Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - 2015-16 Even Semester - May 2016

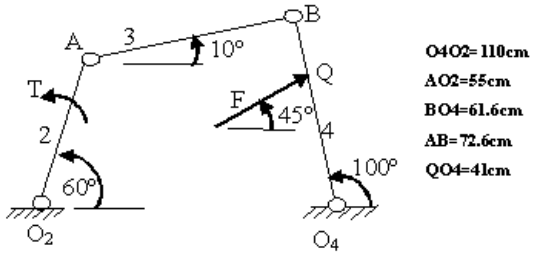
14ME2027 Dynamics of Machinery

Set B

Time : 3 hrs
Total Marks: 100

1. The four-bar linkage has crank 2 driven by torque T ; an external load F=1000 N at an angle of 45°on link 4.

For the particular position of the linkage shown find the value of torque T, all the constraint forces and their reactions necessary for this linkage to be in a position of equilibrium.



OR

2. a) Draw the sketch of a reciprocating steam engine in motion indicating piston, connecting rod and crank . Derive the velocity and acceleration of the piston. (10 marks)

b) A petrol engine has a stroke of 140 mm and connecting rod is 3 times the crank length. The crank rotates at 1000 r.p.m. in the clockwise direction. Determine

(i) velocity and acceleration of the piston, when the crank has travelled through an angle of 45° from inner dead centre, and (6 marks)

(ii) position of the crank for zero acceleration of the piston. (4 marks)

3. a) Draw the turning moment diagram for a single cylinder double acting engine. (4 marks)

b) The turning moment diagram for a multi-cylinder engine has been drawn to a scale 1mm=1000N-m vertically and 1mm = 3º horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: +352, -33, +255, -313, +125, -242,+237 and -381 mm^2 , when the engine is running at a speed of 150r.p.m. If the mass of the flywheel is 1200kg and the total fluctuation of speed is not to exceed ± 2 % of the mean speed, find the minimum value of the radius of gyration. (16 marks)

OR

4. The torque exerted on the crank shaft of a two stroke engine is given by the equation: $T=14500+2300\sin 2\theta-1900\cos 2\theta$, where θ is the crank angle displacement from the inner dead centre. Assuming the resisting torque to be constant, determine

(i) The power of the engine when the speed is 250 r.p.m.

(ii) The moment of inertia of the flywheel if the speed variations is not to exceed ± 1% of the mean speed; and

(iii) The angular acceleration of the flywheel when the crank has turned through 45° from the inner dead centre.

5. a) Explain primary and secondary unbalanced forces of reciprocating parts. (6 marks)

b) Four masses m_1, m_2, m_3 and m_4 are 200 kg, 300 kg, 250 kg and 250 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. (14 marks)

OR

6. a) Find the equivalent stiffness of three springs connected

(i) in series

(ii)in parallel.

Stiffness value of each spring is 30kN/m. Comment on the results. (5 marks)

b) Mass of a single degree damped vibration system measures 5.8 kg and makes 25 free oscillations in 11 seconds.

The amplitude of vibration reduces by 26 % of its initial value after 5 oscillation. Determine

(i) Stiffness of spring

(ii) Logarithmic decrement

(iii) Damping factor

(iv) Critical damping coefficient and

(v) actual damping coefficient

(15 marks)

7. a) Derive the relation for equivalent stiffness of springs connected (5 marks)

(i) in series

(ii) parallel.

b) Mass of a single degree damped vibration system measures 6 kg and makes 25 free oscillations in 11 seconds.

The amplitude of vibration reduces by 30% of its initial value after 5 oscillation. Determine

(i) Stiffness of spring

(ii) Logarithmic decrement

(iii) Damping factor

(iv) Critical damping coefficient and

(v) actual damping coefficient

(15 marks)

OR

8. a) Derive the length of a torsionally equivalent shaft (6 marks)

b) A shaft 1.5 m long is 100 mm in diameter for the first 0.5 m of its length, 50 mm in diameter for the next 0.5 m of the length and 20 mm

in diameter for the remaining length. The shaft carries two rotors at two ends, the first having a mass of 800 kg and 0.85 m radius of gyration

located at the 100 mm diameter end and the second having a mass of 600kg and 0.55 m radius of gyration located at the other end.

Determine the location of the node and natural frequency of torsional vibration of the system Take rigidity modulus C=80GN/m^2. (14 marks)

9. a) Sketch a Porter governor and indicate the following (4 marks)

(i) Height of a governor

(ii) Radius of rotation

b) In the Watt's governor, length of each arm is 250 mm and they are pivoted on the axis of rotation. Determine the governor height

and the radii of rotation of the balls, when the governor speed is 120 r.p.m. (6 marks)

c) A Porter governor has two balls each of mass 4.5 kg and a central load of 17 kg. The arms are all 200 mm long, pivoted on the axis.

If the maximum and minimum radii of rotation of the balls are 130 mm and 90 mm respectively, find the minimum and maximum

speeds and the range of speed. Use suitable sketch. (10 marks)

Wishing you All the Best
