Reg. No. : | | | | | | | | | | | |

R 3457

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Fourth Semester

Mechatronics Engineering

ME 1301 — DYNAMICS OF MACHINERY

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is shaking force? How do you calculate it?

2. Which engine requires large flywheel? Why?
   (a) four stroke / two stroke
   (b) slow speed / high speed engine.

3. Explain the terms 'Static Balancing' and 'Dynamic Balancing'. State the necessary conditions to achieve them.

4. Write a short note on primary and secondary balancing.

5. Explain Degrees of freedom with suitable examples in vibration.

6. Explain the different types of free vibration.

7. Define transmissibility ratio. What do you understand by transmissibility?

8. Find the damping factor of a vibrating system which consists of a mass of 3.5 kg, a spring of stiffness 2.5 N/mm and a damper of damping co-efficient 0.018 N/mm/s.

9. Differentiate between centrifugal governors and inertia governors.

10. Write a short note on gyroscope.

PART B — (5 × 16 = 80 marks)

11. (a) In a four link mechanism shown in figure 11 (a) torque T_3 and T_4 have magnitudes of 30 Nm and 20 Nm respectively. The link lengths are AD = 800 mm, AB = 300 mm, BC = 750 mm and CD = 400 mm. For the static equilibrium of the mechanism, determine the required input torque T_2. (16)

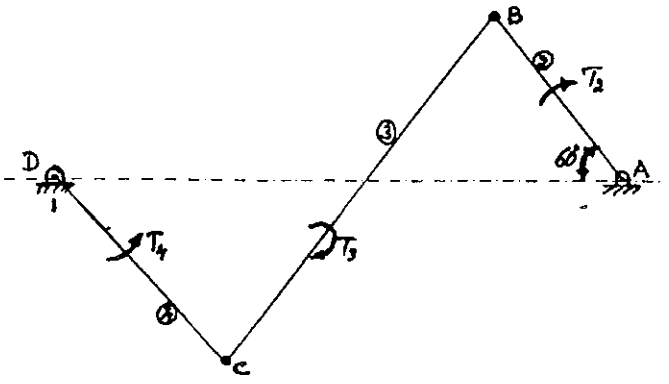

Figure 11 (a)

Or

(b) (i) The maximum and minimum speed of a flywheel are 242 r.p.m and 238 r.p.m respectively. The mass of flywheel is 2600 kg and radius of gyration is 1.8 m. Find (1) mean speed of flywheel, (2) maximum fluctuation of energy and (3) Co-efficient of fluctuation of speed. (6)

(ii) Sketch the turning moment diagrams of single cylinder double stroke engine, four stroke IC engine and a multi cylinder engine. (6)

(iii) Briefly explain jump speed in cam mechanism. (4)

12. (a) A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. if the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions.

Or

(b) The cranks of a two cylinder uncoupled inside cylinder locomotive are at right angles and are 300 mm long. The distance between the centre lines of the cylinder is 650 mm. The wheel centre lines are 1.6m apart. The reciprocating mass per cylinder is 300 kg. The driving wheel diameter is 1.8 m. If the hammer blow is not to exceed 45 kN at 100km/hr, determine :

(i) the fraction of the reciprocating masses to be balanced

(ii) the variation in tractive effort

(iii) the maximum swaying couple.

13. (a) (i) Derive an expression for the Natural frequency of Single Degrees of Freedom system for longitudinal vibration. (8)

(ii) Calculate the Whirling speed of a shaft 20 mm diameter and 0.6m long carrying a mass of 1 kg at its mid-point. The density of the shaft material is 40000 kg/m^3, and E = 200 GN/m^2. Assume the shaft to be freely supported. (8)

Or

(b) The moment of inertia of three rotors A, B and C are respectively 0.3, 0.6 and 0.18 kg m^2. The distance between A and B is 1.5 m and B and C is 1 m. The shaft is 70 mm in diameter and the modulus of rigidity for the shaft material is 84 × 10^9 N/m^2. Find (i) The frequencies of torsional vibrations, (ii) Position of nodes and (iii) amplitude of vibrations. (16)

14. (a) In a single degree of damped vibrating system, a suspended mass of 3.75 kg makes 12 oscillations in 7 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.363 of its initial value in four oscillations. Determine,

(i) Stiffness of the spring

(ii) Logarithmic decrement

(iii) Damping factor

(iv) Damping coefficient. (16)

Or

(b) The barrel of a large gun recoils against a spring on firing. At the end of the firing, a dash pot is engaged that allows the barrel to return to its original position in a minimum time without oscillation. Gun barrel mass is 400 kg and initial velocity is 20 m/s. The barrel recoils 1 m. Determine spring stiffness and damping coefficient. (16)

15. (a) Calculate the range of speed of a porter governor which has equal arms of each 200 mm long and pivoted on the axis of rotation. The mass of each ball is 4 kg and the central mass of the sleeve is 20 kg. The radius of rotation of the balls is 100 mm when the governor begins to lift and 130 mm when the governor is at maximum speed. (16)

Or

(b) Explain the gyroscopic effect on four wheeled vehicle. (16)