kN/mm^2. Determine: **1)** The thickness and width of the leaves. **2)** The initial gap that should be provided between the full length and graduated leaves before the band load is applied. **3)** The load exerted on the bolt after the spring is assembled. **(05)**

3B. It is desired to design a valve spring of I.C. engine for the following details: **(05)**
(a) Spring load when valve is closed = 80 N
(b) Spring load when valve is open = 100 N
(c) Space constraints for the fitment of spring are:
i) Inside guide bush diameter = 24 mm
ii) Outside recess diameter = 36 mm
(d) Valve lift = 5 mm
(e) Spring steel has the following properties:
i) Maximum permissible shear stress = 350 MPa
ii) Modulus of rigidity = 84 kN/mm^2
Find : 1. Wire diameter; 2. Spring index; 3. Total number of coils; 4. Solid length of spring; 5. Free length of spring; 6. Pitch of the coil when additional 15 percent of the working deflection is used to avoid complete closing of coils.

4A. Explain why chain drive is recommended in automotive industry? Write the application, advantages and disadvantages of chain drive over belt or rope drive **(03)**

4B. Load on the journal = 20 000 N; Speed of the journal = 900 rpm; Type of oil is SAE 10, for which the absolute viscosity at 55°C = 0.017 kg / m-s; Oil ambient temperature = 18.5°C; Maximum bearing pressure for the pump = 1.5 N / mm^2. Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. **(07)**

5A. A railway carriage weighing 20kN is moving on a track with a linear velocity of 3.5km/hr. It is brought to rest by two helical compression springs in parallel by undergoing a compression of 160mm. Assume spring index as 6. Permissible shear stress 450MPa. Design the spring and determine wire diameter, mean coil diameter, free length of the spring. Assume G= 81.4MPa for the spring material. **(05)**

5B. A flat belt is required to transmit 30 kW from a pulley of 1.5 m effective diameter running at 300 rpm. The angle of contact is spread over 11/24 of the circumference. The coefficient of friction between the belt and pulley surface is 0.3. Determine, taking centrifugal tension into account, width of the belt required. It is given that the belt thickness is 9.5 mm, density of its material is 1100 kg/m^3 and the related permissible working stress is 2.5 MPa. **(05)**