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## Fifth Semester B.E. Degree Examination, Jan./Feb. 2021 Dynamics 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. Explain the following:
- (i) Two force member.
  - (ii) Three force member.
  - (iii) Member with two focus and a torque.
- (06 Marks)
- b. In the below figure Fig. Q1 (b) a four bar mechanism is shown. Calculate the required value of  $T_2$  and various forces on links for the equilibrium of the system.

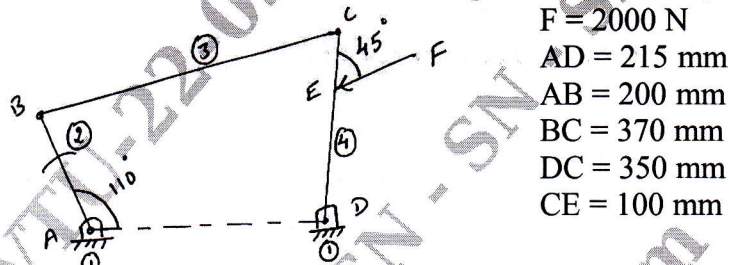


Fig. Q1 (b)

$F = 2000 \text{ N}$   
 $AD = 215 \text{ mm}$   
 $AB = 200 \text{ mm}$   
 $BC = 370 \text{ mm}$   
 $DC = 350 \text{ mm}$   
 $CE = 100 \text{ mm}$

(14 Marks)

OR

- 2 a. State and explain D'Alembert's principle. (06 Marks)
- b. A horizontal gas engine running at 240 rpm has a bore of 500 mm and a stroke of 600 mm. the length of connecting rod is 1.2 m and the mass of the reciprocating parts is 200 kg. The difference between driving and back pressure is  $0.4 \text{ N/mm}^2$ , when the crank has turned through an angle of  $60^\circ$  from the inner dead centre. Neglecting the effect of piston rod, determine
- (i) Net force on the piston or piston effort.
  - (ii) Thrust in the connecting rod.
  - (iii) Pressure in the slide bars.
  - (iv) Tangential force on the crank pin.
  - (v) Thrust on the bearings.
  - (vi) Turning moment on the crank shaft.
  - (vii) Acceleration of the flywheel which has a mass of 100 kg and radius of gyration of 500 mm while the power of the engine is 100 kW.
- (14 Marks)

### Module-2

- 3 a. Explain static and dynamic balancing. (04 Marks)
- b. A rotating shaft carries four masses 1, 2, 3 and 4 which are radially attached to it. The mass centres are 30 mm, 38 mm, 40 mm and 35 mm respectively from the axis of rotation. The masses 1, 3 and 4 are 7.5, 5 and 4 kg respectively. The axial distance between the planes 1 and 2 is 400 mm and 2 and 3 is 500 mm. The masses 1 and 3 are at right angles to each other. Find for complete balance,
- (i) Angle between 1, 2 and 1, 4.
  - (ii) Axial distance between 3 and 4.
  - (iii) Magnitude of mass 2
- (16 Marks)

OR

- 4 a. Derive an expression for the residual unbalanced force at any instant in partial primary balancing. (05 Marks)
- b. The pistons of a 4 cylinder vertical inline engine reach their uppermost position at  $90^\circ$  interval in order of their axial position. Pitch of cylinder = 0.35 m, Crank radius = 0.12 m length of C.R. = 0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has a mass of 2.5 kg, find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane. (15 Marks)

Module-3

- 5 a. Differentiate between flywheel and governor. (06 Marks)
- b. The turning moment diagram for a multi cylinder engine has been drawn to a scale 1 mm = 600 Nm vertically and 1 mm =  $3^\circ$  horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: +52, -124, +92, -140, +85, -72 and +107 mm<sup>2</sup>, when the engine is running at a speed of 600 rpm. If the total fluctuation of speed is not to exceed  $\pm 1.5\%$  of the mean, find the necessary mass of the flywheel of radius 0.5 m. (14 Marks)

OR

- 6 a. Define the following:
- |                    |                           |            |
|--------------------|---------------------------|------------|
| (i) Sensitiveness. | (ii) Governor effort.     |            |
| (iii) Stability.   | (iv) Isochronous governor | (08 Marks) |
- b. A porter governor has arms 250 mm long, each are pivoted on the axis of rotation. Mass of each governor ball is 2 kg. At the mean speed of 200 rpm, it is found that centrifugal force exerted at each ball is 100 N. Neglecting friction, determine the central load if the sleeve movement is restricted to  $\pm 20$ mm. Also determine the range of speed. (12 Marks)

Module-4

- 7 a. Derive an expression for total frictional torque of flat pivot bearing considering uniform wear. (10 Marks)
- b. Derive an expression for total frictional torque of flat collar bearing considering uniform pressure. (10 Marks)

OR

- 8 a. Derive an expression for length of an open belt drive. (10 Marks)
- b. Derive an expression for ratio of belt tensions for V-belt. (10 Marks)

Module-5

- 9 a. Write down the equation for gyroscopic couple considering a body rotating about axis and mention its terms. (04 Marks)
- b. Discuss the gyroscopic effect on aeroplane. (16 Marks)

OR

- 10 Derive an expression for displacement, velocity and acceleration of the follower for the following two cases:
- a. When the roller has contact with the straight flanks.
- b. When the roller has contact with the nose. (20 Marks)

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