

R09

Code No: 55017

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, March - 2017

DYNAMICS OF MACHINERY

(Common to AME, ME, MCT)

Time: 3 hours

Max. Marks: 75

Answer any five questions
All questions carry equal marks

Illustrate your answers with NEAT sketches wherever necessary

1. Design a four-bar linkage to generate the function $y = e^x - x$ for values of x between $x_0 = 0$ and $x_f = 1$ (corresponding to $y_0 = 1$ and $y_f = 01.7183$) using the Chebychev spacing. [15]
- 2.a) What is a free body diagram? Draw and explain the free body diagrams of all the members of a four bar mechanism.
- b) An in-line slider-crank mechanism with 30 mm crank length and connecting rod length of 70 mm operates at a crank speed of 20 rpm. There is a constant 40 N force on the slider (towards the crankshaft). Plot the connecting rod position, position of slider, connecting rod force, and crankshaft torque against the crank position, when the crank angle $\phi = 60^\circ$. [5+10]
3. The mass of a turbine rotor of a ship is 8 tonnes and has a radius of gyration of 0.6 m. It rotates at 1800 rpm clockwise, when looking from the stern. Determine the gyroscopic effects in the following cases :
- a) If the ship travelling at 100 kmph steers to the left in a curve of 75 m radius.
- b) If the ship is pitching and the bow is descending with maximum velocity. The pitching is simple harmonic, the periodic time being 20 s, and the total angular movement between the extreme positions is 10° .
- c) If the ship is rolling, and at a certain instant, has an angular velocity of 0.03 rad/s clockwise when looking from the stern. [15]
- 4.a) What are the different types of friction clutches? Describe with a neat sketch the working of a cone clutch.
- b) In a single block brake, the drum diameter is 300 mm, the angle of contact is 90° , and the coefficient of friction between the lining and the drum is 0.30. If the operating force is 400 N, applied at the end of a lever 400 mm long, determine the torque transmitted by the brake. The distance of the fulcrum from the center of the brake drum is 200 mm, and assume that the force of friction passes through the fulcrum. [7+8]
5. The equation of turning moment curve of a three crank engine is $(5000 + 1500 \sin 3\theta)$ N - m where θ is the crank angle in radians. The M.I. of the flywheel is $9.81 \text{ kN} - \text{m}^2$, and the mean speed is 300 rpm. Determine the:
- a) Power of the engine,
- b) The maximum % fluctuation of speed of the flywheel, when the
- i) Resisting torque is constant, and
- ii) Resisting torque is $(5000 + 600 \sin \theta)$ N - m. [15]

6.a) Show that the sensitiveness for a Watt governor and a Porter governor, having all arms equal in length and intersecting on axis, is the same.

b) In a Porter governor, the upper and lower arms are respectively 200 mm and 250 mm long, and are pivoted on the axis of rotation. The mass of central load is 15 kg, the mass of each ball is 2 kg, and the friction of sleeve is equivalent to a load of 24 N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40° , find, taking friction into account, the range of speed of the governor. [5+10]

7.a) For a reciprocating engine, prove that for one revolution of the crank, the maximum value of primary force occurs two times where as the maximum value of secondary force occurs four times.

b) Four masses A, B, C, and D are carried by a rotating shaft at radii of 100, 25, 200, and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart, and the masses of B, C, and D are 10, 5, and 4 kg respectively. Find the required mass of A and the relative angular setting of the four masses so that the shaft shall be in complete balance. [7+8]

8. A machine of 100 kg mass is supported on a spring of stiffness 700 kN/m, and has an unbalanced rotating element which results in a disturbing force of 350 N at a speed of 3000 rpm. Assuming a damping factor of 0.2, determine its amplitude of motion due to unbalance, the transmissibility, and the transmitted force. [15]

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