

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (AUTOMOBILE ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2018 SUBJECT: THEORY OF MACHINES [AAE3152]

REVISED CREDIT SYSTEM

(23/12/2018)

Duration: 3 Hours

Max. Marks: 50

Instructions to Candidates:

- Answer ALL the questions.
- Missing data if any, may be suitably be assumed.
- **1A.** What do you understand by inversions of mechanisms? Describe any two possible mechanisms **(05)** obtained by double slider crank chain.
- 1B. The cranks and connecting rods of a 4-cylinder in-line engine running at 1800 rpm. are 60 mm (05) and 240 mm each respectively and the cylinders are spaced 150 mm apart. The firing order of cylinders is I-IV-II-III and cranks appear at intervals of 90° in an end view. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine Unbalanced primary forces and couple with reference to central plane of the engine
- 2A. Draw displacement, velocity and acceleration diagram to a suitable scale, when the follower (06) derives following motion by a radial cam. (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 motion, and (iv) the second dwell is for 30°.
- 2B. Prove that, for a disc cam, pressure angle decreases with increase in base circle of the cam. (04)
- 3A. In the mechanism shown in fig., link 2 and link 4 are two wheels of radius 500mm and 250mm respectively, rotating about the centre O₂ and O₄ and rolling on the fixed link 1. If link 2 rotates at an angular velocity of 12 rad/s clockwise find the angular velocity of link 4 by l-centre method.



- **3B.** Two equal involute gear wheels of 20[°] pressure angle have 20 teeth each. Calculate length of **(05)** arc of contact if the addendum was standard and equal to one module. Module of the gear is 6mm. What should be the addendum, if the contact is to be maximum possible?
- **4A.** 'A system dynamically balanced is statistically balanced too'. Justify the statement.

(02) (03)

- **4B.** State and prove law of gearing.
- 4C. A trolley can with a total mass of 2700 kg runs on rail 1 m apart with a speed of 30-km/ hr. The track is curved with a radius of 40 m towards the right of the driver. The car has four wheels each of diameter 70 cm and the total moment of inertia of each pair of wheels and the axle is 15 kgm². The car is driven by a motor running in the direction opposite to that of the wheels at a speed five times the speed of rotation of the wheels .The motor and the gear pinion have a moment of inertia 10 kg m². The rails are at the same level and the height of the center of gravity of the car is 1 m above the rail level. Determine the vertical force exerted by each wheel on the rails.
- 5A. A hartnell governor having a central sleeve spring and two right angle bell-crank levers, (05) operates between 290 rpm and 310 rpm for a sleeve lift of 1.5 cm. The sleeve arm and the ball arm are 8 cm and 12 cm respectively. The levers are pivoted at 12 cm form the governor axis and each ball weighs 24.5 N. The weights are parallel to the governor axis at the lowest equilibrium speed. Determine i) loads on the spring at the lowest and the highest equilibrium speeds and ii) stiffness of the spring.
- **5B.** Fig. shows a reverted planetary train with number of teeth on each gear. Gear 2 is connected to input shaft and is driven at 250 rpm, cw. Gears 4&5 are planet gears which are joined but are free to turn on the shaft carried by the arm 3. Gear 6 is stationary. Find the speed and direction of rotation of arm.

