## MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

# V SEMESTER B.TECH. (AUTOMOBILE ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2018

Reg. No.

SUBJECT: THEORY OF MACHINES [AAE 3152]

### **REVISED CREDIT SYSTEM**

### (21/11/2018)

**Duration: 3 Hours** 

Max. Marks: 50

(02)

#### Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data if any, may be suitably be assumed.
- **1A.** 'Unlike lower pairs, higher pairs cannot be inverted' State whether the statement is true or false **(02)** giving suitable reasons.
- **1B.** Describe elliptical trammel with a neat diagram and prove that, this mechanism can be used to **(03)** trace an ellipse.
- 1C. Derive an equation for stability of a two wheeler when it is precessing on a curved path. (05)
- **2A.** Give a comparison between the function of a governor and a flywheel.
- 2B. A cam has to give following motion to a knife edge follower: i) follower to rise 40 mm with SHM (04) for 120 degree of cam rotation. ii) Follower to dwell for next 30 degree of cam rotation. iii) Follower to return with uniform motion for next 90 degree of cam rotation and iv) dwell for the remaining period.

Draw the displacement diagram for the follower motion, and calculate the max. velocity and acceleration during rise of the follower, if cam rotates at 120rpm cw.

- **2C.** Draw cam profile for the configuration given in **Q.2B**, when the minimum radius of the cam is **(04)** 30mm and the follower is offset to the right by 10mm.
- 3A. Two spur gears having 40 and 30 teeth respectively are of 25<sup>o</sup> involute form. The addendum is (03) 5mm and module is 5.5 mm. If the smaller gear is the driver and rotates at 1200 rpm find the velocity of sliding at the point of engagement.
- **3B.** With a neat diagram, explain function of differential of an automobile **(03)**
- **3C.** Derive an equation to find minimum number of teeth on gear to avoid interference. (04)
- **4A.** It is difficult to completely balance the reciprocating masses in an Internal combustion engine. **(02)** Justify the statement with a neat diagram.

4A. Reciprocating masses per cylinder of a 60° V-engine is 1.5 kg. The stroke and connecting rod (03) length are 100 mm and 200 mm respectively. If the engine runs at 3000 rpm, find the maximum and minimum values of primary and secondary forces.



For the gear train shown in fig., number of teeth on gear 2, 3 and 4 are respectively 100, 99 and 101. Planet gear has 20 teeth. Gear 2 is fixed and gear 3 and 4 are free to rotate on the shaft. If the arm rotates 100 rpm ccw, find the speed and direction of rotation of gear 3 and 4.

- **5A.** In a slider-crank mechanism, the crank is rotating with an angular velocity of 20 rad/s in ccw **(02)** direction. At the instant when the crank is perpendicular to the direction of the piston movement, velocity of the piston is 2 m/s. Find radius of the crank.
- **5B.** Locate all the I-Centers for the mechanism shown in the fig.



- 5C. The upper arms of a Porter governor has lengths 350 mm and are pivoted on the axis of rotation. (05) The lower arms has lengths 300 mm and are attached to the sleeve at a distance of 40 mm from the axis. Each ball has a mass of 4 kg and mass on the sleeve is 45 kg.
  - (i) Determine the equilibrium speed for a radius of rotation of 200 mm and
  - (ii) Find the effort and power of the governor for 1 per cent change in speed.

4C.

(03)