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

Question Paper Code : 51017

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2014.

Third Semester

Aeronautical Engineering

AE 2201/AE 32/ME 1204/080180006/10122 AE 302 — MECHANICS OF MACHINES

(Common to Automobile Engineering)

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Note : A3 size drawing sheet is to be supplied to the students.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the term Kinematic Chain with suitable example.

2. Give the expression for Grubler's criterion for plane mechanisms.

3. Write the expression for frictional torque of single plate clutch for uniform pressure and uniform wear condition.

4. Give the condition for maximum power transmission in flat belts.

5. Name the different types of gear trains.

6. Draw the different shapes of cam followers.

7. Why balancing is necessary of rotating parts necessary for high speed engines?

8. What do you mean by primary and second balancing in balancing of reciprocating masses?

9. Write the concept of Vibration Isolation and Transmissibility.

10. What is the meaning of critical speed of shaft?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain any three inversions of Double Slider crank chain mechanism. (8)

(ii) In a Single Slider Crank Chain mechanism, the crank and connecting rod lengths of an engine are 125 mm and 500 mm respectively. The mass of the connecting rod is 60 kg and its centre of gravity is 275 mm from the crosshead pin centre, the radius of gyration about centre of gravity being 150 mm. If the engine speed is 600 r.p.m. for a crank position of 45° from the inner dead centre, determine, (1) Velocity of the piston. (2) Angular Velocity of the connecting rod. (8)

Or

(b) In the four bar chain ABCD, link AD is fixed and the crank AB rotates at 10 radians per second clockwise. The Lengths of the links are AB = 60 mm; BC = CD = 70 mm; DA = 120 mm. When angle DAB = 60° and both B and C lie on the same side of AD. Find (1) Angular velocities (magnitude and direction) of BC and CD; (2) Angular acceleration of BC and CD. (16)

12. (a) (i) Derive the frictional torque developed in single collar bearing under uniform pressure condition. (6)

(ii) A single plate clutch, both sides are effective, is required to transmit 35 kw at 200 rpm, the pressure being applied axially by means of springs and limited to 150N/cm^2. If the outer diameter of the plate is to be 300 mm, find the required inner diameter of the clutch ring and the total force exerted by the springs. Assume the wear to be uniform and a co-efficient of friction of 0.3. (10)

Or

(b) (i) Determine the angle of contact of flat belt drive with suitable sketch. (6)

(ii) An open belt 100 mm wide connects two pulleys mounted on parallel shafts with their centres 2.4 m apart. The diameter of the larger pulley is 450mm and that of the smaller pulley 300 mm. The coefficient of friction between the belt and the pulley is 0.3 and the maximum stress in the belt is limited to 14 N/mm widths. If the larger pulley rotates at 120 r.p.m., find the maximum power that can be transmitted. (10)

13. (a) An epicyclic gear consists of three gears A, B and C as shown in Fig 1. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 rpm. If the gear A is fixed, determine the speed of gears B and C. (16)

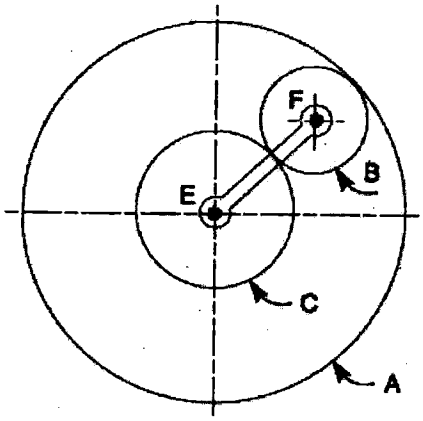

Figure. 1

Or

(b) It is required to set out the profile of a cam to give the following motion to the reciprocating follower with a flat faced reciprocating follower:

(i) Follower to have stroke of 20 mm during 150° of cam rotation;

(ii) Follower to dwell for 30° of cam rotation;

(iii) Follower to return to its initial position during 90° of cam rotation; and

(iv) Follower to dwell for remaining 90° of cam rotation.

The minimum radius of the cam is 35 mm. The out stroke and the return stroke of the follower moves with equal uniform acceleration and retardation. Draw the profile of the cam. (16)

14. (a) A rotating shaft carries four unbalanced masses 18 kg, 14 kg, 16 kg and 12 kg at radii 50 mm, 60 mm, 70 mm and 60 mm respectively. The 2nd, 3rd and 4th masses revolve in planes 80 mm, 160 mm and 280 mm respectively from the plane of first mass and are angularly located at 60°, 135° and 270° respectively measured clockwise from the first mass looking from the end of the shaft. The shaft is dynamically balanced by two masses, both located at 50 mm radii and revolving in planes mid-way between those of 1st and 2nd masses and midway between those of 3rd and 4th masses. Determine the magnitudes of their masses and their respective angular positions. (16)

Or

(b) The following data apply to an outside cylinder uncoupled locomotive;

Mass of reciprocating parts per cylinder = 300 kg,

Mass of reciprocating parts per cylinder = 360 kg.

Angle between cranks = 90. Crank radius = 0.3 m;

Cylinder lines = 1.75 m;

Radius of Balanced Mass = 0.75 m;

Wheel centers = 1.45 m.

If the whole of the rotating and two thirds of reciprocating parts are to be balanced in planes of driving wheels, find their magnitude and angular positions of balanced masses. (16)

15. (a) (i) A 200-kg machine is placed at the end of 2 m long steel ($E = 2 \times 10^5 N/mm^2$) cantilever beam. The machine is observed to vibrate with a natural frequency of 21 Hz. What is the moment of inertia of the beam's cross section about its neutral axis? (8)

(ii) A 200-kg body is attached to a spring of stiffness 80 N/mm in parallel with a viscous damper. The damping coefficient is 800 N/m/sec. Find the frequency of damped vibrations. (8)

Or

(b) A steel shaft ABCD 1.5 m long has flywheel at its ends A and D. The mass of the flywheel A is 600 kg and has a radius of gyration of 0.6 m. The mass of the flywheel D is 800 kg and has a radius of gyration of 0.9 m. The connecting shaft has a diameter of 50 mm for the portion AB which is 0.4 m long; and has a diameter of 60 mm for the portion of BC which is 0.5 m long: and has a diameter of 40 mm for the portion CD which is 0.6 m long. Determine the natural frequency of the torsional vibrations. Also draw the node positions. The modulus of rigidity for the shaft material is 80 GN/ m^2. (16)