

**Fourth Semester B.E. Degree Examination, Dec.2014/Jan.2015**  
**Dynamics of Machines**

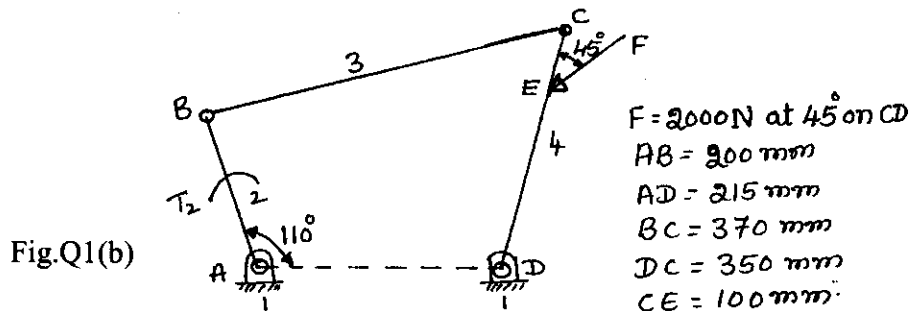
Time: 3 hrs.

Max. Marks: 100

- Note:1. Answer any FIVE full questions, selecting at least TWO questions from each part.**  
**2. Assume missing data suitably.**

**PART - A**

- 1 a. Discuss the equilibrium of the following systems : i) Two force members ii) Three force members iii) Members with two forces and a torque. (06 Marks)
- b. A four bar mechanism under the action of external force is shown in fig.Q1(b). Determine the torque  $T_2$  and various forces on links for the equilibrium of the system. (14 Marks)



- 2 a. Write a brief note on "D'Alembert's principle". (06 Marks)
- b. A three cylinder single acting engine has its cranks set equally at  $120^\circ$  and it runs at 600 rpm. The torque - crank angle diagram for each cycle is a triangle for the power stroke with a maximum torque of 80Nm at  $60^\circ$  from the dead centre of the corresponding crank. The torque on the return stroke is sensibly zero. Determine the following : i) Power developed ii) Coefficient of fluctuation of speed, if the mass of the flywheel is 10 kg and has a radius of gyration of 80mm iii) coefficient of fluctuation of energy iv) Maximum angular acceleration of the flywheel. (14 Marks)
- 3 a. State the laws of dynamic or kinetic friction. (03 Marks)
- b. Derive an expression for the ratio of tensions in a flat belt drive. (07 Marks)
- A 8mm thick belt is required to transmit 15kW running over a pulley at a speed of 15 meters per second. If the coefficient of friction between the belt and the pulley is 0.3 and the angle of lap is  $180^\circ$ , find the width of belt required. The maximum tension in the belt material is not to exceed 20N/mm width of the belt. The density of belt material is  $1000\text{ kg/m}^3$ . (10 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 200, 300, 240 and 360 kg respectively revolving at radii 90, 70, 100, 120mm respectively. The distance from the plane A are 270mm, 420mm and 720mm respectively. Angle between the crank A and B is  $45^\circ$ , B and C is  $75^\circ$ , C and D is  $130^\circ$ . Balancing masses are placed 120mm and 100mm from D and A respectively. The distance between them being 500mm. Find the balancing masses and their angular position if they are placed at a radius of 100mm. (16 Marks)

**PART - B**

- 5 In a Four cylinder engine, the two outer cranks are at  $120^\circ$  to each other and their reciprocating masses are each 100kg. The distance between the planes of rotation of adjacent cranks are 450mm, 750mm and 450mm. Length of each crank is 300mm and length of each connecting rod is 1200mm. Speed of the engine is 240rpm. Find
- The reciprocating masses and relative angular for each of the inner cranks.
  - The unbalance secondary forces and couples if any, measured about the central plane for this arrangement arrived at for primary balancing. (20 Marks)
- 6 a. Define the following terms with reference to a governor : i) Sensitiveness ii) Governor efforts (iii) Isochronism iv) Hunting of governors. (08 Marks)
- b. In an engine governor of porter type, the upper and lower arms are 20 and 25cm long pivoted at the axis of rotation. Mass of each ball – 2kg , friction force on the sleeve together with the resistance of the operating gear is 25N, when running the upper arms inclined at  $35^\circ$  to the vertical, the equilibrium speed is 200rpm. Find i) central load ii) speed at which the sleeve will rise from the given position iii) force exerted on the sleeve if the speed is increased by 10% neglecting the friction force. (12 Marks)
- 7 a. Derive an expression for heel angle of a motor cycle to avoid skidding. (10 Marks)
- b. A ship is propelled by a turbine rotor of mass 5 tonnes at speed 2100rpm. The rotor has a radius of gyration 0.5m and rotates in a clockwise direction when viewed from stern. Find the gyroscopic effects when i) Ship sails at a speed of 30km/hour and steers to the left in curve of 60m radius ii) Ship pitches  $6^\circ$  above and  $6^\circ$  below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and periodic time 20 seconds iii) Ship rolls at an angular velocity of 0.03 rad/sec. (10 Marks)
- 8 For a symmetrical tangent cam operating a roller follower, the least radius of cam is 30mm and roller radius is 15mm. The angle of ascent is  $60^\circ$ , the total lift is 15mm and speed of the cam shaft is 300rpm. Calculate
- Principal dimensions of the cam (i.e the distance between the cam centre and nose centre, nose radius and angle of contact of cam with straight flank).
  - Acceleration of the follower at the beginning of the lift, where the roller just touches the nose and at the apex of circular nose. Assume that there is no dwell between ascent and descent. (20 Marks)

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