

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER- III (New) EXAMINATION – WINTER 2019

Subject Code: 3131906

Date: 3/12/2019

Subject Name: Kinematics and Theory of Machine

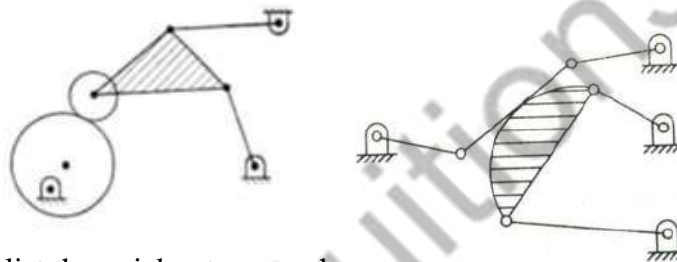
Time: 02:30 PM TO 05:00 PM

Total Marks: 70

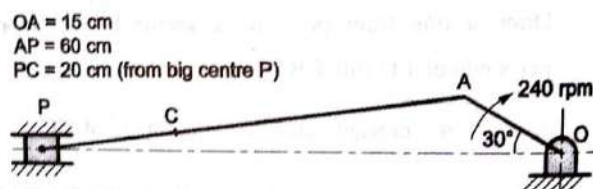
Instructions:

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

- | | Marks |
|--------------------------------------------------------------------------------------------------------------------------|--------------|
| Q.1 (a) Define the following terms. | 03 |
| 1. Higher pair | |
| 2. Completely Constrained motion | |
| 3. Structure | |
| (b) Apply Kutzbach’s criterion to find degree of freedom of the following mechanisms and also predict the motion. | 04 |

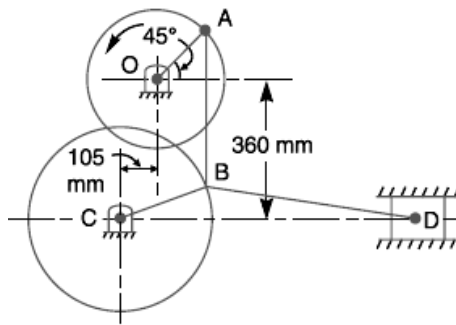


- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| (c) Enlist the quick return mechanisms and describe working of any one of them with neat sketch. | 07 |
| Q.2 (a) Explain types of Instantaneous centers of mechanism. | 03 |
| (b) Prove that if three links move relatively to each other they have three instantaneous centers which must lie on a straight line. | 04 |
| (c) Following data related to reciprocating steam engine as shown in fig. When the crank has turned 30° from inner dead centre. Find: | 07 |
| (i) Acceleration of piston | |
| (ii) Acceleration of C point on connecting rod. | |



OR

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| (c) In the toggle mechanism, as shown in Fig., the slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter-clockwise direction at a speed of 180 r.p.m. The dimensions of various links are as follows : $OA = 180 \text{ mm}$; $CB = 240 \text{ mm}$; $AB = 360 \text{ mm}$; and $BD = 540 \text{ mm}$. For the given configuration, find : 1. Velocity of slider D, 2. Angular velocity of links AB, CB and BD | 07 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|



- Q.3** (a) Explain the phenomena of slip and creep in a belt drive. **03**
 (b) Construct two position synthesis of single slider crank mechanism by relative pole method. **04**
 (c) A four bar mechanism is to be designed, by using three precision points, to generate the function $y = x^{1.5}$, for the range $1 \leq x \leq 4$. Assuming 30° starting position and 120° finishing position for the input link and 90° starting position and 180° finishing position for the output link, find the values of x , y , θ and ϕ corresponding to the three precision points. **07**

OR

- Q.3** (a) List and describe the three phases of synthesis. **03**
 (b) Derive the empirical relation for the ratio of driving tensions for flat belt drive. **04**
 (c) A shaft rotating at 200 r.p.m. drives another shaft at 300 r.p.m. and transmits 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4m. The smaller pulley is 0.5 m in diameter. Calculate the stress in the belt, if it is an open belt drive, Take $\mu = 0.3$. **07**

- Q.4** (a) Define the following terms: **03**
 (1) Dry friction
 (2) Film friction
 (3) Limiting angle of friction
 (b) A vehicle moving on a rough plane inclined at 10° with the horizontal at a speed of 36 km/h has a wheel base 1.8 metres. The centre of gravity of the vehicle is 0.8 metre from the rear wheels and 0.9 metre above the inclined plane. Find the distance travelled by the vehicle before coming to rest and the time taken to do so when The vehicle moves up the plane. The brakes are applied to all the four wheels and the coefficient of friction is 0.5. **04**
 (c) Construct a cam, with a minimum radius of 30 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 : **07**
 1. To raise the valve through 50 mm during 120° rotation of the cam ;
 2. To keep the valve fully raised through next 30° ;
 3. To lower the valve during next 60° ; and
 4. 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.

OR

- Q.4 (a)** Explain with reason the case in which the shoe of the single shoe brake will be pivoted. **03**
- (b)** The inner and outer radii of a single plate clutch are 40 mm and 80 mm respectively. Determine the maximum, minimum and the average pressure when the axial force is 3 kN. **04**
- (c)** Construct a cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to give a knife edge follower the motion as described below : **07**
1. To move outwards through 40 mm during 100° rotation of the cam ;
 2. To dwell for next 80° ;
 3. To return to its starting position during next 90° , and
 4. To dwell for the rest period of a revolution i.e. 90° .
- Draw the profile of the cam when the line of stroke of the follower is off-set by 15 mm. The displacement of the follower is to take place with uniform acceleration and uniform retardation.
- Q.5 (a)** Draw a neat sketch of single plate clutch and also label each component. **03**
- (b)** State and derive the law of gearing. **04**
- (c)** Two 20° involute spur gears have a module of 10 mm. The addendum is one module. The larger gear has 50 teeth and the pinion has 13 teeth. Does interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference? **07**

OR

- Q.5 (a)** Define the following terms: **03**
- (1) Module of gear
 - (2) Backlash
 - (3) Self locking brake
- (b)** Make a comparison of cycloidal and involute tooth form. **04**
- (c)** An epicyclic gear consists of three gears A, B and C as shown in Fig. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 r.p.m.. If the gear A is fixed, determine the speed of gears B and C. **07**

