KUMARAGURU
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B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2013)

Fourth Semester

AERONAUTICAL ENGINEERING

U13AET402**:** Mechanics of Machines

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. A ship is sailing with the propeller rotating clockwise when viewed from the stern. Which among the following will be the effect on the ship when it turns right?

    a) Bow pitching down
    b) Rolling clockwise viewing from stern
    c) Bow pitching up
    d) Rolling anti clockwise viewing from stern

2. Cam and follower is identified as a(n) …………..pair.

3. Choose the incorrect statement from the following with respect to clutches.

    a) Power transmission increases with increase in axial force
    b) Power transmission decreases as number of contact surfaces increase
    c) Power transmission increases as number of contact surfaces increase
    d) Power transmission decreases as the coefficient of friction between the surfaces decreases

4. The expression for ratio of tensions in V belts is written as……………..

5. From the following, select the gear train whose axes have relative motion.

    a) Simple gear train
    b) Compound gear train
    c) Reverted gear train
    d) Epicyclic gear train

6. The mechanism applied in opening and closing of valves in an IC engine is named ……….. mechanism.

7. Infer free torsional vibration among the following.

    a) Helical spring elongating and contracting
    b) Cantilever with particles having two and fro motion perpendicular to its axis
    c) Shaft twisting to and fro about an axis
    d) To and fro motion of particles of body of engine

8. Relation of frequencies of damped and free vibrations is……………..

9. In balancing of rotating masses, what will be the effect of doubling the speed on the magnitude of balancing mass?

    a) Unaffected   b) Doubled

    c) Halved   d) Quadrupled

10. In balancing, secondary moves at comparatively …………….. the speed of primary crank.

PART B (10 x 2 = 20 Marks)

(Not more than 40 words)

11. Differentiate a machine from a mechanism.

12. List four mechanisms which are inversions of single slider crank mechanism.

13. Write down the expression for length of an open belt drive.

14. Define the terms pitch and lead in a screw.

15. Show by sketch a compound gear train.

16. Find the maximum acceleration in a follower executing simple harmonic motion during its outstroke of 90˚ and having a lift of 30 mm. The cam driving the follower is having a speed of 300 rpm.

17. What is meant by forced vibration? What is the vibrating frequency in such a case?

18. A 10 kg mass is suspended by a spring of stiffness 5 N/mm. Determine the natural frequency of its longitudinal vibrations.

19. How will you balance masses rotating in parallel planes?

20. Why complete primary balancing is impossible in single cylinder engines?

PART C (5 x 14 = 70 Marks)

(Not more than 400 words)

Q.No. 21 is Compulsory

21.   i)   A disc, mounted on a shaft, carries three masses 3 kg, 4 kg and 2 kg at (7) radial distances 30 mm, 20 mm and 25 mm and at angular positions of 30˚, 120˚ and 270˚ respectively. The angles are measured counter-clockwise with respect to X axis. Analyse whether the system of masses is in equilibrium.

        If the system is not in equilibrium determine the balancing mass required at any assumed radius.

ii) Illustrate by sketches the concept of balancing multi cylinder inline (7) engines.

22. a) Classify and explain the kinematic pairs with neat sketches.

(OR)

b) A crank and rocker mechanism ABCD has the following dimensions: (10)

AB = 0.75 m; BC = 1.25 m; CD = 1 m; AD = 1.5 m

AD is the fixed link. Crank AB has an angular velocity of 20.94 rad/s counter-clockwise and a deceleration of 280 rad/s^2 at the instant $\angle$DAB = 60°. Find the instantaneous angular velocities and accelerations of links BC and CD.

ii) The moment of inertia of an aeroplane airscrew is 20 kgm^2 and the speed (4) of rotation is 1000 rpm clockwise when viewed from the tail. The speed of flight is 200 kmph. Discuss the effect of reactive gyroscopic couple on the aeroplane when it makes a right handed turn on a path of 150 m radius.

23. a) The thrust of a propeller shaft in a marine engine is taken up by a number of collars integral with the shaft which is 300 mm in diameter. The thrust on the shaft is 200 kN and the speed is 75 rpm. Taking μ = 0.05 and assuming intensity of pressure as uniform and equal to 0.3 N/mm^2, evaluate the external diameter of the collars and the number of collars required, if the power lost in friction is not to exceed 16 kW.

(OR)

b) i) For a flat belt, prove that $T_1/T_2 = e^{\mu\theta}$, where T_1 and T_2 are tensions in the (7) tight and slack sides of the belt, θ is angle of contact between the belt and the pulley, and μ is coefficient of friction between the belt and the pulley.

ii) A flat belt is required to transmit 35 kW from a pulley of 1.5 m effective (7) diameter running at 300 rpm. The angle of lap is 165° and μ = 0.3. Taking centrifugal tension into account, estimate the width of the belt required. It is given that the belt thickness is 9.5 mm, density of its material is 1.1 kg/m^3 and related permissible working stress is 2.5 MPa.

24. a) i) An epicyclic gear train of the sun and planet type has the fixed outer (10) annular A, sun wheel S rotating at 600 rpm and the spider C carrying three planet wheels P that are to be driven. If T_s = 18, T_p = 27 and diametral pitch the same for all the mating gears, determine the required number of teeth. Also find the speed of the planets.

ii) Explain the various torques associated with gear trains. (4)

(OR)

b) Construct the profile of a cam to give the following motion to a knife edged: (i) Follower to have a stroke of 20 mm during 120° of cam rotation, (ii) Follower to dwell for 30° of cam rotation, (iii) Follower to return to its initial position during 120° of cam rotation, (iv) Follower to dwell for remaining 90° of cam rotation. The minimum radius of the cam is 25 mm. The out stroke of the follower is performed with SHM and return stroke with equal uniform acceleration and retardation. Also determine the maximum acceleration during outstroke.

25. a) A vibrating system consists of a mass of 60 kg, a spring of stiffness 30 N/mm and a damper. The damping provided is only 20% of the critical value. Find: (i) the critical damping coefficient (ii) the damping factor (iii) the natural frequency of damped vibration (iv) the logarithmic decrement (v) the ratio of two consecutive amplitudes.

(OR)

b) A machine supported symmetrically on four springs has a mass of 80 kg. The mass of the reciprocating parts is 2.2 kg which move through a vertical stroke of 100 mm with simple harmonic motion. Neglecting damping, determine the combined stiffness of the spring so that the force transmitted to foundation is 1/20 th of the impresses force. The machine crank shaft rotates at 800 rpm.

If under working conditions, the damping reduces the amplitudes of successive vibrations by 30%, find (i) the force transmitted to the foundation at resonance and (ii) the amplitude of vibration at resonance.

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