



VIT

Vellore Institute of Technology

Final Assessment Test – April 2026

Course: BMEE207L - Kinematics and Dynamics of Machines

Class NBR(s): 2906 / 2907 / 2908 / 2909 / 2911 / 2912 Slot: B1+TB1

Time: Three Hours

Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Examine the kinematic behavior of various planar mechanisms.
CO2	Construct velocity and acceleration diagrams for various planar mechanisms.
CO3	Analyze kinematics of cam and gear-train mechanisms.
CO4	Investigate the dynamic forces acting on planar mechanisms.
CO5	Analyse the balancing of masses and vibrations of mechanical systems.
CO6	Assess the characteristics of governors and gyroscopic effects.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

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PART – A (5 X 12 = 60 Marks)

Answer ALL Questions

- Explain the inversion of crank slider chain with a neat sketch. CO1 BL3
- The turning moment diagram of a four stroke engine may be assumed for the sake of simplicity by four triangles in each stroke. The areas of the these triangles are as follows CO4 BL4

Suction stroke = $5 \times 10^{-5} \text{ m}^2$; Compression stroke = $21 \times 10^{-5} \text{ m}^2$; Expansion stroke = $85 \times 10^{-5} \text{ m}^2$; Exhaust stroke = $8 \times 10^{-5} \text{ m}^2$.

All the areas excepting expansion stroke is negative. Each m^2 of area represents 14 MN – m of work.

Assuming the resisting torque to be constant, determine the moment of inertia of the flywheel to keep the speed between 98 RPM and 102 RPM. Also find the size of a rim type flywheel based on the minimum material criterion, given that density of the flywheel is 8150 kg/m^3 ; the allowable tensile stress of the flywheel material is 7.5 MPa. The rim cross section is rectangular, width of the flywheel rim is 4 times of the thickness.
- A pair of involute spur gears with 16° pressure angle and pitch of module 6 mm is in mesh. The number of teeth on pinion is 16 and rotational speed is 240 rpm. In order that interference is just avoided, when the gear ratio is 1.75, find CO3 BL3
 - The addenda on a pinion and gear wheel
 - The length of path of contact
 - The maximum velocity of sliding of teeth on either side of the pitch point.

4. Design a four-link mechanism when motions of the input and output links are governed by a function $y = x^2$ and x varies from 0 to 2 with an interval of 1. Assume input angle vary from 50° to 150° and output angle varies from 80° to 160° . CO4 BL3
5. The turbine rotor of a ship has a mass of 20 tons and a radius of gyration of 0.75 m. Its speed is 2000 RPM. The ship pitches 6° above and below the horizontal position. One complete oscillation takes 18 seconds, and the motion is simple harmonic. Determine: CO6 BL4
- The maximum couple tending to shear the holding down bolts of the turbine.
 - The maximum angular acceleration of the ship during pitching; and
 - The direction in which the bow will tend to turn while rising, if the rotation of the rotor is clockwise when looking from rear.

PART – B (2 X 20 = 40 Marks)

Answer ALL Questions

6. In the toggle mechanism shown in fig.1. The crank OA rotates at 210 rpm counter clockwise increasing at the rate of 60 rad/s^2 . For the given configuration determine CO2 BL4
- Velocity of the slider D and angular velocity of the link BD
 - Acceleration of the slider D and angular acceleration of the link BD.

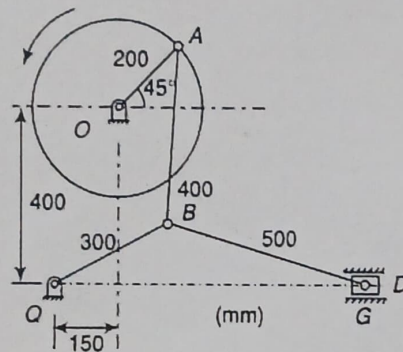


Fig.1.

- 7.a) Four masses, A, B, C and D carried by a rotating shaft at radii 80 mm, 100 mm, 160 mm and 120 mm respectively are completely balanced. Masses B, C and D are 8 kg, 4 kg, and 3 kg respectively. Determine the mass A and the relative angular positions of the four masses if the planes are spaced 500 mm apart. CO5 BL4

OR

- 7.b) Each crank and the connecting rod of a four crank in-line engine are 200 mm and 800mm respectively. The outer cranks are set at 120° to each other and has a reciprocating mass of 200 kg. The spacing between adjacent planes of crank are 400 mm, 600 mm and 500 mm. If the engine is in complete primary balance, determine the reciprocating masses of the inner cranks and their relative angular positions. Also find the secondary unbalanced force if the engine speed is 210 rpm. CO5 BL4

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