Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

III SEMESTER B.TECH (MECHANICAL ENGG.) DEGREE END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: KINEMATICS OF MACHINERY [MME 2102]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. With a neat sketch explain the working of the toggle press mechanism. **03**

1B. A pair of involute spur gears with 16^0 pressure angle and pitch of module 06 mm is in mesh. The number of teeth on pinion is 16 and its rotational speed is 240 rpm. When the gear ratio is 1.75, find in order that the interference is just avoided: (a) addendum on the gear (b) contact ratio, if the addendum is same on both the gears. **03**

1C. A leather belt transmits 9 kW from a motor running at 520 rpm by an open belt drive. The diameter of the driven pulley is 350 mm, center distance between the pulleys is 4 m and speed of the driven pulley is 175 rpm. The belt weighs 1100 kg/m^3 and the maximum allowable tension in the belt is 3.5 N/mm^2. Coefficient of friction = 0.25. Find the width of the belt assuming the thickness to be 10 mm. Neglect the belt thickness to calculate the velocities. **04**

2A. A pinion having 18 teeth of involute profile, 20° pressure angle and 6 mm module drives a gear having 44 teeth. Find: (i) the length of path of contact (ii) contact ratio (iii) angle turned by the gear if the addendum on both the gears is 25% more than the module. **03**

2B. Derive an expression to find the total frictional torque on the frictional surface for a collar bearing using uniform pressure theory. **03**

2C. Derive the expression to find the minimum number of teeth on the pinion to avoid interference between involute gears. **04**

3A. Explain with examples the different types of kinematic pairs classified on the basis of the nature of contact and the type of relative motion between the links. **05**

3B. A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below: **05**

- To raise the valve through 50 mm during 120° rotation of the cam;
- To keep the valve fully raised through next 30°;
- To lower the valve during next 60°; and
- To keep the valve closed during rest of the revolution i.e. 150°;

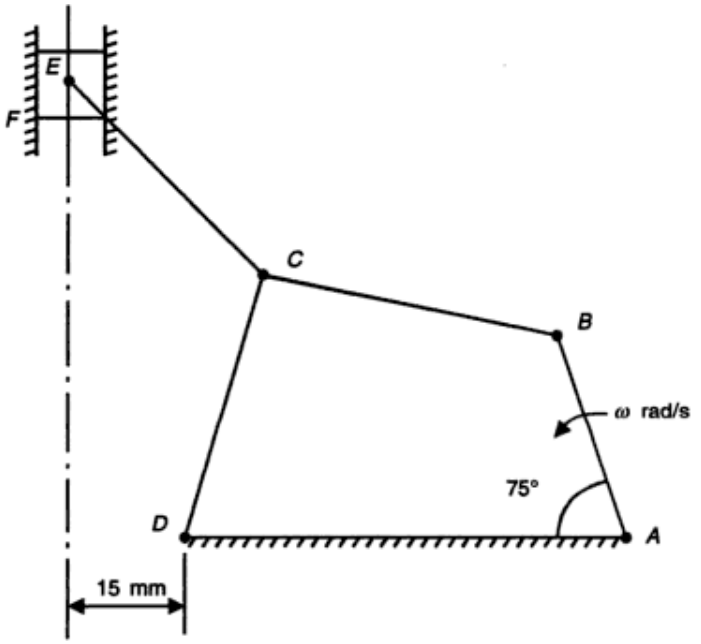
The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft. The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum velocity and acceleration of the valve rod when the cam shaft rotates at 100 r.p.m. Draw the displacement, the velocity and the acceleration diagrams for one complete revolution of the cam.

4A. State and prove the Kennedy's theorem of three instantaneous centers **03**

4B. With a neat sketch explain the differential gear of an automobile. Also derive an expression to determine the rpm of inner and outer wheels using tabular method. **03**

4C. In the mechanism shown in figure below, the dimensions of various links are, AB = 30 mm, BC = 45 mm, CD = 40 mm, AD = 65 mm, CE = 40 mm and angle DAB = 75°. The crank AB rotates at uniform speed of 600 rpm in counterclockwise direction. Determine the linear acceleration of slider E and angular acceleration of link BC. The velocities of various links are tabulated below. **04**

Link	Velocity m/s
AB	1.885
BC	1.15
CD	1.5
CE	1.95
SLIDER E	1.85



5A. The length of crank and connecting rod of a horizontal reciprocating engine are 100 mm and 500 mm respectively. The crank is rotating at 360 rpm. Using Klein's construction, determine the velocity and acceleration of the piston and connecting rod when the crank has turned by 30° from the Inner Dead Centre (IDC). **03**

5B. The annulus gear A as shown in figure ($5b_1$), rotates at 300 rpm about the axis of the fixed wheel S which has 80 teeth. The three-armed spider (only one arm a as shown in figure ($5b_2$)) is driven at 180 rpm. Determine the number of teeth required on the wheel P. **03**

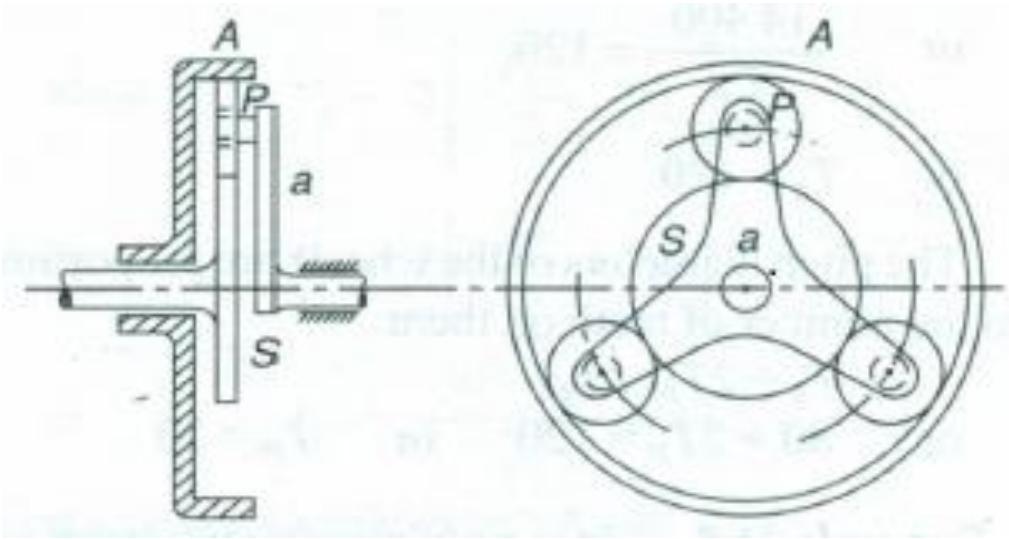


figure ($5b_1$) figure ($5b_2$)

5C. In a mechanism shown in figure below, the crank AB rotates about point A at uniform speed of 240 rpm in clockwise direction. The link CD oscillates about the fixed point D, which is connected to link AB by a coupler link BC. The slider F moves in horizontal guides, being driven by the link EF. Determine: i) velocity of slider F ii) angular velocity of link CD **04**