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Question Paper Code: 31571

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2016

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. Describe the principle used to convert dynamic system to static system.
2. Define the term coefficient of fluctuation of energy.
3. Distinguish static balancing and dynamic balancing.
4. Tell the two conditions in order to have a complete balance of the several revolving masses in different planes.
5. Define damping ratio.
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 curve for an engine is represented by equation $t = (20000 + 9500 \sin 2\theta - 5700 \cos 2\theta)$ *Nm*, where θ is the angle moved by the crank from inner dead centre. If the resisting torque is constant. Find:

(i) Power developed by the engine

(ii) Moment of inertia of flywheel in $kg\text{-}m^2$, if the total fluctuation of speed is not to exceed 1% of mean speed which is 180 *rpm*

(iii) Angular acceleration of the flywheel when the crank has turned through 45° from inner dead center (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 cranks and connecting rods of a 4 cylinder in-line engine running at 1800 *rpm* are 60 *mm* and 240 *mm* each respectively and the cylinders are spaced 150 *mm* apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1 - 4 - 2 - 3. The reciprocating mass corresponding to each cylinder is 15 *kg*. Determine

(i) Unbalanced primary and secondary forces, if any and

(ii) Unbalanced primary and secondary couples with reference to central plane of the engine. (16)

13. (a) The measurements on a mechanical vibrating system show that it has a mass of 8 *kg* and that the springs can be combined to give an equivalent spring of stiffness 5.4 *N/mm*. If the vibrating system has a dashpot attached which exerts a force of 40 *N* when the mass has a velocity of 1 *m/s*, find

(i) Critical damping coefficient

(ii) damping facor

(iii) logarithmic decrement and

(iv) ratio of two consecutive amplitudes (16)

Or

(b) 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)

14. (a) A machine part of mass 2 *kg* vibrates in a viscous medium. Determine the 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 *second*, 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)

Or

(b) The mass of an electric motor is 120 *kg* and it runs at 1500 *rpm*.the armature is 35 *kg* and its CG lies 0.5 *mm* from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted in one-eleventh of the impressed force. Assume that the mass of the motor is equally distributed among the five springs. Determine

(i) Stiffness of each spring

(ii) dynamic force transmitted to the base at the operating speed and

(iii) natural frequency of the system (16)

15. (a) The arms of a Porter governor are 300 *mm* long. The upper arms are pivoted on the axis of rotation. The lower arms are attached to a sleeve at a distance of 40 *mm* from the axis of rotation. The mass of the load on the sleeve is 70 *kg* and the mass of each ball is 10 *kg*. determine the equilibrium speed when the radius of rotation of the balls is 200 *mm*. If the friction is equivalent to a load of 20 *N* at the sleeve, what will be the range of speed for this position? (16)

Or

(b) A ship propelled by a turbine rotor which has a mass of 5 *tonnes* and a speed of 2100 *rpm*. The rotor has a radius of gyration 0.5 *m* and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions:

(i) The ship sails at a speed of 30 *km/hr* and steers to the left in a curve having 60 *m* radius

(ii) The ship pitches 6 *degree* above and 6 *degree* below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 *seconds.*

(iii) The ship rolls and at a certain instant it has an angular velocity of 0.03 *rad/s* clockwise when viewed from stern.

Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case. (16)

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