Fifth Semester B.E. Degree Examination, July/August 2021
Dynamics of Machines

Time: 3 hrs.   Max. Marks:100

Note: *Answer any FIVE full questions.*

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. Define coefficient of fluctuation of speed and coefficient of fluctuation of energy. **(05 Marks)**

  b. The turning moment diagram of a multicylinder engine has been drawn to a scale of 1mm = 500Nm, torque and 1mm = 6° of crank displacement. The intercepted areas between output torque curve and mean resistance line taken in order from one end in square mm are: -30, +410, -280, +320, +250, -360, +280 and -260. If the mean speed is 800rpm and fluctuation of sped is not to exceed 2% of mean speed, determine: i) Mass of the flywheel ii) Mean diameter of the flywheel, if the centrifugal stress in the flywheel is limited to 8N/mm^2; iii) Dimensions of the rectangular cross section of the rim by taking the width of the rim as 5 times the thickness. The density of cost iron is 7200kg/m^3. Neglect the effect of hubs and arms of the flywheel. **(15 Marks)**

3 a. Derive an equation for ratio of belt tensions in a flat belt drive. **(06 Marks)**

  b. A leather belt is required to transmit 7.5kW from a pulley 1.2m in diameter running at 250rpm. The angle embraced is 165° and the coefficient of friction between the belt and the pulley is 0.3. If the safe working stress for the leather belt is 1.5MPa, density of leather 1000kg/m^3 and thickness of belt 10mm. Determine the width of the belt taking centrifugal tension into account. **(14 Marks)**

4 a. What do you mean by static balancing and dynamic balancing? **(04 Marks)**

  b. A shaft carries four 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 at 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 planes A and D   ii) Distance between planes C and D iii) Angular position of mass D. **(16 Marks)**

5 A six cylinder two stroke in-line diesel engine with cylinder centre lines are spaced at 650 mm. In the end view the cranks are 60° apart and in order 1-4-5-2-3-6. The stroke of each piston is 400 mm and the crank to C.R ratio is 1:5. The mass of reciprocating part is 250 kg per cylinder. The engine rotates at 240 rpm. Investigate the engine for out of balance primary and secondary force and couples. Consider the plane which is located exactly mid junction of cylinder 3 and cylinder 4 as reference plane. **(20 Marks)**

6   a.   Define the following terms in connection with governors: i) Hunting   ii) Isochronism
         iii) Governor effort   iv) Governor power.   **(08 Marks)**

    b.   The arms of a porter governor are each 300mm long and are hinged on the axis of rotation.
         The mass of each ball is 5kg. The radius of rotation of the ball is 200mm when the governor
         begins to lift and 250mm at the maximum speed. Determine the maximum and minimum
         speeds, if the mass of the sleeve is 15kg. Also find the range of speed if the frictional force
         at the sleeve is 30N.   **(12 Marks)**

7   a.   Derive an expression for the gyroscopic couple.   **(05 Marks)**

    b.   An automobile is travelling along a curved track 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 axle is parallel to the rear axle
         and the crank shaft rotate in the same sense as the road wheels. The gear ratio of the engine
         to the back wheel is 5:1. The vehicle has a mass of 3 tonnes and its centre of gravity is 0.5m
         above the road level. The width of the track is 1.5m. Calculate the limiting speed of the
         vehicle around the curve for all four wheels to maintain contact with the road surface.
                                                                                 (15 Marks)

8   The following particulars relate to a symmetrical tangent cam having a roller follower:
         Minimum radius of the cam = 40mm
         Lift = 20mm
         Speed = 360rpm
         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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