# CBCS SCHEME

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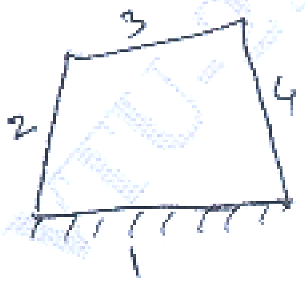
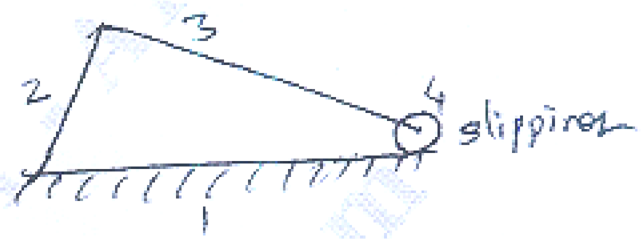
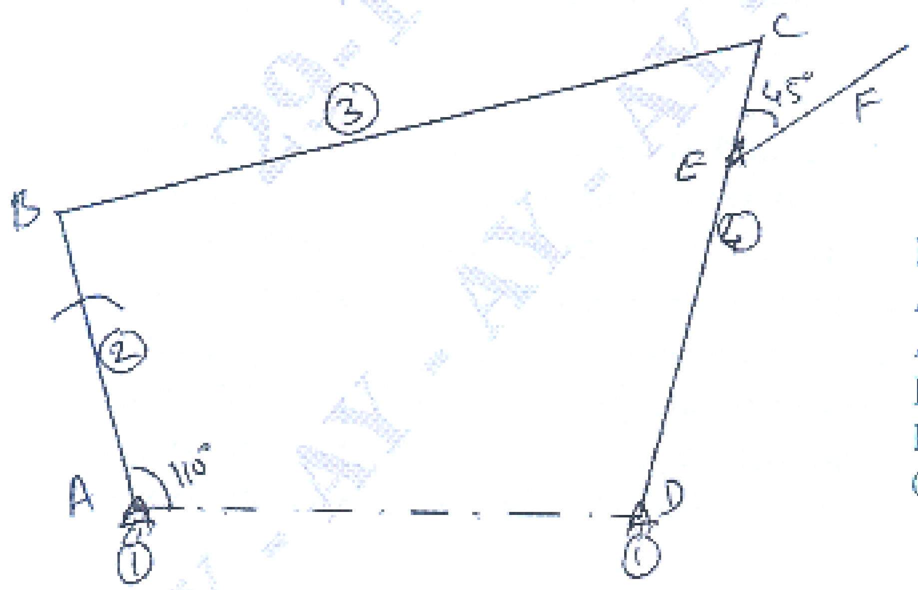
BME503/BMR503

## Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

## Theory of Machines

Time: 3 hrs. Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.*
*2. M : Marks , L: Bloom's level , C: Course outcomes.*

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | Define the following :<br>i) Kinematic pair ii) Mechanism iii) Machine<br>iv) Structure v) Degrees of freedom | 10 | L1 | CO1 |
| | b. | Explain the following with neat sketch :<br>i) Beam Engine ii) Elliptical Trammel | 10 | L2 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Determine the degrees of freedom for the following :<br>i) <br>Fig.Q2(a)(i)<br>ii) <br>Fig.Q2(a)(ii) | 04 | L3 | CO1 |
| | b. | In a slider crank mechanism, the crank OB is 30 mm long and the connecting rod BC is 120 mm long. The crank rotates at a uniform speed of 300 rpm clockwise about centre 'O' for a crank position ∠BOC equal to 60° , draw the configuration and find<br>i) Velocity of piston 'C' and angular velocity of connecting rod BC.<br>ii) Acceleration of piston 'C' and angular acceleration of connecting rod BC. | 16 | L3 | CO2 |
| | | **Module – 2** | | | |
| Q.3 | a. | Discuss the static equilibrium of<br>i) Two forces ii) Three forces iii) Two forces with torque member | 06 | L2 | CO3 |
| | b. | In the Fig.Q3(b), a four-bar mechanism is shown. Calculate the required value of $T_2$ and various forces on links for the equilibrium of the system.<br><br>F = 2000 N<br>AD = 215 mm<br>AB = 200 mm<br>BC = 370 mm<br>DC = 350 mm<br>CE = 100 mm<br>Fig.Q3(b) | 14 | L3 | CO3 |

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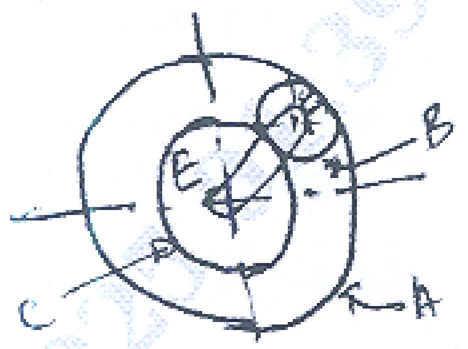
| | | **OR** | | | |
| Q.4 | a. | State and explain D'Alembert's Principle. | 04 | L1 | CO3 |
| | b. | When the crank is 45° from the inner dead centre on the down stroke, the effective steam pressure on the piston of a vertical steam engine is 2.5 bar. The diameter of the cylinder = 0.75 m, Stoke of the piston = 0.5 m and length of connecting rod = 1 m. Determine the torque on the crank shaft, if the engine runs at 350 rpm and the mass of the reciprocating parts is 200 kg. | 16 | L3 | CO3 |
| | | **Module – 3** | | | |
| Q.5 | a. | What is interference and explain the methods to avoid interference. | 06 | L1 | CO1 |
| | b. | Two spur gears have 24 and 30 teeth of module = 10 mm<br>Standard addendum = 1 module, Pressure angle = 20°. Find<br>i) Length of path of contact<br>ii) Length of arc of contact<br>iii) Contact ratio | 14 | L3 | CO1 |
| | | **OR** | | | |
| Q.6 | | An epicyclic gear consists of three gears A, B and C as shown in Fig.Q6. The gear 'A' has 72 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 centre of A at 18 rpm. If the gear 'A' is fixed, determine the speed of gears 'B' and 'C'.<br><br>Fig.Q6 | 20 | L3 | CO1 |
| | | **Module – 4** | | | |
| Q.7 | a. | Explain briefly static and dynamic balancing as applied to revolving masses in different planes. | 04 | L2 | CO4 |
| | b. | A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise as A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 10 mm, find their magnitude and angular positions. | 16 | L4 | CO4 |

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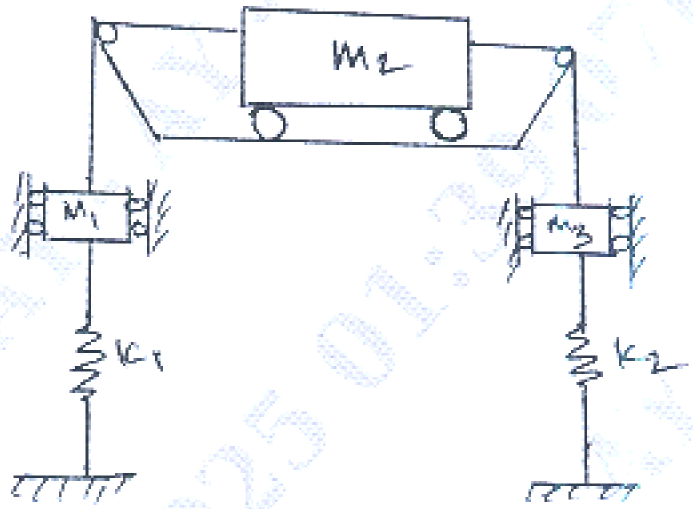
| | | **OR** | | | |
| Q.8 | a. | With usual notations, explain the primary and secondary unbalanced forces of reciprocating masses. | 06 | L2 | CO4 |
| | b. | Explain the following :<br>i) Sensitiveness of the governor   ii) Isochronous governor | 04 | L2 | CO5 |
| | c. | The arms of a porter governor are 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how the speed range is modified. | 10 | L3 | CO5 |
| | | **Module – 5** | | | |
| Q.9 | a. | Define Logarithmic Decrement. Show that logarithmic decrement 'δ' is given by $\frac{2\pi\xi}{\sqrt{1-\xi^2}}$ for underdamped system. | 08 | L2 | CO6 |
| | b. | Determine the natural frequency of the system shown in Fig.Q9(b). Assume that the wires connecting the masses are stiff and in tension.<br><br>Fig.Q9(b) | 12 | L3 | CO6 |
| | | **OR** | | | |
| Q.10 | a. | Determine the natural frequency of a spring mass system where the mass of the spring is also to be taken into account. | 10 | L2 | CO6 |
| | b. | A mass of 100 kg been mounted on a spring dashpot system having spring stiffness of 19600 N/m and damping co-efficient of 100 N-s/m. The mass is acted upon by a harmonic force of 39 N at the undamped natural frequency of the system. Determine<br>i) Amplitude of vibration of the mass<br>ii) Phase difference between the force and displacement<br>iii) Force transmissibility ratio | 10 | L3 | CO6 |

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