Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

III SEMESTER B.TECH (MECHANICAL ENGG.) END SEMESTER

MAKE-UP EXAMINATIONS, DEC 2017

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. A mechanism in which the crank AB is rotating uniformly at 180 rpm in clockwise direction is shown in figure Q1A. The blocks at D and E are working in frictionless guides. The dimensions of the links are: AB = 450 mm; BD = 1500 mm; BC = 900 mm and CE = 900 mm. Draw the velocity diagram and determine the velocities of blocks D and E using relative velocity method. **(5)**

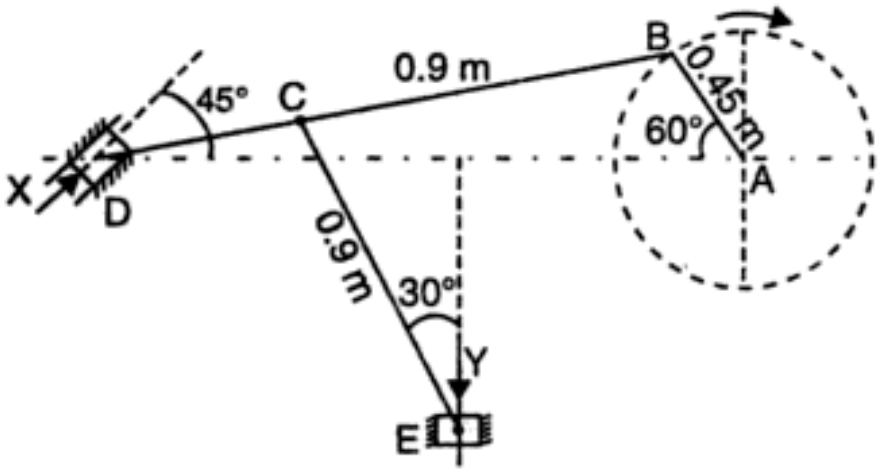

Figure Q1A

1B. Explain the working of a mechanism that is used for drawing an ellipse. **(3)**

1C. Sketch and explain any two types of wedge cams. **(2)**

2A. In the mechanism shown in figure Q2A, determine the acceleration of the slider C. O_1A = 100 mm, AB=120 mm, O_2B = 150 mm, and BC= 350 mm. The crank O_1A rotates uniformly at 240 rpm. The velocities of links are as **(5)**

follows:

$o_2b = v_b = 0.65$ m/s

$ab = v_{ba} = 2.4$ m/s

$o_1c = v_c = 0.5$ m/s

$bc = v_{cb} = 0.6$ m/s

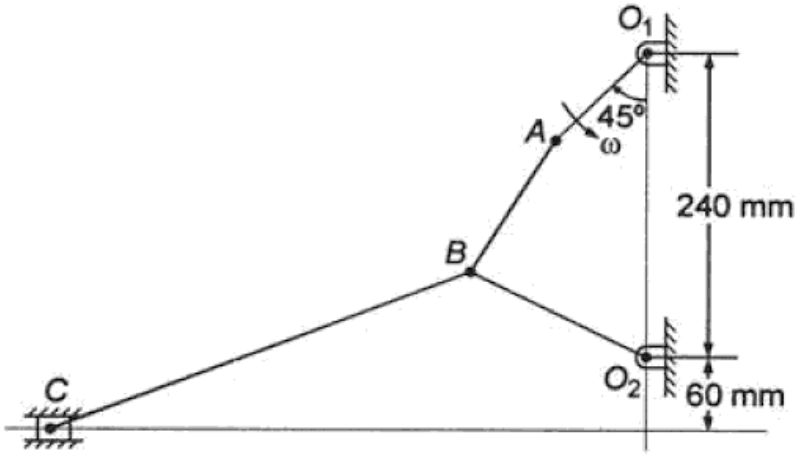

Figure Q2A

2B. A pinion with 20 involute teeth and 125 mm pitch circle diameter drives a rack. The addendum of both pinion and rack is 6.25 mm. What is the least pressure angle which can be used to avoid interference? With this pressure angle, find the length of the arc of contact and minimum number of teeth in contact at any given instance. **(3)**

2C. Derive an expression for total frictional torque for a single plate clutch with inner and outer radii r_1 and r_2 respectively, considering uniform wear theory with a clear description of the notations used. **(2)**

3A. Two mating gears have 20 and 40 involute teeth of module 10 mm and 20^0 pressure angle. The addendum on each wheel is to be made of such a length that the line of contact on each side of the pitch point is half the maximum possible length. Determine the addendum for each gear wheel, length of path of contact, arc of contact and contact ratio. **(5)**

3B. With a neat sketch explain the working of a toggle mechanism. **(3)**

3C. Write any two significant differences between simple and compound gear train. **(2)**

4A. An epicyclic gear train consists of a sun wheel S, a stationary annulus E and three identical planet wheels P carried on a star-shaped planet carrier C as shown in Figure Q4A. The size of different toothed wheels are such that the planet rotates at 1/5th the speed of the sun wheel. Minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100 Nm. Determine: i) the number of teeth on different wheels of the train, ii) torque necessary to keep the annulus stationary. **(5)**

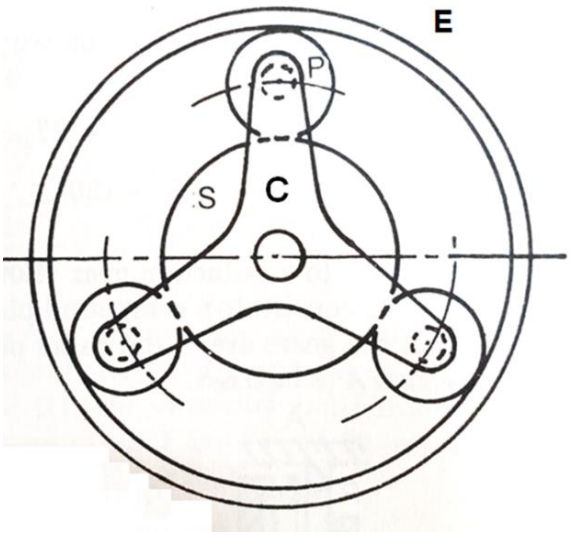

Figure Q4A.

4B. A V-belt having uppermost face width equal to 22 mm and nominal thickness equal to 14 mm is used to transmit power with V-groove angle 40^0. If the mass of the belt is 0.4 kg/m and maximum allowable stress is 1.5 N/mm^2, determine the maximum power that can be transmitted. Angle of contact is 155^0 and coefficient of friction is 0.2. **(3)**

4C. Mention any two disadvantages of a gear drive. **(2)**

5A. Draw the profile of a cam operating a roller reciprocating follower with the following data: **(5)**

Minimum radius of cam = 25 mm

Lift = 30 mm

Roller diameter = 20 mm

The cam lifts the follower for 120^0 With Simple Harmonic Motion followed by a dwell period of 30^0. Then the follower lowers down during 150^0 of the cam rotation with uniform acceleration and retardation followed by a dwell period. The cam rotates in clockwise direction.

5B. A multi-disc clutch has 4 discs on the driving shaft and 3 on the driven shaft. The outside diameter of the contact surfaces is 300 mm and inside diameter is 150 mm. Assuming uniform wear and coefficient of friction as 0.3, find the maximum axial intensity of pressure between the discs for transmitting 50 kW at 1800 rpm. **(3)**

5C. With neat sketches explain any two types of kinematic pairs based on the nature of mechanical constraints. **(2)**