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18ME44

**Fourth Semester B.E. Degree Examination, July/August 2022**

**Kinematics of Machines**

Time: 3 hrs.

Max. Marks: 100

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

**Module-1**

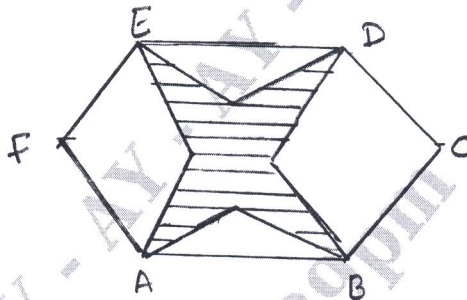
1 a. Define the following :

- i) Kinematic chain.
- ii) Structure.
- iii) Machine.
- iv) Mechanism.

(08 Marks)

b. Find the degrees of freedom for the following mechanism.

(04 Marks)



c. What is Inversion? Explain any one Inversion of double slider crank mechanism with the help of a neat sketch. (08 Marks)

**OR**

2 a. Explain the construction and working of Peaucillieri Mechanism with a neat sketch. Prove that it generates an exact straight line. (08 Marks)

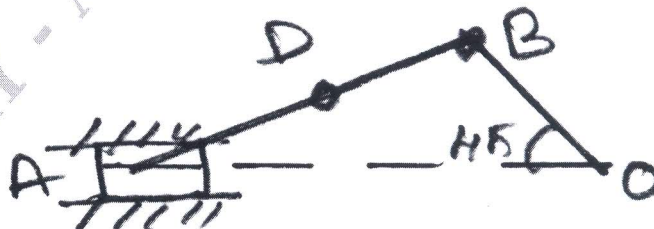
b. What are the field applications and advantages of Quick return motion mechanism? Explain the crank and slotted lever mechanism using a neat sketch. (12 Marks)

**Module-2**

3 The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 rpm. The crank is 150mm and connecting rod is 600mm. Determine

- i) Linear velocity and acceleration of the midpoint of the connecting rod and
- ii) Angular velocity and angular acceleration of the connecting rod, at a crank angle of  $45^\circ$  from the Inner dead centre position. (20 Marks)

Fig. Q3

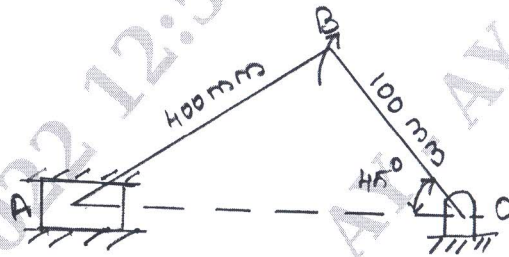


**OR**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- 4 a. State and prove Arnold Kennedy theorem. (06 Marks)  
 b. Locate all the Instantaneous centres of the slider crank mechanism as shown in Fig. Q4(b). The lengths of crank OB and connecting rod AB are 100mm and 400mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s. Find  
 i) Velocity of the slider A      ii) Angular velocity of the connecting rod AB. (14 Marks)

Fig. Q4(b)

**Module-3**

- 5 a. Derive analytical expressions for the determination of velocity and acceleration of Piston of a reciprocating engine. (12 Marks)  
 b. If the crank and connecting rod are 150mm and 600mm long respectively and the crank rotates at a constant speed of 100 rpm, determine the velocity and acceleration of Piston. The angle which the crank makes with the Inner dead centre is  $30^\circ$ . (08 Marks)

**OR**

- 6 a. Derive Freudensteins equation for slider bar Mechanism. (10 Marks)  
 b. Design a four bar mechanism to co-ordinate three positions of the Input and Output links as follows :

$\theta_1 = 20^\circ$	$\phi_1 = 35^\circ$
$\theta_2 = 35^\circ$	$\phi_2 = 45^\circ$
$\theta_3 = 50^\circ$	$\phi_3 = 60^\circ$

Using Freudenstein's equation for four bar mechanism.

(10 Marks)

**Module-4**

- 7 a. State the different types of Cam's and follower and explain. (04 Marks)  
 b. A cam, with a minimum radius of 25mm 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.  
 i) To raise the valve through 50mm during  $120^\circ$  rotation of the cam.  
 ii) To keep the valve fully raised through next  $30^\circ$ .  
 iii) To lower the valve during next  $60^\circ$  and  
 iv) To keep the valve closed during rest of the revolution is  $150^\circ$ .  
 The diameter of the roller is 20mm and the diameter of the cam shaft is 25mm. Draw the profile of a cam when the line of stroke is offset 15mm from the axis of the cam shaft. The displacement of the valve, while being raised and lowered, is to take place with SHM. (16 Marks)

**OR**

- 8 a. Define the following terms related to cam :  
 i) Base circle.  
 ii) Pressure angle.  
 iii) Cam profile.  
 iv) Lift.

(04 Marks)

- b. Design a cam for operating the exhaust valve of an oil engine. It is required to give equal uniform acceleration and retardation during opening and closing of the valve each of which corresponds to  $60^\circ$  of cam rotation. The valve must remain in the fully open position for  $20^\circ$  of cam rotation.

The lift of the valve is 37.5mm and the least radius of the cam is 40mm. The follower is provided with a roller of radius 20mm and its line of stroke passes through the axis of the cam. (16 Marks)

**Module-5**

- 9 a. Derive the expression for length of path of contact and arc of contact for a pair of involute gear's in contact. (08 Marks)
- b. Two gear wheel mesh externally and are to give a velocity ratio of 3. The teeth are of involute form of module 6mm and standard addendum of one module. Pressure angle =  $18^\circ$ , Pinion rotates at 90 rpm.  
Find i) Number of teeth on each wheel so that interference is just avoided.  
ii) Length of path of contact      iii) Length of arc of contact  
iv) Maximum velocity of sliding between teeth      v) Number of pairs of teeth in contact. (12 Marks)

**OR**

- 10 a. Explain with neat sketch : i) Simple gear Train      ii) Compound gear Train  
iii) Epicyclic gear Train. (06 Marks)
- b. An epicyclic gear train consists of sun wheel (S), a stationary internal gear (E) and three identical planet wheels (P) carried on a star shaped planet carrier (C). The size of different toothed wheels are such that the planet carrier 'C' rotates at  $1/5$  of the speed of the sun wheel. The minimum number of teeth on any wheel is 6. The driving torque on the sun wheel is 100 N/m. Determine :  
i) Number of teeth on different wheels of train.  
ii) Torque necessary to keep the internal gear stationary. (14 Marks)

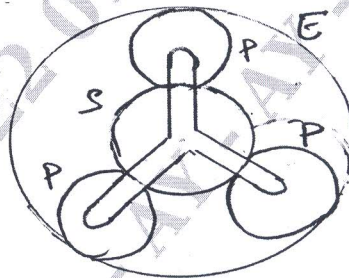


Fig. Q10(b)

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