

**B.E. DEGREE EXAMINATIONS: NOVEMBER 2009**

Fifth Semester

**AERONAUTICAL ENGINEERING**

U07AR502: Mechanics of Machines

**Time: Three Hours**

**Maximum Marks: 100**

**Answer ALL the Questions:-**

**PART A (10 × 1 = 10 Marks)**

1. The method of obtaining different mechanisms by fixing different links in a kinematic chain is known as
  - a) Kinematic Chain
  - b) Inversion of the mechanism
  - c) Actuator
  - d) Compound mechanism
2. Whenever a rotating body changes its axis of rotation, a couple is applied on the rotating body, known as
  - a) Centrifugal couple
  - b) Overturning couple
  - c) Centrode
  - d) Gyroscopic couple
3. The maximum inclination of a plane at which a body remains in equilibrium over the inclined plane by the assistance of friction is
  - a) Angle of friction
  - b) Angle of Repose
  - c) Wedge angle
  - d) Angle of inclination
4. The ratio between the velocities of the driver and the follower or driven is known as
  - a) Speed ratio
  - b) Acceleration ratio
  - c) Velocity Ratio
  - d) Belt Ratio
5. When the gears are arranged in such a manner that one or more gears move upon and around another gear, then the gear train is known as
  - a) Simple gear train
  - b) Epicyclic gear train
  - c) Reverted gear train
  - d) Compound gear train
6. When the flanks of the cam connecting the base circle and nose are of convex circular arcs, then the cam is known as
  - a) Convex cam
  - b) Circular
  - c) Circular arc cam
  - d) speed cam
7. When there is reduction in amplitude over every cycle of vibration, the motion is said to be
  - a) Natural vibrations
  - b) Forced vibrations
  - c) Transient vibrations
  - d) damped vibrations
8. The speed at which the shaft tends to vibrate violently in the transverse direction is called
  - a) Critical speed
  - b) Safe speed
  - c) Torsional speed
  - d) Transverse speed

9. If the cylinder centre lines of the multi-cylinder engines are in the same plane and also in the same side of the centre line of the crank shaft, then the multi-cylinder engines are
- a) Inline engines
  - b) Centre engines
  - c) Universal engines
  - d) Radial engines
10. Swaying couple is maximum when  $\theta$  is
- a)  $90^\circ$
  - b)  $45^\circ$  or  $225^\circ$
  - c)  $180^\circ$
  - d)  $360^\circ$

**PART B (10 x 2 = 20 Marks)**

- 11. Define binary joint
- 12. What is Axode?
- 13. Define Coulomb friction
- 14. What is the main function of a clutch?
- 15. What is Undercutting?
- 16. What is throw of a Cam?
- 17. What is torsionally equivalent shaft?
- 18. State any two reasons under which critical speed occurs in a shaft
- 19. What are the problems that arise in balancing linkages?
- 20. State the effects of partial balancing in locomotives

**PART C (5 x 14 = 70 Marks)**

21. (a) Explain any four inversions of single slider crank chain

**(OR)**

(b) In a four bar chain ABCD, AD is fixed and is 120mm long. The crank AB is 30 mm long and rotates at 100 rpm clockwise. While the link CD = 60mm oscillates about D, BC and AD are of equal length. Find the angular velocity of link CD when angle  $BAD = 60^\circ$

22. (a) Classify the types of friction. State the laws of dry and fluid friction.

**(OR)**

(b) A turn buckle with right and left hand threads is used to couple two railway coaches. The threads which are square have a pitch of 10 mm and a mean diameter of 30 mm and are of angle start type. Taking the co-efficient of friction as 0.1,

- (i) Determine the work to be done in drawing the coaches together a distance of 200mm against a steady load of 20 KN
- (ii) If the load increases from 20 KN to 25 KN over the distance of 200mm, what is the work to be done?

23. (a) A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with  $20^\circ$  pressure angle, 12mm module and addendum 10mm. Find the length of path of contact, arc of contact and contact ratio.

**(OR)**

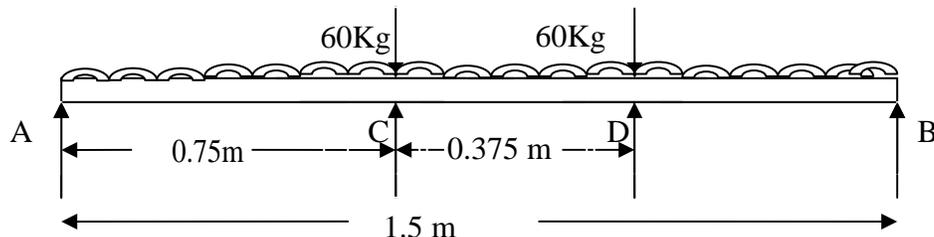
(b) A cam profile is to give the following motion to a knife edge follower

- (i) Out stroke during 60 of cam rotation.
- (ii) Dwell for the next 30 of cam rotation.
- (iii) Return stroke during next 60 of cam rotation.
- (iv) Dwell for the remaining 210 of cam rotation.

The stroke of 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 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
- (b) Axis of the follower is offset by 20mm right hand side from axis of the cam shaft

24.(a) A shaft 1.5 m long, supported in flexible bearings at the ends, carries two wheels each of 60 Kg mass. One wheel is situated at the center of the shaft and the other at a distance of 375 mm from the centre. The shaft is hollow of external diameter 75mm and internal diameter 40mm. The density of the shaft material is  $7700 \text{ kg/m}^3$ . Find the frequency of transverse vibration. Take  $E = 200 \text{ GPa}$ .



**(OR)**

(b) A body having a mass of 15 kg is suspended from a spring which deflects 12mm under the weight of the mass. Determine the frequency of the free vibrations. What is the viscous damping force needed to make the motion aperiodic at a speed of 1mm/s? If, when damped to this extent, a distributing force having a maximum value of 100N and vibrating at 6 Hz is made to act on the body, determine the amplitude of the ultimate motion.

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

- (i) the fraction of the reciprocating masses to be balanced
- (ii) the variation in tractive effort and
- (iii) the maximum swaying couple

**(OR)**

(b) A, B, C and D are four masses carried by a rotating shaft at radii 100 mm, 150 mm, and 200 mm respectively. The planes in which the masses rotates 4kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft must be in complete balance.

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