Reg. No. : | | | | | | | | | | |

Question Paper Code: 35701

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

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. State and explain D ' Alemberts principle.
2. List few functions of flywheel.
3. What is hammer blow?
4. State the conditions for static and dynamic balancing.
5. What happens to the natural frequency of vibration of a spring mass system, when the mass of the spring is not neglected?
6. What is degree of freedom?
7. Define the term damping factor.
8. What is transmissibility ratio?
9. How to differentiate applied torque and reaction torque?
10. Define the term spin, precession and gyroscopic planes.

PART - B (5 x 16 = 80 Marks)

11. (a) A horizontal steam engine running at 120 *rpm*, has a bore of 250 *mm* and stroke of 400 *mm*. The connecting rod is 0.6 *m* and mass of the reciprocating parts is 60 *kg*. When the crank has turned through an angle of 45° from the inner dead centre, the steam pressure on the cover end side is 550 kN/m^2 and that on the crank end side is 70 kN/m^2. Considering the diameter of the piston rod equal to 50 *mm*, determine: turning moment on the crank shaft, thrust on the bearing and acceleration of the flywheel, if the power of the engine is 20 *kW*, mass of the flywheel 60 *kg* and radius of gyration 0.6 *m.* (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) A shaft carries four masses *A*, *B*, *C* and *D* of magnitude 200 *kg*, 300 *kg*, 400 *kg* and 200 *kg* respectively and revolving at radii 80 *mm*, 70 *mm*, 60 *mm* and 80 *mm* in planes measured from *A* at 300 *mm*, 400 *mm* and 700 *mm*. The angles between the cranks measured anticlockwise are *A* to *B* 45°, *B* to *C* 70° and *C* to *D* 120°. The balancing masses are to be placed in planes *X* and *Y*. The distance between the planes *A* and *X* is 100 *mm*, between *X* and *Y* is 400 *mm* and between *Y* and *D* is 200 *mm*. If the balancing masses revolve at a radius of 100 *mm*, find their magnitudes and angular positions. (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 mass of 10 *kg* is suspended from one end of a helical spring, the other end being fixed. The stiffness of the spring is 10 *N/mm*. The viscous damping causes the amplitude to decrease to one-tenth of the initial value in four complete oscillations. If a periodic force of 150 *cos* 50 *t N* is applied at the mass in the vertical direction, find the amplitude of the forced vibrations. What is its value of resonance? (16)

15.(a) In an engine governor of the porter type, the upper and lower arms are 200*mm* and 250 *mm* respectively and pivoted on the axis of rotation. The mass of the central load is 15 *kg*, the mass of each ball is 2 *kg* and friction of the sleeve together with the resistance of the operating gear is equal to a load of 25 *N* at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°, find taking friction into account and range of speed of the governor. (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)