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

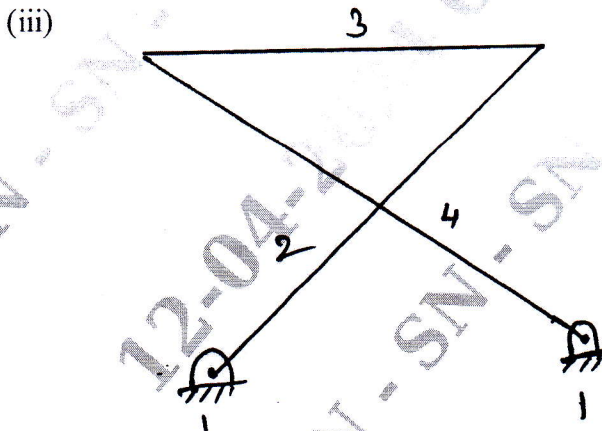
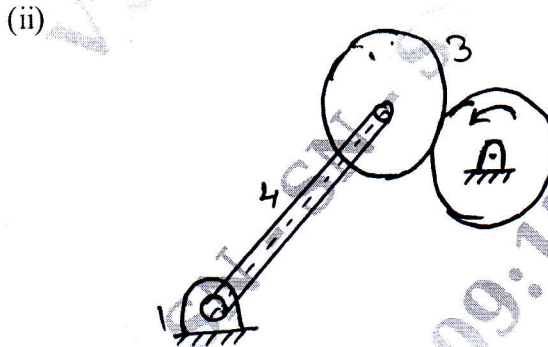
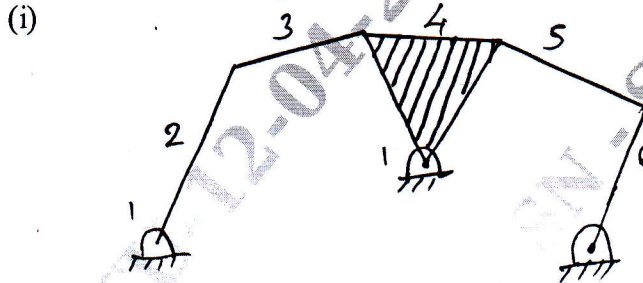
Time: 3 hrs.

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:



(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)

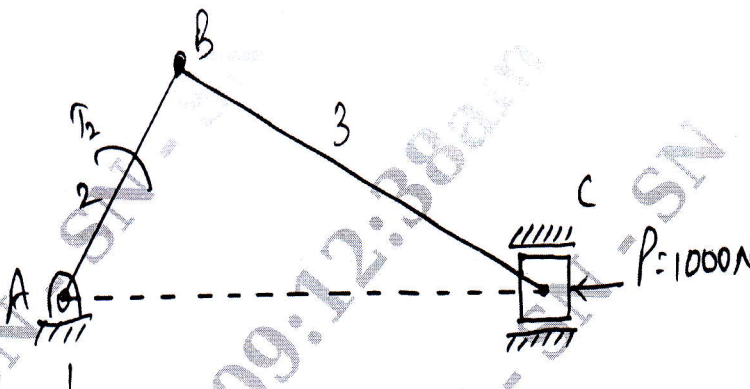


Fig. Q5

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)
