CBCS SCHEME

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21ME51

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Theory of Machines

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define Kinematic pair and explain different types of kinematic pairs. **(08 Marks)**

b. In a 4 bar mechanism, the dimensions of links are AB = 50 mm, BC = 66 mm, CD = 56 mm and AD = 100 mm. At the instant when the angle DAB = 60°, the link AB has an angular velocity of 10.5 rad/s in counter clockwise direction. Determine,
(i) Linear velocity at point C. (ii) Velocity of point E on BC, when BE = 40 m,
(iii) Angular velocity of links BC and CD. **(12 Marks)**

OR

2 a. What is Coriolis component of acceleration? Explain with neat sketch. **(08 Marks)**

b. In an IC engine mechanism, crank radius is 50 mm and connecting rod length is 200 mm. The crank rotates at 100 rad/s in clockwise direction. At a particular instant, the crank is at 40° from TDC position. For this position, find the velocity of the piston using complex algebra method. **(12 Marks)**

Module-2

3 a. State the condition of equilibrium of a body subjected to a system of,
(i) 2 force
(ii) 3 force. **(06 Marks)**

b. Link O_4C of a four bar mechanism C shown in Fig.Q3 (b) is subjected to a torque $T_4 = 1$ Nm in counter clockwise direction. The link BC is subjected to a force Q = 45 N downwards. Determine the torque T_2 on link O_2B and the reactions at O_2 and O_4. The lengths of the links are as follows :
$O_2O_4 = 90$ mm, $O_2B = 50$ mm, BC = 55 mm, $O_4C = 30$ mm, BD = BC = 27.5 mm.

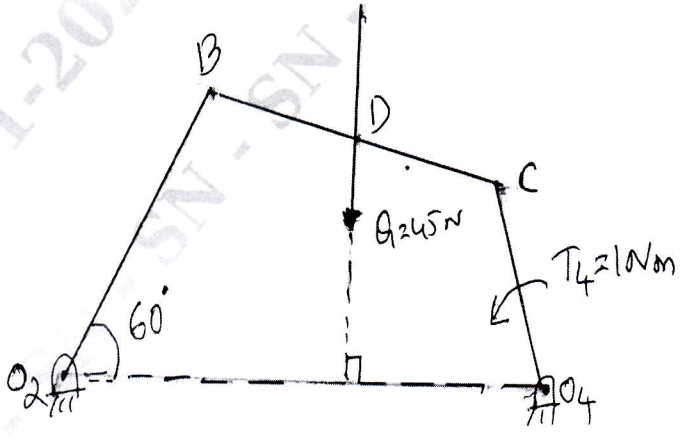

Fig. Q3 (b) **(14 Marks)**

OR

4 a. Explain D'Alembert's principle for dynamic force analysis. **(06 Marks)**

b. The slider crank mechanism of a single cylinder diesel engine is shown in Fig.Q4 (b). A gas force 17800 N acts to the left through piston C. The crank rotates counter clockwise direction at a constant speed of 1800 rpm.
Determine the force F_{14} on the piston for the following details :
$O_2B = 75$ mm, $O_2G_2 = 50$ mm, $BC = 280$ mm, $BG_3 = 125$ mm
$m_2 = 2.25$ kg, $m_3 = 3.65$ kg, $m_4 = 2.75$ kg, $I_2 = 0.0055$ kg.m^2, $I_3 = 0.041$ kg.m^2 **(14 Marks)**

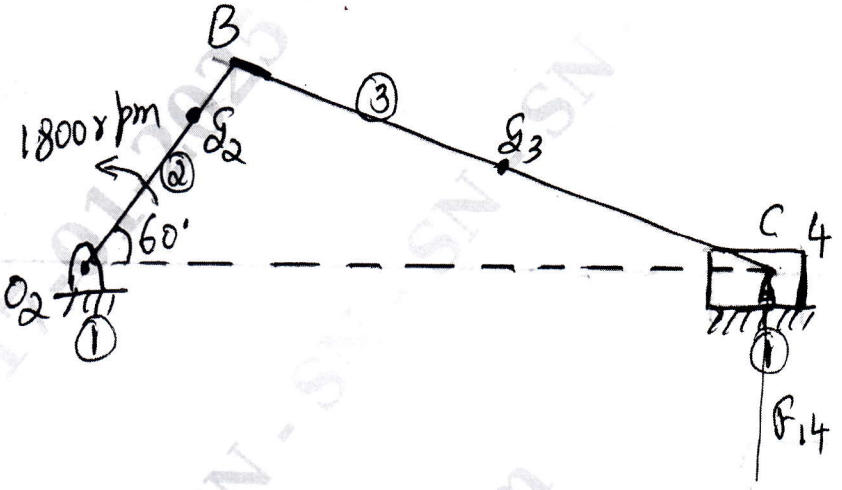

Fig. Q4 (b)

Module-3

5 a. Derive an expression for length of path of contact and length of arc of contact for a pair of involute gears in contact. **(08 Marks)**

b. Two mating gears with module pitch of 6.5 mm have 19 and 47 teeth of 20° pressure angle and 6.5 mm addenda. Determine the number of pairs of teeth in contact and the angle turned through by the larger wheel for one pair of teeth in contact. **(12 Marks)**

OR

6 a. Explain with neat sketch, classification of gear trains. **(08 Marks)**

b. The arm of an epicycle gear train rotates at 100 rpm in anticlockwise direction. The arm carries two wheels A and B having 36 and 45 teeth respectively. The wheel A is fixed and the arm rotates about the centre of wheel A. Find the speed of wheel B. What will be the speed of B, if the wheel A instead of being fixed, makes 200 rpm clockwise. **(12 Marks)**

Module-4

7 a. Explain static and dynamic balancing of rotating masses. **(08 Marks)**

b. Four masses A, B, C and D as shown below are completely balanced.

	A	B	C	D
Mass(kg)	-	30	50	40
Radius (mm)	180	240	120	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°, B and C make angles of 210° and 120° respectively with D is same sense. Find :

(i) The magnitude and the angular position of mass A.

(ii) The position of planes A and D. **(12 Marks)**

OR

8 a. Explain primary and secondary balancing as used for balancing of reciprocating masses. **(08 Marks)**

b. The cranks and connecting rods of a 4 cylinder in-line engine running at 1800 rpm and 60 mm and 240 mm respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 15 kg. Determine unbalanced primary and secondary forces and couples, if any, with reference to central plane of the engine. **(12 Marks)**

Module-5

9 a. Explain the different methods used to get the solution for longitudinal vibration. **(12 Marks)**

b. A vibrating system consists of a mass of 30 kg, a spring of stiffness 20 kN/m and a damper of damping factor 0.25. Calculate :

(i) The critical damping co-efficient.
(ii) The natural frequency of damped vibrations.
(iii) The logarithmic decrement and
(iv) The ratio of two successive amplitudes. **(08 Marks)**

OR

10 a. Derive an expression for magnification factor for a damped forced vibrations. **(12 Marks)**

b. An industrial machine of mass 450 kg is supported on springs with a statistical deflection of 5 mm. If the machine has a rotating unbalance of 0.25 kg m, determine,

(i) The force transmitted to the floor at 1200 rpm.
(ii) The dynamical amplitude at this speed. **(08 Marks)**

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