

B.E DEGREE EXAMINATIONS: NOV / DEC 2014

(Regulation 2009)

Fourth Semester

AERONAUTICAL ENGINEERING

AER105: Mechanics of Machines

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Piston and cylinder of a reciprocating steam engine forms a
 - a) Turning pair
 - b) Rolling pair
 - c) Sliding pair
 - d) Spherical pair
2. Which of the following is an inversion of single slider crank chain?
 - a) Beam engine
 - b) Watt's indicator mechanism
 - c) Elliptical trammel
 - d) Whitworth quick return motion mechanism
3. The power transmitted by means of a belt depends upon
 - a) Velocity of the belt
 - b) Tension under which the belt is placed on the pulleys
 - c) Arc of contact between the belt and the smaller pulley
 - d) All the above
4. In the thrust bearing the load acts
 - a) Along the axis of rotation
 - b) Parallel to the axis of rotation
 - c) Perpendicular to the axis of rotation
 - d) In any direction
5. Offset is provided to a cam follower mechanism to
 - a) Minimize the side thrust
 - b) Accelerate
 - c) Avoid jerk
 - d) None of these
6. A differential gear in auto mobiles is used to
 - a) Reduce speed
 - b) Assist in changing speed
 - c) Provide jerk free movement of vehicle
 - d) Help in turning

7. Strain Energy is
- a) Energy stored in a body when strained with in elastic limit. b) Energy stored in a body when strained up to the breaking.
- c) Maximum Strain which can store in the body d) Proof Resilience per volume of unit material
8. A shaft carrying two rotors at its ends will have
- a) no node b) one node
- c) two nodes d) three nodes
9. Partial Balancing means
- a) balancing partially the revolving masses b) balancing partially the reciprocating masses
- c) best balancing of engines d) all of the above
10. For dynamic balancing of a shaft
- a) net dynamic force acting on the shaft is equal to zero b) net couple due to dynamic acting on the shaft is equal to zero
- c) both a and b d) none of the above

PART B (10 x 2 = 20 Marks)

11. Differentiate between a machine and a structure
12. Define higher pair. Mention any two examples.
13. What is the effect of centrifugal tension in belt drives?
14. State law of gearing.
15. What is the difference between base circle and pitch circle?
16. List any four types of follower used in cam.
17. What is meant by free and forced vibration?
18. Define Torsional vibration.
19. Why rotating masses are to be dynamically balanced?
20. Define hammer blow.

PART C (5 x 14 = 70 Marks)

21. a) Explain any two inversions of single slider crank mechanism in detail with neat sketches.
- (OR)**
- b) The crank of a slider crank mechanism rotates clockwise at a constant speed of 300rpm. The crank is 150mm and the connecting rod is 600mm long. Determine 1. Linear velocity

and acceleration at midpoint of connecting rod and 2. Angular velocity and acceleration of connecting rod at a crank angle of 45 degree from its inner dead centre position.

22. a) A vertical screw with single start square threads 50mm mean diameter and 12.5mm pitch is raised a load of 10KN by means of a hand wheel, the boss of which is threaded to act as a nut. The axial load is taken up by a thrust collar which supports the wheel boss and has mean diameter of 60mm. If $\mu=0.15$ for the screw and 0.18 for the collar and the tangential force applied by each hand to the wheel is 100N; find suitable diameter of the hand wheel.

(OR)

- b) What are the types of flat belt drives? And explain with neat sketch.

23. a) An Epicyclic gear train consists of three gears A, B and C. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear meshes B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18rpm. If the gear A is fixed determine the speed of gears B and C.

(OR)

- b) A cam is to give the following motion to a knife edged follower:

1. outstroke during 60° of cam rotation
2. dwell for next 30° of cam rotation
3. return stroke during next 60° of cam rotation
4. dwell for remaining 210° of cam rotation

The stroke of the follower is 40mm and the minimum radius of the cam is 50mm.

The follower moves with uniform velocity during both the outstroke and return stroke. Draw the profile of the cam when A) the axis of the follower passes through the axis of the cam shaft and B) axis of follower is offset by 20mm from the axis of the cam shaft.

24. a) A flywheel is mounted on a vertical shaft at a distance of 0.9m from one end and 0.6m from other end. The both ends of the shaft are fixed and its diameter is 50mm. The flywheel has a mass of 500Kg. Find the natural frequencies of longitudinal and transverse vibration. Take $E=200\text{GN/m}^2$.

(OR)

- b) A steel shaft 1.5m long is 95mm in diameter for the first 0.6m of its length, 60mm in diameter for the next 0.5m of the length and 50mm in diameter for the remaining 0.4m of its length. The shaft carries two flywheels at two ends, the first having a mass of 900kg and 0.85m radius of gyration located at the 95mm diameter end and the second having a mass

of 700kg and 0.55m radius located at the other end. Determine the location of the node and the natural frequency of free torsional vibration of the system. Take $G=80 \text{ GN/m}^2$

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

(OR)

- b) An inside cylinder locomotive has its cylinder centre line 0.7m apart and has a stroke of 0.6m. The rotating masses per cylinder are equivalent to 150 Kg at the crank pin and the reciprocating masses per cylinder to 180 Kg. The wheel centre lines are 1.5m apart. The cranks are at right angles.

The whole of the rotating and $\frac{2}{3}$ of the reciprocating masses are to be balanced by masses placed at a radius of 0.6m. Find the magnitude and direction of the balancing masses. Find the fluctuation in rail pressure under one wheel, variation of tractive effort and the magnitude of swaying couple at a crank speed of 300rpm.
