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**Fifth Semester B.E. Degree Examination, June/July 2017**

**Dynamics of Machines**

Time: 3 hrs.

Max. Marks:100

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

**PART - A**

- 1 A slider crank mechanism has crank = 0.5m, connecting rod = 1.75m. When the crank is  $60^\circ$  away from IDC, a force of 1kN acts on slider, along line of stroke, away from crank centre. Find the torque T, needs to be applied on crank for static equilibrium of m/sm by
  - a. Virtual work method (10 Marks)
  - b. Drawing free body diagrams and applying equilibrium conditions. (10 Marks)
  
- 2 a. Explain in brief either "D'Alembert's principle" or "dynamically Equivalent system. (06 Marks)
- b. Turning moment curve for one revolution of a multi cylinder engine above and below the line of mean resisting torque are given by  $-0.5, +1.2, -0.95, +1.45, -0.85, +0.71, -1.06$  Sq. Cm. The vertical and horizontal scales are  $1\text{cm} = 7000 \text{ N-m}$  and  $1\text{cm} = 30^\circ$ . The engine speed is 800 rpm and it is desired that the fluctuation from minimum to maximum speed should not be more than 2% of average speed. Determine the moment of inertia of the flywheel. (14 Marks)
  
- 3 a. What are Pivot and Collar bearings? Explain in brief with sketches. (06 Marks)
- b. An open belt connects two flat pulleys. The smaller pulley is 30cm in diameter and runs at 200rpm. The angle of lap on this pulley is  $160^\circ$  and the coefficient of friction between the belt and pulley face is 0.25. The belt is on the point of slipping when 2.61kW power is being transmitted. Which of the following alternative would be more effective in increasing the power transmitting capability?
  - i) Increasing the tension in the belt by 10%
  - ii) Increasing the coefficient of friction by 10% by the application of a suitable dressing to the belt. (14 Marks)
  
- 4 a. The weights  $W_1, W_2, W_3$  and  $W_4$  are 1962 N, 2943N, 2354N and 2550.6N respectively, in a plane perpendicular to shaft axis. The corresponding eccentricities are 20cm, 15cm, 25cm and 30cm respectively and the angles between the successive masses are  $45^\circ, 75^\circ$  and  $135^\circ$ . Are these weights statically balanced? (06 Marks)
- b. A shaft is supported in bearings 180cm apart and project 45cm beyond bearing at each end. The shaft carries three pulleys one at each end and one at the middle of its is length. The end pulleys weigh 471 N and 196.2N and their eccentricities are 1.5cm and 1.25cm respectively. The central pulley weighs 549.4N and its centre of gravity is 1.5cm from shaft axis. If the pulleys are arranged to give static balance, determine :
  - i) Relative angular positions of the pulleys and
  - ii) Dynamic forces at bearings when the shaft rotates at 300 rpm. (14 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.



**PART - B**

- 5 a. Explain Method of Direct and Reverse Crank'. (06 Marks)
- b. The firing order in a 6 - cylinder vertical 4 - stroke in - line engine is 1-4-2-6-3-5. The stroke is 100mm and length of each connecting rod is 200mm. The pitch distances are 100mm, 100mm, 150mm, 100mm and 100mm respectively. The reciprocating mass per cylinder is 1kg and engine runs at 3000rpm. Determine maximum magnitudes of secondary unbalance force and couple, choosing a plane midway between the cylinders 3 and 4 as the reference plane. (14 Marks)
- 6 a. Explain in brief 'the effect of friction at sleeve on the performance of Porter Governor'. (06 Marks)
- b. A spring loaded governor of the Hartnell type has arms of equal lengths. The weights rotate in a circle of 13cm diameter when the sleeve is in the mid-position and the weight arms are vertical. The equilibrium speed for this position is 450rpm, neglecting friction. The maximum sleeve movement is to be 2.5cm and the maximum variation of speed, taking friction into account is to be  $\pm 5\%$  of mid-position equilibrium speed. The weight of sleeve is 39N and the friction may be considered equivalent to 29N at the sleeve. The power of the governor must be sufficient to overcome the friction by a 1% change of speed either way at mid position. Determine, neglecting obliquity effect,
- Weight of each rotating mass
  - Spring stiffness in N/m
  - Initial compression of spring
- (14 Marks)
- 7 a. Explain in brief:
- Angular momentum
  - Spin motion
  - Precessional motion.
- (06 Marks)
- b. A rail Car has a total weight of 39240 N, there are two axles, each of which together with wheels has moment of inertia of  $30 \text{ kg-m}^2$ . The centre distance between the two wheels on an axle is 1.5m and each wheel is of 37.5cm radius. Each axle is driven by a motor and its speed is 3 times the speed of wheel. Each motor has a moment of inertia of  $15 \text{ kg-m}^2$  and runs opposite to that of axle. The centre of gravity is 105cm above rails. Determine the limiting speed when it is negotiating a curve of 240m radius such that no wheel leaves the rail. (14 Marks)
- 8 a. Write a brief note on 'Undercutting in Cams'. (06 Marks)
- b. A symmetrical Cam with convex flanks operates a flat footed follower. The lift is 8mm, base circle radius is 25mm and the nose radius is 12mm. If the total angle of cam action is  $120^\circ$ , find the radius of convex flanks. Also determine the maximum velocity and maximum acceleration when the cam shaft rotates at 500 rpm. (14 Marks)

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