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...n (Full Time) DEGREE END SEMESTER EXAMINATIONS, April/May 2019

Mechanical Engineering

Fourth Semester

ME8401 DYNAMICS OF MACHINES

(Regulation 2012)



Time : 3 Hours

Answer ALL Questions

Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Bring out clearly the two main objectives of doing force analysis in machine parts.
2. Define coefficient of fluctuation of speed.
3. Can a single cylinder engine be fully balanced? if not Why?
4. Differentiate between balancing of rotating masses and reciprocating masses ?..
5. Sketch the Time Vs Displacement for Critically-damped systems.
6. Determine the natural frequency of mass of 10kg suspended at the bottom of two springs (of stiffness:5N/mm and 5N/mm) in parallel.
7. Define the following : i. Natural frequency of vibration ii. Logarithmic decrement
8. Define critical or whirling speed..
9. Differentiate between governor and fly wheel.
10. What is the effect of gyroscopic couple on rolling of ship? Why?

Part – B (5 x 16 = 80 marks)

11. (i) Define coefficient of fluctuation of speed and coefficient of fluctuation of energy. (4)
(ii) A two cylinder engine is having a flywheel of mass 906 kg and its radius of gyration is 675 mm. The engine develops 26.5 k W of power and the mean speed is 270 rpm .If the allowable coefficient of energy fluctuation is 1.93, find the maximum and minimum speed of the flywheel. (12)
12. a) (i) What is meant by primary and secondary unbalance in reciprocating engines? (6 mark)
(ii) Three masses of 8kg, 12kg and 15kg attached at radial distances of 80mm, 100mm and 60mm respectively to a disc on a shaft are in complete balance. Determine the angular positions of the masses 12kg and 15kg relative to 8kg mass. (10mark)

(OR)

- b) Determine the unbalanced forces and couples in case of following in-line engines
(i) two cylinder engine with opposed piston (II) four cylinder four stroke engine with cranks of cylinder at $0^\circ, 180^\circ, 0^\circ, 180^\circ$ (III) six cylinder four stroke engine with cranks of cylinder at $0^\circ, 120^\circ, 240^\circ, 240^\circ, 120^\circ, 0^\circ$ (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) (i) A cantilever shaft 25mm diameter and 600mm long has a disc of mass 100kg at its free end. The young's modulus for the shaft material is 200 GN/m^2 . Determine the frequency of longitudinal and transverse vibration of the shaft. (10)
(ii) Explain the sketches for different cases of damped vibrations. (6)
14. a) A mass of 10kg 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 $150 \cos 50t \text{ N}$ is applied at the mass in the vertical direction. Find the amplitude of the forced vibrations? What is its value of resonance? (16)
- (OR)
- b) A weight of 55 N suspended by a spring of stiffness 1.1 k N/m is forced to vibrate by a harmonic force of amplitude 9 N. Taking viscous damping constant as 77 N.s/m , find i. Resonant frequency ii. amplitude at resonance iii. Phase angle at resonance iv. Amplitude of vibration if the frequency of the excitation force 180 c/min . (16)
15. a) A porter governor has equal arms each 250mm long and pivoted on the axis of rotation. Each ball has a mass of 5kg and mass of the central load on the sleeve is 25kg. The radius of rotation of the ball is 150mm when governor is at maximum speed. Find the maximum and minimum speed and range of speed of the governor. (16)
- (OR)
- b) The driving axle of a locomotive with two wheels has a mass moment of inertia of 350 kgm^2 . The wheels are 1.8m in diameter. The distance between the planes of the wheels is 1.5m. When traveling at 100 km/hr , the locomotive over a defective rail which causes the right side wheel to fall 10mm and rise again in a total time of 0.1 sec, the vertical motion of the wheel being with SHM. Find the maximum gyroscopic torque and direction in which it acts when the wheel falls.? (16)

