CBCS SCHEME

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18AE/AS44

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Mechanisms and Machine Theory

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Briefly explain :
i) Kinematic chain
ii) Kinematic pair
iii) Mechanism
iv) Degree of freedom
v) Inversion. **(10 Marks)**

b. Determine the degree of freedom for the following Fig.Q1(b). **(10 Marks)**

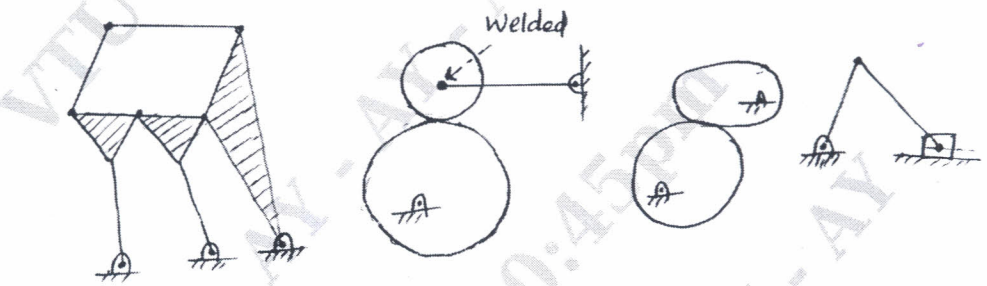

Fig.Q1(b)

OR

2 a. With a neat sketch explain the working of a crank and slotted lever mechanism. Explain its stroke length in terms of crank radius, fixed link length and length of the slotted bar. **(08 Marks)**

b. Derive an expression for necessary condition for exact steering. **(06 Marks)**

c. With a neat sketch briefly explain the working of elliptical trammel. **(06 Marks)**

Module-2

3 An engine mechanism shown in Fig.Q3. The crank CB = 100 mm and the connecting rod BA = 300 mm with centre of gravity G, 100 mm from B. In the position shown, the crank shaft has a speed of 75 rad/s and an angular acceleration of 1200 rad/s^2.
Find : i) Velocity of G and angular velocity of AB
ii) Acceleration of G and angular acceleration of AB. **(20 Marks)**

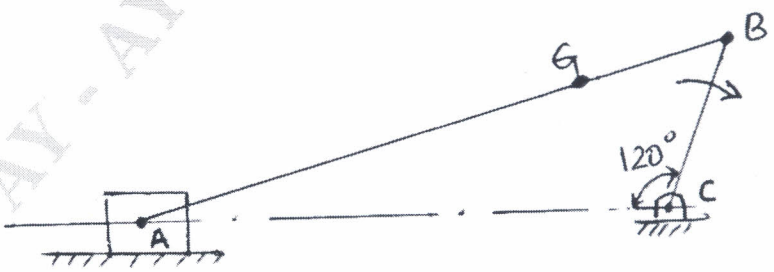

Fig.Q3

OR

4 a. Explain the condition for equilibrium of the following system :
i) Two force member
ii) Three force member
iii) Member with two force and a torque
iv) Four force member. **(08 Marks)**

b. In the Fig.Q4(b) a four bar mechanism is shown. Determine the required value of T_2 and various forces on links for the equilibrium of the system. **(12 Marks)**

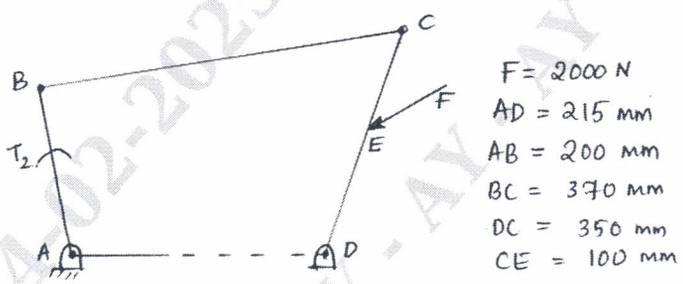

Fig.Q4(b)

Module-3

5 a. State and prove law of gearing. **(08 Marks)**

b. Two spur gears have 24 and 30 teeth of module 10 mm and standard addendum = 1 module, pressure angle = 20°.
Find:
i) Length of path of contact
ii) Arc of contact
iii) Contact ratio. **(08 Marks)**

c. Differentiate between cycloidal teeth and involute teeth. **(04 Marks)**

OR

6 a. What are epicyclic gear trains? State their applications. **(06 Marks)**

b. In an epicyclic gear train, the internal wheels A and B, and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and F gears with B and D. All the wheels have same module and the number of teeth are : $Z_C = 28$, $Z_D = 26$, $Z_E = Z_F = 18$.
i) Sketch the arrangement
ii) Determine the number on teeth on A and B
iii) If the arm G make 100 rpm clockwise and gear A is fixed find the speed of gear B
iv) If the arm G makes 100 rpm clockwise and wheel A makes 10 rpm counter clockwise, find the speed of the wheel B. **(14 Marks)**

Module-4

7 a. What is static and dynamic balancing? Briefly discuss the balancing of a rotating mass, where both the balancing masses are on the same side. **(06 Marks)**

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 radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured form A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are 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 100 mm, find their magnitudes and angular positions. **(14 Marks)**

OR

8 a. Four masses M_1, M_2, M_3 and M_4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 200 mm, 150 mm, 250 mm and 300 mm respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balancing mass required, if the radius of rotation is 200 mm. **(10 Marks)**

b. Briefly explain the balancing of reciprocating masses with an example. **(10 Marks)**

Module-5

9 a. Derive an expression for spring stiffness of a Hartnell governor. **(10 Marks)**

b. In a porter governor, each the four arms is 400 mm long. The upper arms are pivoted on the axis of the sleeve whereas the lower arms are pivoted at a distance 45 mm from the axis of rotation. Each ball has mass of 8 kg and load on the sleeve is 60 kg. Two extreme radii of rotation of the governor balls are 250 mm and 300 mm. Determine the equilibrium speeds by

i) Neglecting the sleeve friction

ii) Considering the friction force at sleeve as 10N. **(10 Marks)**

OR

10 a. Formulate the equation for gyroscopic couple on an rotating disc. **(06 Marks)**

b. Explain the gyroscopic effect on aeroplane for following conditions when viewed from rear i.e tail,

i) Propeller turns clockwise and aeroplane takes left turn

ii) Propeller turn counter clockwise and aeroplaen takes off. **(10 Marks)**

c. An aeroplane makes a complete half circle of 50 m radius towards left when flying at 200 km/hr. The mass of the rotary engine is 400 kg with radius of gyration 300 mm. The engine runs at 3000 rpm counter clockwise when viewed from the rear. Determine the gyroscopic couple and its effect on the aircraft. **(04 Marks)**

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