CBCS SCHEME

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21AU44

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

Time: 3 hrs. Max. Marks: 100

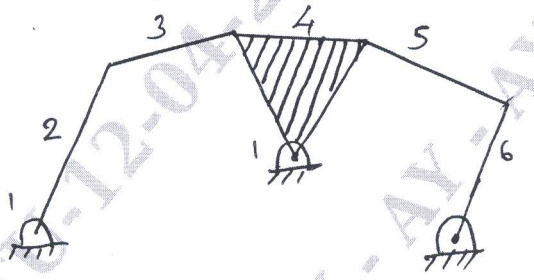
Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

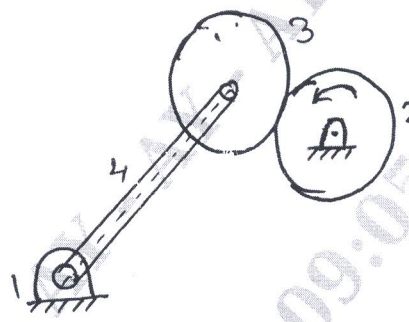
1 a. Discuss the working of a beam engine and coupling rod of Locomotive with relevant sketch. **(10 Marks)**

b. Determine the mobility of the mechanisms for the following :

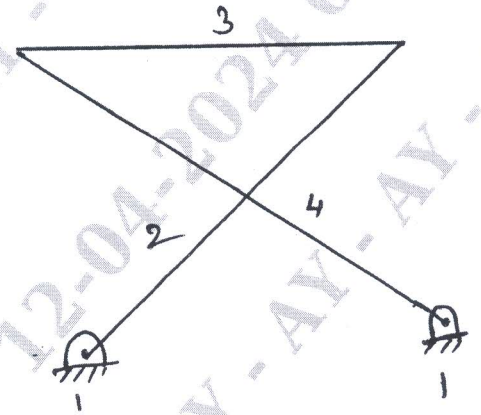
(i)



(ii)



(iii)



(10 Marks)

OR

2 In a slider crank mechanism, the crank OB = 30 mm and the connecting rod BC = 120 mm. The crank rotates at a uniform speed of 300 rpm clockwise. Find

(i) Velocity of Piston C and angular velocity of connecting rod BC

(ii) Acceleration of piston C and angular acceleration of connecting rod BC. **(20 Marks)**

Module-2

3 a. Derive an expression for length of arc of contact, path of contact and contact ratio. **(10 Marks)**

b. In an epicyclic gear train, the arm A is fixed to the shaft S. The wheel B having 100 teeth rotates freely on this shaft S wheel F 150 teeth is separately driven. If the arm A runs at 200 rpm. Wheel F at 100 rpm in the same direction. Find (i) No. of teeth of gear C. (ii) Speed of wheel B. **(10 Marks)**

OR

4 A Cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower through a roller 1.5 cm diameter. The follower motion is defined as below :

(i) Outward during 150° with UARM (ii) Dwell for next 30°

(iii) Return during 120° with SHM (iv) Dwell for the remaining period.

Stroke of the follower is 3 cm. Minimum radius of the cam is 3 cm. Draw the cam profile.

(a) Follower axis passes through cam axis.

(b) Follower axis is offset to the right by cam. **(20 Marks)**

Module-3

5 A slider crank mechanism is shown in Fig. Q5. The force applied to the piston is 1000 N. when the crank is at 60° from IDC. Calculate the driving torque T_2. **(20 Marks)**

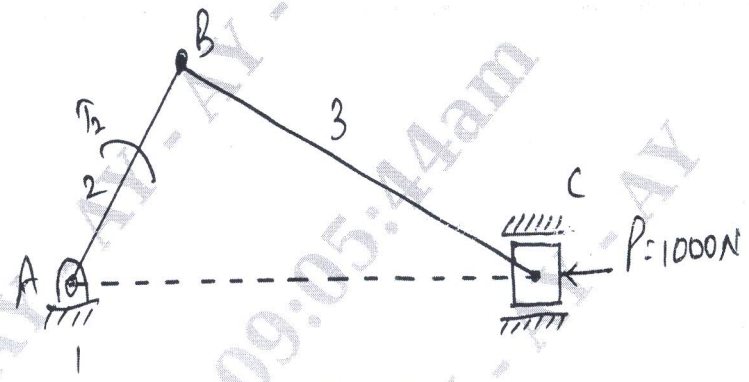


Fig. Q5

OR

6 a. With a derivation, explain D'Alembert's principle. **(10 Marks)**

b. When a 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.
Stroke of the piston = 0.50 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 reciprocating parts is 200 kg. **(10 Marks)**

Module-4

7 a. Derive a relation between E, e_{max} and K_S or relation between e_{max}, K_S and I. **(06 Marks)**

b. Derive an expression for size of flywheel. **(08 Marks)**

c. Prove that the maximum fluctuations of energy C is given by C = 0.02 qE for a flywheel. **(06 Marks)**

OR

8 a. Derive an expression for Porter Governor for speed and height. **(10 Marks)**

b. The radius of rotation of the balls of a Hartnell governor is 8 cm at the minimum speed of 3000 rpm. Neglecting gravity effect determine the speed after the sleeve is lifted by 6 cm, also determine the initial compression of the spring, governor effort and power. The particulars of the governor are, length of ball arm = 15 cm, length of sleeve arm = 10 cm, mass of each ball = 4 kg and stiffness = 25000 N/m. **(10 Marks)**

Module-5

9 a. Derive an expression for total frictional torque for a flat pivot bearing. **(10 Marks)**

b. Derive an expression for total frictional torque for flat collar bearing. **(10 Marks)**

OR

10 a. Derive an expression for length of open belt drive. **(12 Marks)**

b. Derive an expression for ratio of belt tensions. **(08 Marks)**

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