Reg. No.



MANIPAL INSTITUTE OF TECHNOLOGY

V SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

## **END SEMESTER EXAMINATIONS, NOV/DEC 2016**

SUBJECT: THEORY OF MACHINES [AAE3152]

## REVISED CREDIT SYSTEM (26/11/2016)

Time: 3 Hours

MAX. MARKS: 50

## Instructions to Candidates:

✤ Answer ALL the questions.

stituent Institution of Manipal University

- Missing data may be suitable assumed.
- 1A. The firing order in a 6-cylinder vertical 4-stroke in-line engine is I-IV-II-VI-III-V. (05) The piston stroke is 100 mm and length of each connecting rod is 200 mm. The pitch distance between cylinder centerlines are 100 mm, 150 mm, 100 mm 150 mm and 100 mm respectively. The reciprocating masses per cylinder are 1 kg and the engine runs at 3000 rpm. Determine the out of balance primary forces and couples on this engine taking a plane mid-way between the cylinders 3 and 4 as the reference plane.

1B	State and prove Kenned	ly's theorem for I-Centers	(03)
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- **1C.** Differentiate between a Governor and a flywheel
- 2A. A spring loaded governor of the Hartnell type has arms of equal lengths. The weight rotates in a circle of 13 cm diameter when the sleeve is in mid-position and the weight arms are vertical. The equilibrium speed for this position is 450 rpm, neglecting friction. The maximum sleeve movement is to be 2.5 cm and the maximum variation of speed, taking friction into account, is to be 5 % of the mid-position speed. The weight of the sleeve is 39 N and the friction may be considered equivalent to 29 N at the sleeve. The power of the governor must be sufficient to overcome the friction by a one per cent change of speed either way at mid-position. Determine, neglecting obliquity effect of arms:

(a) Weight of each rotating mass. (b) Spring stiffness in N/cm. (c) Initial compression of spring

- 2B. Two involute spur gears of module 3 mm and with 18 and 26 teeth operate at (03) a pressure angle of 20°. Find out the maximum addendum for the gears so that no interference occurs. Assume the addendum for gears to be equal.
- **2C.** With a neat diagram describe Elliptical trammel

(02)

- **3A.** State and prove law of gearing
- **3B.** Derive an equation for Gyroscopic couple.



- (03) in shown (04)
- In the planetary gear train shown in fig., Gear A is driver and gear B and D are compounded. Gears E and C are internal gears with gear C is fixed. Number of Teeth on gears are shown in the fig. If the Driver gear rotates at 720rpm ccw, when seen from right, find the speed of The driven gear. Also calculate the speed ratio.

## 4A.

In the mechanism shown in Fig. the crank  $O_2A$ rotates at 20 rpm in the direction indicated. For the given configuration, determine (i) the velocities of sliding at B and D. Given  $O_2A = 12$ cm, AB = 48 cm, BC = 18cm, and CD = 18 cm.



- **4B.** Define the following: (i) Governor stability (ii)Backlash in Gear (iii) kinematic **(02)** pair (iv) Pressure angle of the cam
- **4C.** What is the physical meaning of Contact ratio in gears is 1.7 (01)
- 5A. A knife edge follower is offset to the right by 1.2 cm. The lift of the follower is (06) 4cm. The base circle radius of the cam is 2.5cm. The cam rotates at 120rpm in the ccw direction. Lay out the cam profile if (i) the rise is for 150° of cam rotation, the first 60° being with constant acceleration and rest at constant deceleration. (ii) the dwell is for 30°. (iii) the return is for 150° of cam rotation with uniform velocity and (iv) the second dwell is for 30°.
- **5B.** In Q 5A, find the maximum velocity of the follower during the outstroke. **(01)**
- **5C.** Explain Interference and undercutting in involute gears and the means to **(03)** minimize the same.

(07)