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Subject Code:- AME0502

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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: V - CARRY OVER THEORY EXAMINATION - APRIL 2023

Subject: Theory of Machines

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C.** It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION A

20

1. Attempt all parts:-

- 1-a. In a kinematic chain, a quaternary joint is equivalent to (CO1) 1
- (a) One binary joint
- (b) Two binary joint
- (c) Three binary joint
- (d) Four binary joint
- 1-b. The number degrees of freedom of a planar linkage with 4 links and 4 simple revolute joints are (CO1) 1
- (a) 1
- (b) 2
- (c) 3
- (d) 4
- 1-c. A radial cam is one (CO2) 1
- (a) that reciprocates in the guides
- (b) in which the follower translates/reciprocate along an axis passing through

the cam centre of rotation.

(c) in which axis of follower and cam are perpendicular to each other

(d) none of the above

1-d. Consider the following statements Cam followers are generally classified according to 1

1. The nature of its motion

2. The nature of its surface in contact with the cam

3. The speed of the cam

Which of the statements given above are correct? (CO2)

(a) 1, 2 and 3

(b) Only 1 and 2

(c) Only 2 and 3

(d) Only 1 and 3

1-e. The resultant force is equal to the _____ of all the forces. (CO3) 1

(a) algebraic Sum

(b) Product

(c) Substraction

(d) Division

1-f. Crank effort is the product of crank pin radius and _____ (CO3) 1

(a) Thrust on sides

(b) Crankpin effort

(c) Force acting along connecting rod

(d) Piston effort

1-g. The mass used to balance the mass defect is known as _____ (CO4) 1

(a) Balancing mass

(b) Defect mass

(c) Replacement mass

(d) Fixing mass

1-h. A single or uncoupled locomotive is one, in which the effort is transmitted to (CO4) 1

(a) Both the pair of wheels

(b) Alternatively, between the wheels

(c) One pair of wheels

(d) Neither of the wheels

- 1-i. Axis of rotation of wheel in gyroscope is called _____ (CO5) 1
- (a) Spin axis
 - (b) Vertical axis
 - (c) Horizontal axis
 - (d) Angular axis
- 1-j. Which of the following factor is not responsible for the stability of a 4 wheel vehicle while negotiating a turn? (CO5) 1
- (a) Pitching
 - (b) Reaction due to weight of Vehicle
 - (c) Effect of Gyroscopic couple due to Wheel
 - (d) Effect of Gyroscopic Couple due to Engine

2. Attempt all parts:-

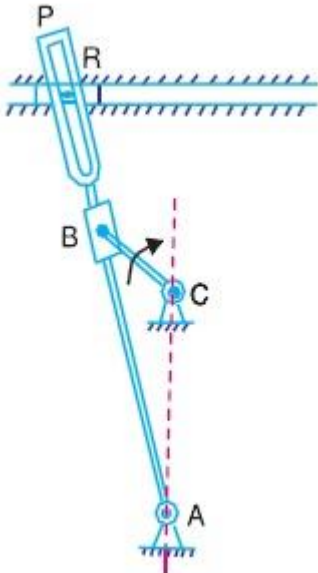
- 2.a. What are the components of acceleration? (CO1) 2
- 2.b. Differentiate between radial follower and radial cam. (CO2) 2
- 2.c. What is the function of flywheel. (CO3) 2
- 2.d. What is meant by term 'Sensitivity of governor? (CO4) 2
- 2.e. Name the different axis associated with gyroscope. (CO5) 2

SECTION B

30

3. Answer any five of the following:-

- 3-a. Explain working and draw the kinematic link diagram of crank & slotted lever QRMM, also deduct an expression for its stroke length. (CO1) 6
- 3-b. Figure shows the layout of QRMM of the oscillating link type. The driving crank BC is 30 mm long and the time ratio of the working stroke to the return stroke is to be 1.7. If the length of the working stroke of R is 120 mm, determine the dimensions of AC and AP. (CO1) 6



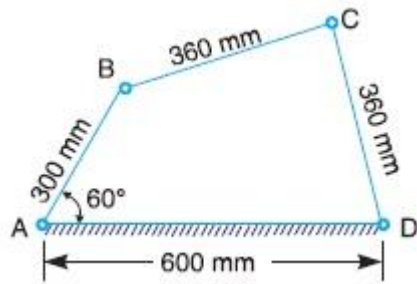
- 3-c. Derive an expression for minimum number of teeth required on a pinion in order to avoid interference. (CO2) 6
- 3-d. Derive an expression for the length of the path of contact in a pair of meshed spur gears. (CO2) 6
- 3.e. The crank and connecting rod of a steam engine are 0.3 m and 1.5 m in length. The crank rotates at 180 rpm. clockwise. Determine the velocity and acceleration of the piston when the crank is at 40 degrees from the inner dead center position. Also determine the position of the crank for zero acceleration of the piston. (CO3) 6
- 3.f. A loaded Porter governor has four links each 250 mm long, two revolving weight each of 30 N and a central dead weight of 200 N. All the links are attached to respective sleeves at radial distances of 40 mm from the axis of rotation. The masses revolve at a distance of 150 mm at a minimum speed and a radius of 200 mm at maximum speed. Determine the range of speed. (CO4) 6
- 3.g. A uniform disc of diameter 300 mm and of mass 5 kg is mounted on one end of an arm of length 600 mm. The other end of the arm is free to rotate in a universal bearing. If the disc rotates about the arm with a speed of 300 rpm clockwise, looking from the front, with what speed will it process about the vertical axis? (CO5) 6

SECTION C

50

4. Answer any one of the following:-

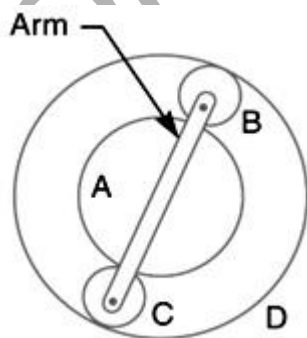
- 4-a. In a pin jointed four bar mechanism, as shown in figure, $AB = 300$ mm, $BC = CD = 360$ mm, and $AD = 600$ mm. The angle $BAD = 60^\circ$. The crank AB rotates uniformly at 100 rpm. Locate all the instantaneous centers and find the angular velocity of the link BC . (CO1) 10



- 4-b. What do you understand by Coriolis component of acceleration? Under what circumstances, is it produced? Show that magnitude of Coriolis component of acceleration is $2v\omega$, where v is velocity of slider and ω is angular velocity of link in which slider is sliding. How is the sense and direction of this acceleration determined? (CO1) 10

5. Answer any one of the following:-

- 5-a. A cam is to give the following motion to a knife-edged follower: 10
1. Outstroke during 60° of cam rotation;
 2. Dwell for the next 30° of cam rotation;
 3. Return stroke during next 60° of cam rotation, and
 4. Dwell for the remaining 210° of cam rotation.
- The stroke of the follower is 40 mm and the minimum radius of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Draw the profile of the cam when the axis of the follower passes through the axis of the cam shaft. (CO2)
- 5-b. An epicyclic train of gears is arranged as shown in figure. How many revolutions does the arm, to which the pinions B and C are attached, make: 10
1. when A makes one revolution clockwise and D makes half a revolution anticlockwise, and
 2. when A makes one revolution clockwise and D is stationary? The number of teeth on the gears A and D are 40 and 90 respectively. (CO2)



6. Answer any one of the following:-

- 6-a. A vertical double acting steam engine has a cylinder 300 mm diameter and 450 mm stroke and runs at 200 rpm. The reciprocating parts have a mass of 225 kg 10

and the piston rod is 50 mm diameter. The connecting rod is 1.2 m long. When the crank has turned through 125° from the top dead center, the steam pressure above the piston is 30 kN/m^2 and below the piston is 1.5 kN/m^2 . Calculate the effective turning moment on the crank shaft. (CO3)

- 6-b. The turning moment diagram for a petrol engine is drawn to the following scales: Turning moment, $1 \text{ mm} = 5 \text{ N-m}$; crank angle, $1 \text{ mm} = 1^\circ$. The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line taken in order are 295, 685, 40, 340, 960 and 270 mm^2 . The rotating parts are equivalent to a mass of 36 kg at a radius of gyration of 150 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1800 rpm. (CO3) 10

7. Answer any one of the following:-

- 7-a. The following data refer to two-cylinder locomotive with cranks at 90° : Reciprocating mass per cylinder = 300 kg; Crank radius = 0.3 m; Driving wheel diameter = 1.8 m; Distance between cylinder centre lines = 0.65 m; Distance between the driving wheel central planes = 1.55 m. Determine: 1. the fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 km/h.; 2. the variation in tractive effort; and 3. the maximum swaying couple. (CO4) 10
- 7-b. A Porter governor has four equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed, Find the range of speed, sleeve lift, governor effort and power of governor in the following cases; 10
- When the friction at the sleeve is neglected, and
 - When the friction at the sleeve is equivalent to 10 N. (CO4)

8. Answer any one of the following:-

- 8-a. An Aeroplane makes a complete half circle of 50 meters radius, towards left, when flying at 200 km per hr. The rotary engine and the propeller of the plane has a mass of 400 kg and a radius of gyration of 0.3 m. The engine rotates at 2400 rpm clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. (CO5) 10
- 8-b. In a belt transmission dynamometer, the diameters of the driving and driven pulleys are 0.36 m and 0.8 m respectively. The power transmitted from the driving to the driven shaft is 20 kW. The speed of the driving shaft is 500 rpm. If the distance between the center of the driving pulley and the dead mass is 1.2 10

m and distance between intermediate pulley to fulcrum of lever is 400 mm, determine the weight on the lever. (CO5)

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