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10ME54

Fifth Semester B.E. Degree Examination, June/July 2023
Dynamic of Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Discuss the equilibrium of the following systems
   i) Two force members
   ii) three force members
   iii) member with two forces and a torque. **(09 Marks)**

   b. With usual notations, explain the principle of virtual work, considering a slider crank mechanism. **(11 Marks)**

2 a. What is the function of a flywheel? How does it differ from that of a governor? **(05 Marks)**

   b. The turning moment diagram for four stroke gas engine may be assumed for simplicity to be represented by four triangles. The areas of which from the line of zero pressure are as follows :

   Suction stroke = $0.45 \times 10^{-3} m^2$
   Compression stroke = $1.7 \times 10^{-3} m^2$
   Expansion stroke = $6.8 \times 10^{-3} m^2$
   Exhaust stroke = $0.65 \times 10^{-3} m^2$

   Each m^2 of area represents 3MN-m of energy. Assuming the resisting torque to be uniform. Find the mass of the rim of flywheel required to keep the speed between 202 and 198 rpm. The mean radius of the rim is 1.2m. **(15 Marks)**

3 a. Derive the expression for the ratio of belt tensions. **(06 Marks)**

   b. Determine the width of a 9.75mm thick belt required to transmit 15kW from a motor running at 900 rpm. the diameter of the driving pulley of the motor is 300mm. The driven pulley runs at 300 rpm and the distance between centers of the two pulleys is 3mts. The density of leather is $1000 Kg/m^3$. The maximum allowable stress in leather is 2.5MPa. The coefficient of friction between leather and pulley is 0.3. Assume open belt drive and neglect slag and slip of the belt. **(14 Marks)**

4 a. Explain how a single rotating mass is balanced by balancing mass in same plane. **(05 Marks)**

   b. A shaft carries from masses A, B, C and D placed in parallel planes perpendicular to the shaft axis and in this order along the shaft. The masses B and C are 40Kg and 28Kg and both are at 160mm radius. While the masses in planes A and D are 200mm radius. Angle between B and C is 100°, B and A is 190°, both angles being measured in the same sense. Planes A and B are 250mm apart, B and C are 500mm apart. If the shaft is to be in complete balance. Determine : i) Masses in plane A and D ii) Distance between planes C and D iii) Angular position of mass D. **(15 Marks)**

PART – B

5 A four cylinder vertical engine has cranks 300mm long the planes of rotation of the first, third and fourth cranks are 750mm, 1050mm and 1650mm respectively from that of the second crank and their reciprocating masses are 150Kg, 400Kg and 250Kg respectively. Find the mass of the reciprocating parts for the second cylinder and relative angular positions of the crank in order that the engine may be in complete primary balance. If each connecting rod of all four cylinders is 1.35m long and the speed is 300 rpm. Find the maximum unbalanced secondary force and couple. **(20 Marks)**

6 a. Define the following terms applied to governors.
   i) Sensitiveness
   ii) Isochronisms
   iii) Hunting. **(06 Marks)**

b. In a porter governor the upper and lower arms are each 200mm long and are hinged on the main axis. Each ball weight 25N and the weight of the sleeve is 250N. The force of friction at the sleeve is 25N. The inclination of the arms to the vertical is 30° and 45° in the lowest and highest potion respectively. Calculate :
   i) The travel of the sleeve
   ii) The speeds at the bottom, middle and top of the travel taking friction into account during upward travel
   iii) The speeds at the bottom, middle and top of the travel during downward travel neglecting friction. **(14 Marks)**

7 a. With usual notations and diagram derive an expression for the gyroscopic couple produced by a rotating disc. **(06 Marks)**

b. An automobile is travelling along a curved truck of 200m mean radius. Each of the four road wheels have a mass of 80Kg with a radius of gyration of 0.4m. The rotating parts of the engine have a mass moment of inertia of $10Kg/m^2$. The engine axis is parallel to the rear axial and the crank shaft rotates in the same sense as the road wheels. The gear ratio of the engine to the backwheel is 5:1. The vehicle has a mass of 3 tonnes and its centre of gravity is 0.5m above road level. The width of the track of the vehicle is 1.5m. Calculate the limiting speed of the vehicle around the curve for all four wheels to maintain conduct with the road surface. **(14 Marks)**

8 The following particulars relate to a symmetrical tangent cam having a roller follower :
Minimum radius of the cam = 40mm, Lift = 200mm, Speed = 360rpm, Roller diameter = 44mm, Angle of Ascent = 60°.
Calculate the acceleration of the follower :
   i) At beginning of lift
   ii) When the roller just touches the nose. **(20 Marks)**

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