Fifth Semester B.E. Degree Examination, December 2011
Dynamics of Machines

Time: 3 hrs.   Max. Marks:100

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

PART – A

1   a.   State the conditions for static equilibrium of a body, subjected to a system of i) two forces ii) three forces.   **(04 Marks)**

    b.   A four bar mechanism under the action of two external forces is shown in the Fig.Q1(b). Determine the torque to be applied on the link AB for static equilibrium. The dimensions of the links are AB = 50mm, BC = 66mm, CD = 55mm, CE = 25mm, CF = 30mm, AD = 100mm, angle BAD = 60°, P = 500N and Q = 600N.   **(16 Marks)**
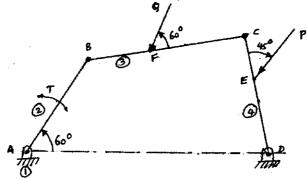

Fig.Q1(b)

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 to 6° of crank displacement. The intercepted areas between output torque curve and mean resistance line, taken in order from one end, in square millimeter are : −30, +410, −280, +320, −330, +250, −360, +280 and −260. If the mean speed is 800rpm and fluctuation of speed 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 rim is limited to 8 N/mm². 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 cast iron is 7200kg/mm³. Neglect the effect of hubs and arms of the flywheel.   **(15 Marks)**

3   a.   State the laws of dry friction.   **(05 Marks)**

    b.   Derive an expression for the ratio of tensions in a flat belt drive.   **(05 Marks)**

    c.   A 8mm thick belt is required to transmit 15kW running over a pulley at a speed of 15 metres per second. If the coefficient of friction between the belt and the pulley is 0.3 & the angle of lap is 180°, find the width of belt required. The maximum tension in the belt material is not to exceed 20 N/mm width of the belt. The density of belt material is 1000 kg/m³.   **(10 Marks)**

4   a.   What do you mean by static balancing and dynamic balancing?   **(05 Marks)**

    b.   A rotating shaft carries four masses A, B, C and D, which are radially attached to it, along the shaft axis. The mass centres are 40mm, 50mm, 60mm and 70mm respectively from the axis of rotation. The masses B,C and D are 60kg, 50kg and 40kg respectively. The angles of the masses C and D with respect to mass B are 90° and 210° in same sense, respectively. The planes containing B and C are 0.5m apart. For a complete balanced system, determine
    i)   The mass and angular position of mass A.
    ii) The position of planes containing masses A and D.   **(15 Marks)**

PART – B

5 a. A single cylinder reciprocating engine has the following data:
Speed the engine = 120rpm; Stroke = 320mm ; Mass of reciprocating parts = 45kg ; Mass of revolving parts = 35kg at crank radius. If 60% of the reciprocating parts and all revolving parts are to balanced, find i) Balance mass required at radius of 300mm and ii) unbalanced force when the crank has turned 60° from the TDC. **(10 Marks)**

   b. A 90° V engine has 2 cylinders, placed symmetrically. The two connecting rods operate a common crank. The length of connecting rods are 320mm each and crank radium is 80mm. The reciprocating mass per cylinder is 12kg. If the engine runs at 600rpm, determine the resultant primary and secondary forces. Also, find the maximum resultant secondary force. **(10 Marks)**

6 a. Define the following, with respect to the working of governors:
i) Sensitiveness   ii) Isochronism   iii) Hunting of governors
iv) Effort of a governor   v) Stability of a governor   **(10 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 and mass of the sleeve is 15kg. The radius of rotation of the ball is 200mm, when the governor begins to lift and 250mm, when the governor is at the maximum speed. Determine:
   i) Range of speed, neglecting the sleeve friction.
   ii) Range of speed, if the frictional force at the sleeve is 30N. **(10 Marks)**

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

   b. A ship is propelled by a turbine rotor of mass 2000kg and has a speed of 1800 rpm. The rotor has a radius of gyration of 0.35m and rotates in the clockwise direction, when viewed from the bow. Determine the gyroscopic couple and its effect when the ship
   i) turns right at a radius of 200m with a speed of 15 knots (1 knot = 1.853km/hr)
   ii) pitches with bow raising, with an angular velocity of 0.08 rad/sec.
   iii) rolls at angular velocity of 0.1 rad/sec. **(15 Marks)**

8 A straight sided cam has both sides tangential to the base circle, with a radius of 25mm. The total angle of action = 120°. A lift of 10mm is given to the roller 20mm diameter, the centre of which moves along a straight line, passing through the axis moves along a straight line passing through the axis of the cam. The camshaft has a speed of 240 rpm. Determine
i) The radius of the nose arc.
ii) The velocity and acceleration of the roller centre when the roller is in contact with the cam at the end of one of the straight flanks adjacent to the nose.
iii) The acceleration of roller centre at the peak. **(20 Marks)**

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