Printed Page:-   Subject Code:- AME0502

Roll. No:

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.

<div align="center">SECTION A   20</div>

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.   A point on a connecting link of a double slider crank mechanism traces a (CO1)   1

                (a) Straight line path

                (b) Hyperbolic path

                (c) Parabolic path

                (d) Elliptical path

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.   The angle between the direction of the follower motion and a normal to the pitch curve is   1
        called (CO2)

        (a) Pitch angle

        (b) Prime angle

        (c) Base angle

        (d) Pressure angle

1-e.   Calculate torque acting on the crank, if tangential force acting on the engine is 150 kN and   1
        300 mm is the crank radius. (CO3)

        (a) 65 kN/m

        (b) 25 kN/m

        (c) 45 kN.m

        (d) None of the above

1-f.   Which of the following are functions of flywheel? (CO3)   1

        (a) Increase power capacity of the electric motor

        (b) Store and release energy during work cycle

        (c) Increase amplitude of speed fluctuations

        (d) All of the listed

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 governor is said to be isochronous when the equilibrium speed for all radii or rotation the   1
        balls within the working range is (CO4)

        (a) Not constant

        (b) Constant

        (c) Varies uniformly

        (d) Uniform acceleration

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. In which of the following dynamometers does the entire energy or power produced by the engine is absorbed by the friction resistances of the brake? (CO5)　　1

(a) Torsional dynamometer

(b) Prony brake dynamometer

(c) Epicyclic train dynamometer

(d) Belt transmission dynamometer

2. Attempt all parts:-

2.a. Define the following: Kinematic links, Kinematic chain. (CO1)　　2

2.b. Differentiate between radial follower and radial cam. (CO2)　　2

2.c. Define the term 'Coefficient of fluctuation of speed'.(CO3)　　2

2.d. What is the function of governor? (CO4)　　2

2.e. What is gyroscopic effect? (CO5)　　2

SECTION B　　30

3. Answer any <u>five</u> of the following:-

3-a. What are the inversions of four bar chain and also explain the double crank, crank rocker and double rocker mechanism with their kinematic link diagram. (CO1)　　6

3-b. Explain the working of Whitworth's QRMM with kinematic link diagram. Also explain why it is a type of quick return motion mechanism? (CO1)　　6

3-c. What is the difference between a simple and reverted gear train? Explain with the help of sketches. (CO2)　　6

3-d. In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the center of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of gear B? (CO2)　　6

3.e. Prove that the torque exerted on the crank-shaft, when friction and inertia of moving parts of a reciprocating engine is considered but weight of the connecting rod is neglected, is given by: (CO3)　　6

$$T = F_p \times r \left(\sin\theta + \frac{\sin 2\theta}{2\sqrt{n^2 - \sin^2\theta}} \right)$$

3.f. Four masses m_1, m_2, m_3 and m_4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The　　6

corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. (CO4)

3.g.   Derive an expression for gyroscopic couple when the disc is rotating with angular velocity   6
ω. (CO5)

$$C = I\omega\omega_P$$

SECTION C   50

4. Answer any <u>one</u> of the following:-

4-a.   In a slider crank mechanism, the lengths of the crank and the connecting rod are 200 mm and   10
800 mm respectively. Locate all the I-centers of the mechanism for the position of the crank when it has turned 30° from the inner-dead center. Also, find the velocity of the slider and angular velocity of the connecting rod if the crank rotates at 40 rad/s. (CO1)

4-b.   In a four-bar chain ABCD, AD is the fixed link 12 cm long, crank AB is 3 cm long and   10
rotates uniformly at 100 rpm clockwise while the link CD is 6 cm long and oscillate about D. Link BC is equal to the link AD. Find the angular velocity of link DC when angle BAD is 60°. (CO1)

5. Answer any <u>one</u> of the following:-

5-a.   An epicyclic gear consists of three gears A, B and C as shown in figure. The gear A has 72   10
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 center of A at 18 rpm. If the gear A is fixed, determine the speed of gears B and C.   (CO2)
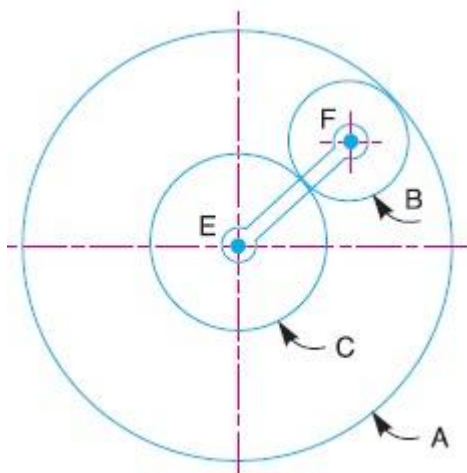
5-b.   A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required   10
to give a knife edge follower the motion as described below:

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. Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 900 rpm. (CO2)

6. Answer any <u>one</u> of the following:-

6-a. Derive an expression for displacement, velocity and acceleration of piston in single slider crank chain. (CO3)   10

6-b. The turning moment diagram for a multi-cylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: + 52, – 124, + 92, – 140, + 85, – 72 and + 107 mm^2, when the engine is running at a speed of 600 rpm. If the total fluctuation of speed is not to exceed ± 1.5% of the mean, find the necessary mass of the flywheel of radius 0.5 m. (CO3)   10

7. Answer any <u>one</u> of the following:-

7-a. A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A, and the relative angular setting of the four masses so that the shaft shall be in complete balance. (CO4)   10

7-b. A Hartnell governor having a central sleeve spring and two right-angled bell crank levers moves between 290 rpm and 310 rpm for a sleeve lift of 15 mm. The sleeve arms and the ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and mass of each ball is 2.5 kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine: 1. Load on the spring at the lowest and the highest equilibrium speeds, and 2. Stiffness of the spring. (CO4)   10

8. Answer any <u>one</u> of the following:-

8-a. In a belt transmission dynamometer, the driving the pulley rotates at 300 rpm. The distance between the center of the driving pulley and the dead mass is 800 mm. The diameter of each of the driving as well as the intermediate pulleys is equal to 360 mm. Find the value of the dead mass required to maintain the lever in a horizontal position when the power transmitted is 3 kW. Also, find its value when the belt just begins to slip on the driving pulley, μ being 0.25 and the maximum tension in the belt 1200 N.(CO5)   10

8-b. The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a   10

speed of 3000 rpm clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship:

1. When the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h.

2. When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees. (CO5)