Total No. of printed pages = 4

ME 181503

04/01/23

Roll No. of candidate

2022

B.Tech. 5th Semester End-Term Examination

ME and IPE

MECHANISMS AND DYNAMICS OF MACHINES

(New Regulation and New Syllabus)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Select the correct answers. $(10 \times 1 = 10)$

   (i) In reciprocating engines, primary forces are

      (a) Completely balanced   (b) Partially balanced

      (c) Cannot be balanced   (d) Balanced by secondary forces

   (ii) The gyroscopic acceleration of a disc is

      (a) $\omega(d\omega/dt)$ (b) $d\omega/dt$

      (c) $r\omega^2$ (d) $r(d\omega/dt)$

   (iii) The purpose of a link is to

      (a) Transmit motion   (b) Guide other links

      (c) Act as a support   (d) All of the above

   (iv) In balancing of reciprocating masses, Hammer Blow is the

      (a) Maximum vertical unbalanced force caused by the balance mass provided

      (b) Maximum horizontal unbalanced force caused by the balance mass provided

      (c) Resultant of the above two

      (d) All of the above

[Turn over

(v)   If the ratio of the length of connecting rod to crank radius increases, then

    (a)   Primary force increases   (b)   Primary force decreases

    (c)   Secondary force increases   (d)   Secondary force decreases

(vi) The axes of spin, precession and gyro couple are contained in

    (a)   One plane

    (b)   Two mutually perpendicular planes

    (c)   Three mutually perpendicular planes

    (d)   Two parallel planes

(vii) An aeroplane takes right turn, propeller rotates cw as viewed from rear, result is

    (a)   Raise tail and lower nose   (b)   Raise nose and lower tail

    (c)   Tilt about spin axis   (d)   No effect

(viii) The direction of Coriolis acceleration is

    (a)   Along the surface of sliding

    (b)   Perpendicular to the surface of sliding along angular speed

    (c)   Perpendicular to the surface of sliding opposite to angular speed

    (d)   Inclined to the surface of sliding based on normal/tangential acceleration

(ix) Gruebler's equation gives

    (a)   Total number of links in a mechanism

    (b)   Number of degrees of freedom in a mechanism

    (c)   Number of lower pairs in a mechanism

    (d)   Number of higher pairs in a mechanism

(x)   In a 4 bar mechanism (L+S) <(P+Q). It will be a rocker-rocker mechanism if

    (a)   The link opposite to the shortest link is fixed

    (b)   The shortest link is fixed

    (c)   The link adjacent to the shortest link is fixed

    (d)   Two links are fixed

2. For the quick return mechanism shown in figure, find the velocity and acceleration of the slider D. AB rotates at 40 rpm. (15)
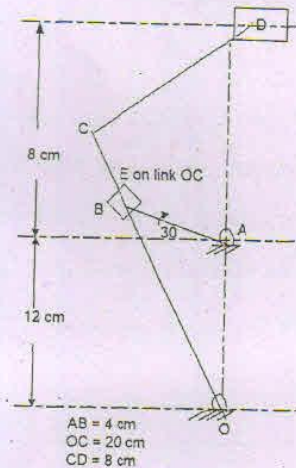
AB = 4 cm
OC = 20 cm
CD = 8 cm

3. (a) Differentiate between kinematic analysis and kinematic synthesis. What is movability?

(b) Design a four bar mechanism to coordinate the input angles as 15°, 30° and 45° and output angles as 30°, 40° and 55°. (5 + 10)

4. (a) Why reciprocating masses are partially balanced?

(b) An inside cylinder locomotive has its cylinder centre lines 0.8 m apart and stroke is 0.6 m. Rotating masses are equal to 150 kg at the crank pin and reciprocating mass per cylinder is 300 kg. Wheel centre lines are 1.8 m apart and cranks are at right angles. Whole of the rotating and 2/3 of the reciprocating masses are to be balanced by balance masses placed at radius 0.5 m. Determine

(i) Magnitude and direction of balancing masses

(ii) Fluctuation of rail pressure under wheel

(iii) Variation of tractive effort

(iv) Swaying couple at crank speed of 300 rpm (3 + 12)

5. (a) Explain the cause of gyroscopic couple and its effect with a diagram with spin, precision and couple planes and axes.

(b) An aeroplane flying at 240 km/hr turns left at a radius of 60 m to complete a quarter circle. The mass of the rotary parts is 450 kg with a radius of gyration of 320 mm. Engine rotates at 2000 rpm CW when viewed from rear. What is gyroscopic couple and its effect on the aeroplane?

In what way the effect changed when engine rotates CW when viewed from front (nose end) and the aeroplane turns right? (3 + 12)

6. (a) Explain the working of a steering gear mechanism in detail with diagram.

(b) How quick return motion is achieved in Whitworth Quick Return mechanism? Explain with diagram. (8 + 7)

7. Answer any three : (3 × 5 = 15)

(a) Significance of Chebyshev's spacing of precision points to minimize errors

(b) Differentiate between binary, ternary and quaternary links with diagrams

(c) Differentiate between primary and secondary imbalance

(d) Gyroscopic couple and its effect on a ship

(e) Balancing of radial engine