CBCS SCHEME

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21AU44

Fourth Semester B.E. Degree Examination, June/July 2024
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 the following : i) Machine ii) Inversion iii) Degree of freedom. **(06 Marks)**

b. With a neat sketch explain :
i) Quick return motion mechanism ii) Geneva wheel **(10 Marks)**

c. Determine degree of freedom of the linkage shown in Fig Q1(c)

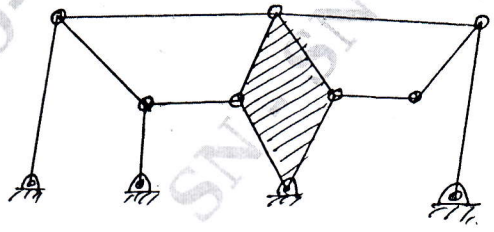

Fig Q1(c) **(04 Marks)**

OR

2 The crank and connecting rod of a theoretical steam engine are 0.5m and 2m long respectively. The crank makes 180rpm is the clockwise direction. When it has turned 45° from the inner dead centre position, determine :
i) Velocity of piston
ii) Angular velocity of connecting rod
iii) Velocity of point E on the connecting rod 0.5m from the crank end
iv) Velocities of rubbing at the pins of the crank, shaft crank of cross head when the diameter of their pins are 50mm, 60mm and 30mm respectively.
v) Position and linear velocity of any point G on the connecting rod which has the least velocity relative to crank shaft. **(20 Marks)**

Module-2

3 a. Derive the equation for length of path of contact. **(06 Marks)**

b. Explain with a neat sketch
i) Simple gear train
ii) Compound gear train
iii) Reversed gear train **(06 Marks)**

c. In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arms of the gear train rotates 150rpm in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of the gear B. If the gear A instead of using fixed makes 300 rpm in the clockwise direction, what will be the speed of gear B. Arrangement is shown in Fig Q3(c)

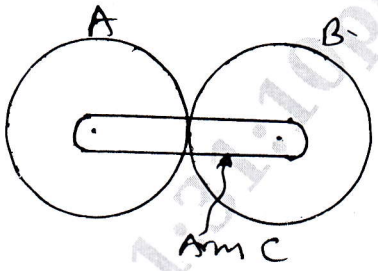

Fig Q3(c) **(08 Marks)**

OR

4 A cam with 25mm as a minimum radius is rotating clockwise at a uniform speed of 1000rpm and has to give the motion of the knife – edge follower as defined below :

i) Follower to move outwards through 25mm during 120° of cam rotation
ii) Follower to dwell for the next 60° of cam rotation
iii) Follower to return to its starting position during next 90° of cam rotation
iv) Follower to dwell for the rest of the cam rotation

The displacement of the follower takes place with uniform and equal acceleration and retardation an both the outward and return strokes. Draw the cam profile when follower axis passes through the axis of the cam. Also determine the maximum velocity and acceleration during outstroke and return stroke. **(20 Marks)**

Module-3

5 a. Draw the free body diagrams for the following mechanisms. Also name the mechanisms

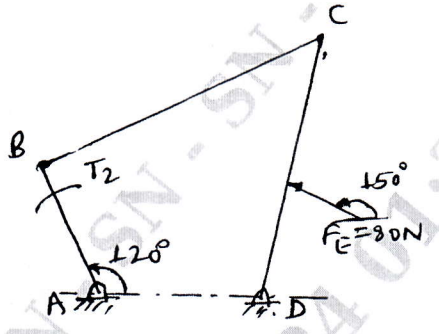

Fig Q5(a)-i)

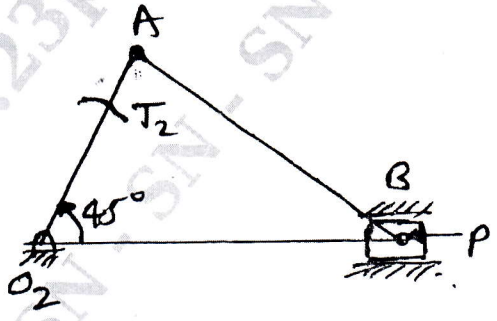

Fig Q5(a)-ii) **(10 Marks)**

b. A four bar link mechanism is acted upon by forces as shown in the Fig Q5(b). Determine the torque T_2 to be applied an link 2 to keep the mechanism in equilibrium. Given : AD = 50mm, AB = 400mm, BC = 100mm, DC = 75mm and DE = 35mm. **(10 Marks)**

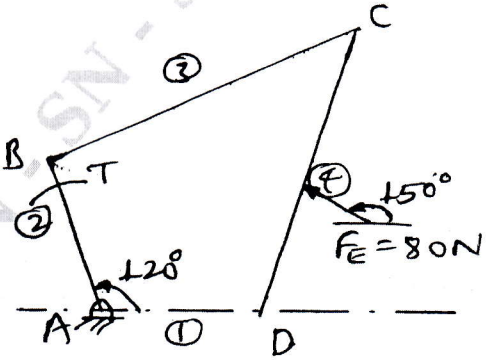

Fig Q5(b)

OR

6 The following data relate to a horizontal reciprocating engine :

Mass of reciprocating parts	=	120Kg
Crank length	=	90mm
Engine speed	=	600rpm
Connecting rod mass	=	90Kg
Length between centers	=	450mm
Distance of centers of mass From big end centre	=	180mm
Radius of gyration about an axis through centre of mass	=	150mm

Find the magnitude and direction of the inertia torque an the crankshaft when the crank has turned 30° from the inner dead centre by analytical method. Given : n = 5. **(20 Marks)**

Module-4

7 a. Define the following and mention its equation:
(i) Coefficient of fluctuation of speed (q)
(ii) Total fluctuation of speed (K_s)
(iii) Coefficient of fluctuation of energy (K_e)
(iv) Coefficient of steadiness **(08 Marks)**

b. A vertical double acting steam engine develops 73.6 kW at 250 rpm. The maximum fluctuation of energy is 30% of work done per stroke. The maximum and minimum speeds are not to vary more than 1% on either side of mean speed, find the mass of flywheel required. If the radius of hydration is 0.6 m. **(12 Marks)**

OR

8 a. Define governor and derive an expression for height of the porter governor with a neat sketch. **(10 Marks)**

b. The arms of Hartnell governor are of equal length. When the Sleeves is in the middle position, the masses rotate in a circle with a diameter of 150 mm. Neglecting the friction, the equilibrium speed for this position is 360 rpm. Maximum variation of speed, taking friction into account is to be 6% of the mid-position speed for a maximum sleeve movement of 30 mm. The sleeve mass is 5 kg and the friction at the sleeve in 35 N. Assuming that the power of the governor is sufficient to overcome the friction by 1% change of speed on each side of the mid position, find the:
(i) Mass of each rotation ball (ii) Initial compression of spring **(10 Marks)**

Module-5

9 a. Write short notes on: (i) Types of friction (ii) Laws of friction **(06 Marks)**

b. A flat foot step bearing 300 mm in diameter supports a load of 10 kN. If the coefficient of friction is 0.1 and speed of the shaft is 60 rpm. Find the power loss in friction. Assuming:
(i) Uniform pressure (ii) Uniform wear condition **(14 Marks)**

OR

10 a. Derive an expression for:
(i) Length of open belt drive (ii) Ratio of belt tensions **(12 Marks)**

b. A chain drive is used for reduction of speed from 240 rpm to 120 rpm. The number of teeth on the driving sprocket is 20. Find the number on teeth on the driven sprocket. If the pitch circle diameter of the driven sprocket is 600 mm and centre to centre distance between the two sprockets is 800 mm. Determine the pitch and length of the chain. **(08 Marks)**

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