Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY A Constituent Institute of Manipal University, Manipal

IV SEMESTER B.TECH (INDUSTRIAL & PRODUCTION ENGG.) END SEMESTER EXAMINATIONS, JUNE 2017

SUBJECT: THEORY OF MACHINES [MME 2213]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data may be suitably assumed.
- **1A.** Define the following precisely.

i) Inversion .ii) Machine iii) Lower pair iv) Kinematic chain, 2

- **1B.** With a neat sketch explain the crank and slotted lever mechanism. Mention its **5** application.
- **1C.** Determine the mobility of the mechanisms given in Fig. 1c,



Fig 1c (Q 1C)

- **2A.** State and prove the law of gearing.
- **2B.** State and prove Kennedy's theorem of instantaneous centre.

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- 2C. A belt drive transmits 8 kW of power from a shaft rotating at 240 rpm to another shaft rotating at 160 rpm. The belt is 8 mm thick. The diameter of the smaller pulley is 600 mm and the two shafts are 5 m apart. The coefficient of friction is 0.25. If the maximum stress in the belt is limited to 3 N/mm², find the width of the belt for (a) an open belt drive, and (b) a cross belt drive.
- 3A. A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular positions of the four masses so that the shaft shall be in complete balance.
- 3B. An engine mechanism is shown in Fig. 3b. The crank CB = 100 mm and the connecting rod BA = 300 mm with centre of gravity G, 100 mm from B. In the position shown, the crankshaft has a speed of 75 rad/s and an angular acceleration of 1200 rad/s². Find:
 - **a.** velocity of G and angular velocity of AB,
 - **b.** acceleration of G and angular acceleration of AB.



Fig. 3b (Q 3B)

- 4A. A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to 5 be designed to give a roller follower, at the end of a valve rod, motion described below :
 - a) To raise the valve through 50 mm during 120° rotation of the cam
 - b) To keep the valve fully raised through next 30° ;
 - c) To lower the valve during next 60° ; and
 - d) To keep the valve closed during rest of the revolution i.e. 150° ;

The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm.

Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft

- 4B. A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.
- 5A. Derive an expression for the minimum number of teeth required on the pinion in 3 order to avoid interference in involute gear teeth when it meshes with wheel.
- **5B.** An epicyclic gear train is shown in figure **5b**. The number of teeth on A and B are 80 and 200. Determine the speed of the arm a
 - i. if A rotates at 100 rpm clockwise and B at 50 rpm counter-clockwise
 - ii. if A rotates at 100 rpm clockwise and B is stationary



Fig 5b. (Q 5B)

5C. Briefly explain natural frequency and free vibration.

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