CBCS SCHEME

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21MR51

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Theory of Machines

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. What do you mean by degrees of freedom of a kinematic pair? How are pairs classified? Give example. **(08 Marks)**

b. Fig.Q1(b) shows a mechanism in which $Q_A = Q_C = 100$mm, AB = QB = 300mm and CD = 250mm. The crank 0A rotates at 150rpm in the clockwise direction. Determine the :
i) Velocity of the slides at D
ii) Angular velocity of links QB and AB
iii) Rubbing velocity at the pin B which is 40mm in diameter.

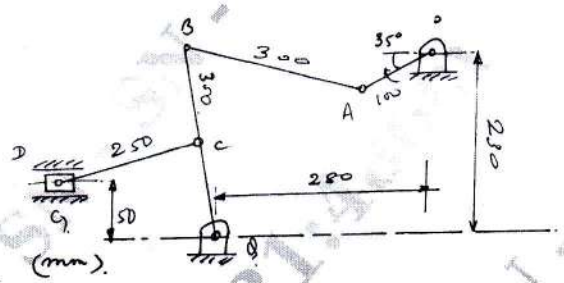

Fig.Q1(b) **(12 Marks)**

OR

2 a. Define the following with example :
i) Kinematic link
ii) Kinematic chain
iii) Kinematic inversion
iv) Mechanism. **(10 Marks)**

b. For the configuration of slider crank mechanism Fig.Q2(b), calculate the
i) Acceleration of the slider at B
ii) Acceleration of the point E
iii)Angular acceleration of the link AB OA rotates at 20rad/sec counter clockwise.

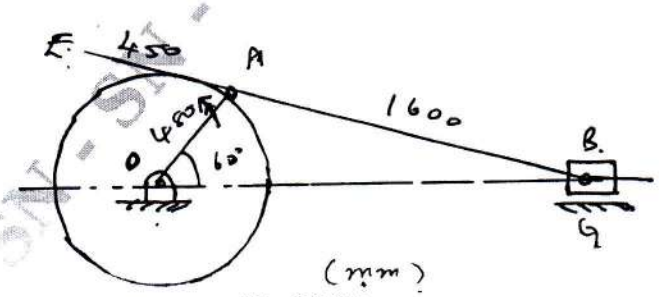

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. In a four–link mechanism shown in Fig.Q3(a), torques T_3 and T_4 have magnitude of 30Nm and 20Nm respectively. The link lengths are AD = 800mm, AB = 300mm, BC = 700mm and CD = 400mm. For the static equilibrium of the mechanism, determine the required input torque T_2.

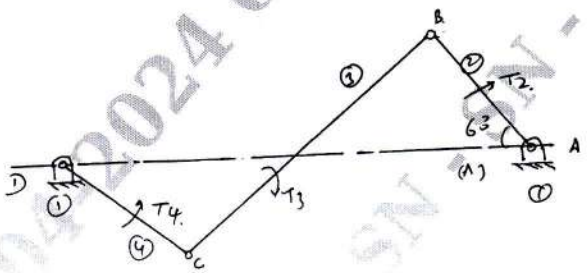

Fig.Q3(a) **(12 Marks)**

b. A reverting machine is driven by a motor of 3KW. The actual time to compute one reverting operation is 1.5seconds and it absorbs 12kN.m of energy. The moving parts including the fly wheel are equivalent to 220kg at o.5m radius. Determine the speed of the flywheel immediately after reverting if it is 360rpm before reverting. Also find he number of reverts closed per minute. **(08 Marks)**

OR

4 a. In a vertical double acting steam engine, the connecting rod is 4.5 times the crank. The weight of the reciprocating part is 120kg and the stroke of the piston is 440mm. The engine runs at 250rpm. If the net load are the piston due to steam pressure is 25kN when the crank has turned. Through an angle of 120° from the to P dead centre, determine the :

i) Thrust in the connecting rod

ii) Pressure are slide bars.

iii)Tangential force on the crank rod. **(08 Marks)**

b. State and explain D'Alembert's principle. **(06 Marks)**

c. What is a Flywheel? What is its use? **(06 Marks)**

Module-3

5 a. What is path of contact and arc of contact? Deduce the expression to fixed its magnitude. **(12 Marks)**

b. Two 20° involutes spur gears mesh externally and give a velocity ratio of 3. The module is 3mm and the addendum is equal to 1.1 module. If the pinion rotates at 120rpm, determine the i) minimum number of teeth on each wheel to avoid interference ii) contact ratio. **(08 Marks)**

OR

6 a. With the help of neat sketches explain compound gear train and epicyclic gear train. **(10 Marks)**

b. An epicyclic gear train consists of an arm and two gears A and B having 30 and 40 teeth respectively. The arm rotates above the centre of the gear A at a speed of 80rpm counter clockwise. Determine the speed of the gear B if : i) The gear A is fixed ii) The gear a revolves at 240rpm clockwise instead of being fixed by Tubular method and algebraic method. **(10 Marks)**

Module-4

7 a. Define the following terms :
   i) Sensitiveness
   ii) Governor power
   iii) Isochronism Governor
   iv) Controlling force. **(08 Marks)**

   b. A, B, C and D are masses carried b a rotating shaft at radius 100, 125, 200 and 150mm respectively. The planes in which the masses, revolve are speed 600mm apart and the masses. B, C and D are 10, 5, 4 kg respectively. Find the required mass A and the relative angular positions of the 4 masses to keep the shaft in balance. **(12 Marks)**

OR

8 a. Explain the terms primary balancing and secondary balancing as used for balancing of reciprocating masses. **(06 Marks)**

   b. A porter governor has equal arms each 250mm long and pivoted on the axis of rotation. Each ball has a mass of 5kg and the mass of the central land on the sleeve is 25kg. The radius of rotation of the ball is 150mm. When the governor beings to lift and 200mm when the governor is at maximum speed. Find the range of speed, sleeve lift, governor effort and power of the governor in the following causes :
   i) When the friction at the sleeve is neglected
   ii) When the friction at sleeve is 10N. **(14 Marks)**

Module-5

9 a. What are free, damped and forced vibrations? Explain. **(06 Marks)**

   b. What is logarithmic decrement? Derive the relation for the same. **(08 Marks)**

   c. A vibrating system consists of a mass of 50kg, a spring with a stiffness of 30kN/m and a damper. The damping provided is only 20% of the critical value. Determine the :
   i) Damping factor
   ii) Critical damping coefficient
   iii) Natural frequency of damped vibration
   iv) Logarithmic decrement
   v) Ratio of two consecutive amplitudes. **(06 Marks)**

OR

10 a. A rotor has a mass of 12kg and is mounted mid way on a 24mm diameter horizontal shaft supported at the ends by two bearings. The bearings are 1m apart. The shaft rotates at 2400rpm. If the centre of mass of the rotor 0.11mm away from the geometric centre of the rotor due of a certain manufacturing defect, find the amplitude of the state vibration and the dynamic force transmitted to the bearing $E = 200GN/m^2$. **(08 Marks)**

   b. Define magnification factor and transmissibility plot and explain magnification factor vs ratio of frequencies and phase angle is frequency ratio. **(12 Marks)**

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