Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2015

Subject Code: 2142504 **Date:30/05/2015**
Subject Name: Theory of Machines
Time: 10:30am-1.00pm **Total Marks: 70**
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** In a crank and slotted lever mechanism shown in Fig 1, the distance between fixed centres O and A is 250 mm. Length of links are as follows: OP = 100 mm, AR = 400 mm, RS = 150 mm and AOP = 120°. Uniform speed of crank OP is 60 rpm clockwise. Line of stroke of the ram is 450 mm above A and perpendicular to OA. Calculate the velocity of the ram S. **07**

(b) For the figure and data given in Q.1 (a) determine acceleration of ram S. **07**

Q.2 **(a)** A simple band brake is fitted on a crane having barrel diameter of 0.5 m. The band embrace $3/4^{th}$ of the circumference of the brake drum of diameter 0.7 m. The tight end of the band is attached to the fulcrum of the brake-lever while the slack end of the band is attached to a pin which is 0.1 m away from the fulcrum. Calculate the braking torque acting on the drum shaft if the operating force of 392.4 N is acting on the lever at a distance of 0.65 m from the fulcrum. The coefficient of friction is 0.3. Instead of attaching the tight end to of the band to the fulcrum of the lever, if it is attached to a pin 20 mm away from the fulcrum of the lever and on the opposite side of the pin to which the slack end of the band is attached, what will be the increase of braking torque acting on the drum shaft? Assume same angle of wrap for this case also. **07**

(b) Explain difference between machine and a mechanism. Define following terms: (i) Transmission Angles (ii) Degrees of Freedom (iii) Inversion of a mechanism **07**

OR

(b) In the toggle mechanism shown in Fig 2, the slider D is constrained to move in a horizontal path the crank OA is rotating in CCW direction at a speed of 180 rpm the dimensions of various links are as follows: OA = 180 mm, CB = 240 mm, AB = 360 mm and BD = 540 mm
Find: (i) Velocity of slider, (ii) Angular velocity of links AB, CB and BD using method of Instantaneous centres. **07**

Q.3 **(a)** Derive the equation of angular velocities of shafts connected by a Hooke's joint. **07**

(b) Explain undercutting of the cam. Enlist 4 different types of follower motions stating a typical application of each. **07**

OR

Q.3 **(a)** Enlist various straight line mechanisms and prove that Peaucellier mechanism is a straight line mechanism. **07**

(b) A cam with a minimum radius of 25 mm is to be designed for a knife-edge follower. Information available is as follows: (a) Rise of the follower through 35 mm during 60° of cam rotation, (b) Dwell for next 40° of the cam rotation (c) Descending of the follower during the next 90° of cam rotation (d) Dwell during rest of the cam rotation. Draw the profile of the dam if the ascending and descending of the cam is with simple harmonic motion and the line of stroke of the follower is offset by 10 mm from the axis of the cam shaft. **07**

Q.4 **(a)** A single plate friction clutch, with both sides of the plate being effective, is used to transmit power of an engine at 2400 rpm. If has outer and inner radii of 45 mm and 35 mm respectively. The pressure is applied axially by means of spring and has maximum intensity of 78.5 kPa. Determine: total axial force applied by springs and power transmitted. Assume coefficient of friction as 0.3. **06**

(b) Derive the equation of belt velocity for maximum power transmission using a belt drive. **08**

OR

Q.4 **(a)** The arm of an epi-cyclic gear train shown in Fig 3, rotates at 100 rpm in CCW direction. The arm carries two wheels A and B with 36 and 45 teeth respectively. The wheel A is fixed and arm rotates about centre of A. Find the speed and direction of rotation of wheel B. What will be the speed and direction of rotation of wheel B, if wheel A rotates at 200 rpm in CW direction? **06**

(b) Design a 4-bar mechanism to generate function $y = \log_{10}(x)$ in interval $1 \leq x \leq 2$. Use 3 precision points. Range of input angle = 90° (CCW) whereas range of output angle is 60° (CCW). Starting values of input and output angles may be considered as 60°. Take length of the fixed link as 40 mm. **08**

Q.5 **(a)** Enlist and explain methods for reducing or eliminating interference in mating gears. Also clearly state disadvantage of each. **07**

(b) Describe a step by step procedure for the synthesis of slider crank mechanism using 3 precision points. **07**

OR

Q.5 **(a)** A 6 mm module, 24-tooth pinion is to drive a 36-tooth gear. The gears are cut on the 20° full-depth involute system. Find and tabulate the addendum, dedendum, clearance, circular pitch, base pitch, tooth thickness, base circle radii, length of paths of approach and recess, and contact ratio. **08**

(b) Explain following terms in context to kinematic synthesis: **06**

(1) Function Generation (2) Structural Error (3) Precision points

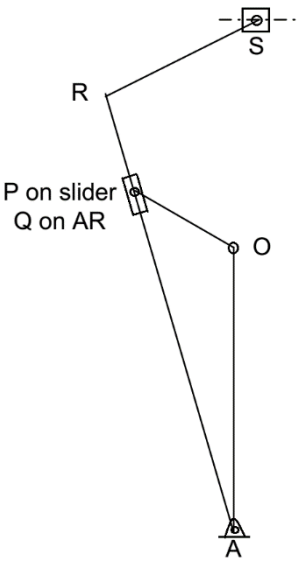

Fig. 1 (Q.1 (a))

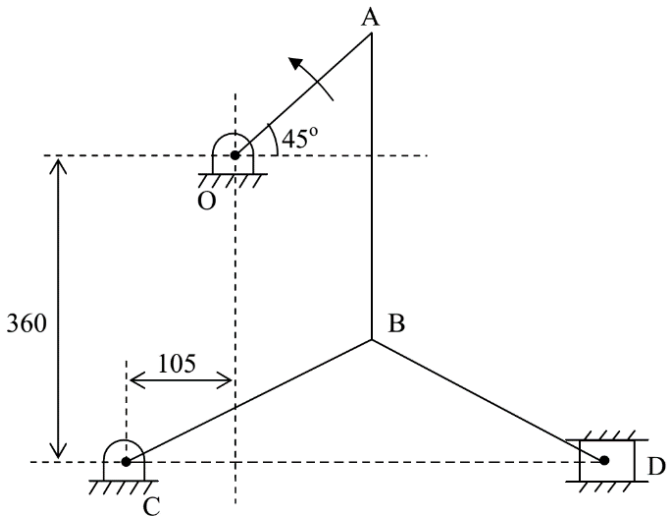

Fig. 2 (Q.2 (b))

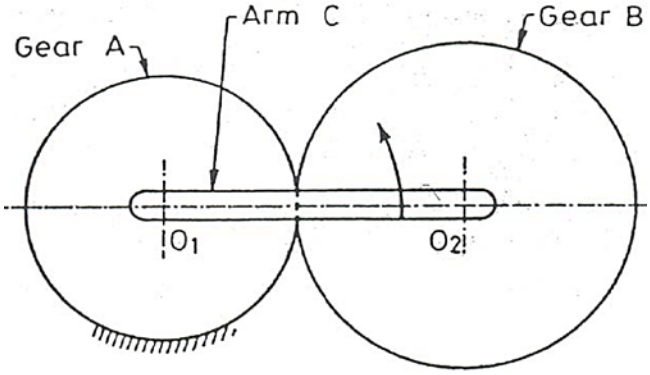

Fig 3 (Q.4 (a))

Note: Figures are not to the scale and dimensions are in mm.

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