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Question Paper Code: 35701

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Fifth Semester

Mechanical Engineering

01UME501 - DYNAMICS OF MACHINERY

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Define the term dynamic equivalent of two mass system.
2. What is meant by coefficient of fluctuation of energy?
3. State why it is not possible to complete balancing of reciprocating parts.
4. Define direct and reverse crank methods of balancing reciprocating parts.
5. What happens to the natural frequency of vibration of a spring mass system, when the mass of the spring is not neglected?
6. Define magnification factor.
7. Tell the significance of the term isolation factor.
8. List the factors affects the critical speed of a shaft.
9. Express the sensitiveness of the governor.
10. Calculate the causing precession for a disc which is spinning with an angular velocity of ω *rad/sec* and angular velocity of precession ωp *rad/sec* about the axis of spin.

PART - B (5 x 16 = 80 Marks)

11. (a) The crank pin circle radius of a horizontal engine is 300 *mm*. The mass of the reciprocating parts is 250 *kg*. When the crank has travelled 60° from IDC, the difference between the driving and the back pressures is 0.35 N/mm^2. The connecting rod length between centres is 1.2 *m* and the cylinder bore is 0.5 *m*. if the engine runs at 250 *rpm* and if the effect of piston rod diameter is neglected. Calculate:

(i) pressure on slide bars

(ii) thrust in the connecting rod

(iii) tangential force on the crank pin

(iv) turing moment on the crank shaft (16)

Or

(b) The turning moment diagram of a four stroke engine is assumed to be represented by four triangles, the areas of which the line of zero pressure are
Suction stroke = 440 mm^2
Compression stroke = 1600 mm^2
Expansion stroke = 7200 mm^2
Exhaust stroke = 660 mm^2
Each mm^2 of area represents 3N.m of energy. If the resisting torque is uniform, determine the mass of the rim of a flywheel to keep the speed between 218 and 222rpm when the mean radius is to be 1.25m. (16)

12. (a) The following data apply to an outside cylinder uncoupled locomotive:
Mass of rotating parts per cylinder is 360 *kg*; Mass of reciprocating parts per cylinder is 300 *kg;* Angle between crank is 90°; crank radius is 0.3 *m*; cylinder centres is 1.75 *m*; radius of balance masses is 0.75 *m*; wheel centres is 1.45 *m*.
If whole of the rotating and two-thirds of reciprocating parts are to be balanced in planes of the driving wheels, find:

(i) Magnitude and angular positions of balance masses.

(ii) Speed in kilometers per hour at which the wheel will lift off the rails when the load on each driving wheel is 30 *kN* and the diameter of thread of driving wheels is 1.8 *m*, and

(iii) Swaying couple at speed arrived at in (ii) above. (16)

Or

(b) The stroke of each piston of 6 cylinder 2 stroke inline engine is 320mm and the connecting rod is 800mm long. The cylinder centre lines are spaced at 500mm. the crack are at 60° apart and firing order is 145236. The reciprocating mass per cylinder is 100kg and the rotating parts are 50kg per crank. Determine the out – of – balance force and couples about the mid plane if the engine rotates at 200rpm. (16)

13. (a) A steel shaft 1.5*m* long is 95*mm* in diameter for the first 0.6*m* of its length, 60*mm* in diameter for the next 0.5*m* of the length and 50 *mm* in diameter for the remaining 0.4 *m* of its length. The shaft carries two flywheels at two ends, the first having a mass of 900 *kg* and 0.85 *m* radius of gyration located at the 95 *mm* diameter end and the second having a mass of 700 *kg* and 0.55 *m* radius of gyration located at the other end. Determine the location of the node and the natural frequency of free torsional vibration of the system. The modulus of rigidity of shaft material may be taken as 80 GN/m^2. (16)

Or

(b) A vertical shaft of 5 mm diameter is 200 mm long and is supported in long bearings at its ends. A disc of mass 50 kg is attached to the centre of the shaft. Neglecting any increase in stiffness due to the attachment of the disc to the shaft, find the critical speed of rotation and the maximum bending stress when the shaft is rotating at 75% of the critical speed. The centre of the disc is 0.25 mm from the geometric axis of the shaft. E = 200 GN/m^2. (16)

14. (a) A 400 *kg* motor supported by four springs, each of constant 150 *kN/m*, and a dashpot of constant c = 6500 *Ns/m* is constrained to move vertically. Knowing that the unbalance of the rotor is equivalent to a 23 *g* mass located at a distance of 100 *mm* from the axis of rotation. For a speed of 800 *rpm* determine the amplitude of the fluctuating force transmitted to the foundation and the amplitude of the vertical motion of the motor. (16)

Or

(b) A machine part of mass 2 *kg* vibrates in a viscous medium. Determine them damping coefficient when a harmonic exciting force of 25 *N* results in a resonant amplitude of 12.5 *mm* with a period of 0.2 *s*. If the system is excited by a harmonic force of frequency 4 *Hz* what will be the percentage increase in the amplitude of vibration when damper is removed as compared with that with damping. (16)

15. (a) A pair of locomotive driving wheels with the axle, have a moment of inertia of 180 kg-m^2. The diameter of the wheel treads is 1.8 m and the distance between wheel centre is1.5m. When the locomotive is travelling on a level track at 95km/h, defective ballasting causes one wheel to fall 6 mm and to rise again in a total time of 0.1s. If the displacement of the wheel takes place with simple harmonic motion, find: (i) The gyroscopic couple set up, and (ii) The reaction between the wheel and rail due to this couple. (16)

Or

(b) The turbine rotor of a ship has a mass of 3500 *kg*. It has a radius of gyration of 0.45 *m* and a speed of 3000 *r.p.m*. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship:

(i) When the ship is steering to the left on a curve of 100 *m* radius at a speed of 36 *km/h*.

(ii) When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 *s*and the total angular displacement between the two extreme positions of pitching is 12 *degrees*. (16)