USN

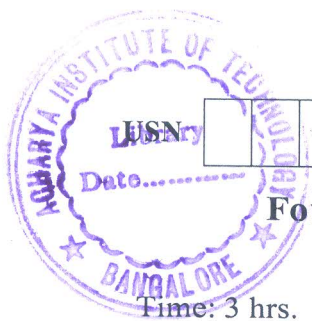# Fourth Semester B.E. Degree Examination, Aug./Sept.2020
Kinematics of Machines

Time: 3 hrs.   Max. Marks: 80

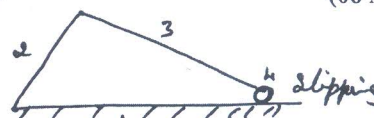*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Difference between: (i) Machine and Mechanism   (ii) Machine and Structure **(06 Marks)**
   b. Explain with neat sketch of Whitworth quick return motion mechanism. **(10 Marks)**

OR

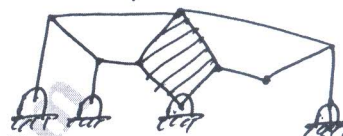2 a. Determine the following: **(06 Marks)**
      (i) Mobility of the given mechanism in Fig.Q2(a)(i)

      Fig.Q2(a)(i)

      (ii) DOF of the given linkage in Fig.Q2(a)(ii).

      Fig.Q2(a)(ii)

   b. Explain DOF, mobility of mechanism and Grubler's criterion for determining DOF for mechanism. **(06 Marks)**
   c. Explain Ratchet and Pawl mechanism with neat sketch. **(04 Marks)**

Module-2

3 The Fig.Q3 shows a four bar mechanism crank O_2A rotates at 200 rpm and an angular acceleration of 150 rad/sec^2 at the instant when the crank makes an angle of 45° to the horizontal. Find the acceleration of point B and C, and angular velocities and angular acceleration of link 3 and 4.
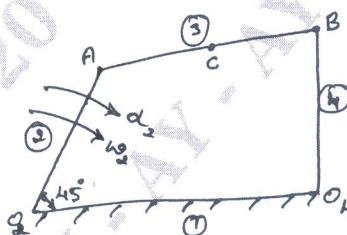
Fig.Q3 **(16 Marks)**

OR

4 a. State and prove Arnold-Kennedy's theorem. **(06 Marks)**
   b. For the 4 bar mechanism shown in Fig.Q4(b). Determine the angular velocity of link AB and the absolute velocity of point 'B' by instantaneous centre method. Also locate all the centres.
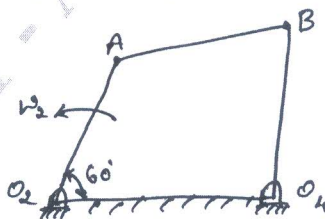
$O_2A = 50$ mm
$AB = 66$ mm
$BO_4 = 56$ mm
$O_2O_4 = 100$ mm
$\omega_2 = 10.5$ rad/sec

Fig.Q4(a) **(10 Marks)**

Module-3

5   If the crank and connecting rod are 150 mm and 600 mm long respectively and the crank rotates at a uniform speed of 100 rpm clockwise, determine:
- (i) Angular velocity and angular acceleration of connecting rod
- (ii) Velocity and acceleration of piston by using Raven's approach. The angle which the crank makes with the inner dead centre is 30°. **(16 Marks)**

OR

6   Determine the velocity and acceleration of the piston by Kelvin's construction of the following specifications. Stroke = 300 mm, ratio of length of connecting rod to crank length = 4, speed of the engine = 300 rpm, position of crank = 45°with IDC. **(16 Marks)**

Module-4

7 a. Obtain an equation for arc of contact of spur gear with neat sketch. **(06 Marks)**
    b. Two gear wheels of module pitch 4.5 mm have 24 and 33 teeth respectively. Pressure angle = 20°. Each wheel has a standard addendum of one module. Find :
- (i) Length of arc of contact
- (ii) Maximum velocity of sliding if the speed of smaller wheel is 120 rpm. **(10 Marks)**

OR

8 a. Sketch and explain an automobile differential. **(06 Marks)**
    b. In an epicyclic gear train of sun and planet type, the pitch circle diameter of the annular wheel A is 425 mm and module is 5mm. When the annular wheel is stationary, the spider which carries 3 planet gears P of equal size has to make one revolution for every 6 revolutions of the driving spindle carrying sun wheel S. Determine the number of teeth on all the wheels. **(10 Marks)**

Module-5

9 a. Sketch and explain the following:
- (i) Disc cam with translating follower
- (ii) Wedge cam with translating follower **(04 Marks)**
    b. The exhaust valve of a diesel engine has a lift of 62.8 mm. It is operated by a cam to give cycloidal motion during opening and closing periods each of which corresponds to 120° of cam rotation. The follower is provided with a roller of 20 mm diameter and its line of stroke is radial, minimum radius of the cam is 25 mm, draw the profile of cam. Also determine the maximum velocity and acceleration of the follower during outward and inward stroke, if the speed of the cam is 300 rpm clockwise. **(12 Marks)**

OR

10 The following data relate to a cam operating an oscillating roller follower:
Minimum radius of cam = 44 mm
Diameter of roller = 14 mm
Length of the follower arm = 40 mm
Distance of fulcrum centre from cam centre = 50 mm
Angle of ascent = 75°
Angle of descent = 105°
Angle of dwell for follower in the highest position = 60°
Angle of oscillating of follower = 28°
Draw the profile of the cam if the ascent and descent both take place with SHM. **(16 Marks)**

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