GANPAT UNIVERSITY
B. Tech. V Sem. Marin Engineering
CBCS Regular Examination Nov. 2014
2MR504 – Dynamics of Vibration

[Time: 3 Hour] [Total Marks: 70]

Instructions:
(1) Attempt all questions.
(2) Assume suitable data if necessary.
(3) Figures to the right indicate full marks

SECTION - I

Que. 1

(A) Explain the effect of gyroscopic couple on bearings with neat sketches for the following cases: [4]
(a) When the disc spins clockwise direction when viewed from the right end and precesses in counter clockwise direction.
(b) When the disc spins in clockwise direction when viewed from the left end and precesses in clockwise direction.

(B) Explain angular acceleration of a disc with neat sketch and derive the equation for the same. [4]

(C) A uniform disc having radius of gyration 90 mm and a mass of 5 kg is mounted at the centre on a horizontal axle of 100 mm length between the bearings. The disc spins about the axle at 1000 rpm in counter clockwise when viewed from the right hand side bearing. The axle precesses about a vertical axis at 60 rpm in the clockwise direction when viewed from top side. Determine the resultant reaction at each bearing due to the mass and the gyroscopic effect. [4]

OR

Que. 1

(A) Explain the effect of gyroscopic couple on sea vessel with neat sketch. [4]

(B) The turbine rotor of a ship has a mass of 2.2 tones and rotates at 1800 rpm in clockwise when viewed from the left. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and its effect when, [8]
(1) Ship turns right at a radius of 250 m with a speed of 25 km/hr.
(2) Ship pitches with the bow rising at an angular velocity of 0.8 rad/sec.
(3) Ship rolls at an angular velocity of 0.1 rad/sec.

Que. 2

(A) Explain the external balancing with neat sketch in which the plane of the disturbing mass lies on one end of the planes of the balancing masses. [4]

(B) A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine: [7]
(1) The magnitude of the masses at A and D
(2) The distance between planes A and D, and
(3) The angular position of the mass at D.

OR

Que. 2

(A) Explain the primary and secondary crank for a single cylinder engine and explain the forces developed due to primary and secondary cranks. Use usual notations for answer. [4]

(B) Four masses of magnitudes 5 kg, 6 kg, 7 kg and M kg revolve in planes A, B, C and D respectively. The planes are spaced A to B 0.8 m, A to C 1.2 m, A to D 2 m. The masses are all at the same radius. Find the magnitudes of the mass M and the relative angular positions of the masses for complete balance. [7]

Que. 3 Attempt the followings (Any three) [12]

(A) Draw the schematic diagram of gyroscope and explain it with gimbal system and its various degrees of freedom. Also explain active and reactive forces and gyroscopic couples.

(B) The turbine rotor of a ship has mass of 2000 kg and rotates at 25 rev/sec clockwise when viewed from the stern. The radius of gyration of rotor is 0.30 meter. Determine gyroscopic couple and effect when,
(i) The ship turns right at a radius of 250 m with a speed of 25 km/hr.
(ii) The ship rolls at an angular velocity of 0.1 rad/sec.

(C) Explain balancing of several masses rotating in different plane with neat sketch.

(D) Explain transfer of force from one plane to another with neat sketch.

SECTION - II

Que. 4

(A) Define vibration. Enlist the examples in which vibrations are undesirable and desirable. Also enlist the main causes of vibration and methods to reduce the vibration. [4]

(B) Explain and derive the equation for natural frequency of transverse vibration with neat sketch. [4]

(C) Derive the equation of motion for a simple pendulum. Also find the natural frequency of the system in which considers mass of the ball is 3 kg and length of the pendulum is 2 m. Neglect the mass of the rod or string. [4]

OR

Que. 4

(A) Explain energy method to derive equation of motion for a single spring mass system. [4]

(B) For a given spring mass system as shown in Fig. (A), find the natural frequency of oscillation for the roller. Take, k = 1000 N/m; m = 5 kg and r = 30 mm. [8]

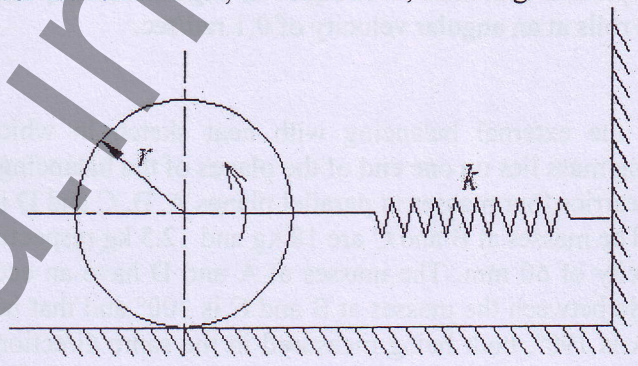

Fig. (A)

Que. 5

(A) What do you mean by damped vibration? Explain equivalent damper systems with neat sketches. [4]

(B) A vibrating system having following specifications: [7]
Mass of the body = 60 kg, spring stiffness = 800 N/m, Initial displacement of mass = 250 mm and frictional force = 7 N. Determine: (1) Reduction of amplitude per cycle, (2) Number of cycles before it brings to stop, (3) Time elapsed before stopping, and (4) Distance at which mass stops from the mean position.

OR

Que. 5

(A) Explain rate of decay of the damped oscillations with neat sketch. [5]

(B) In a spring mass dashpot system, stiffness of the spring is 10 kN/m on which mass of 10 kg is supported. The damping co-efficient is 10 Ns/m. Determine: (1) Damped natural frequency (2) Logarithmic decrement and (3) amplitude after 2 cycles, if initial displacement is 5 mm. [6]

Que. 6 Attempt any three. [12]

(A) Explain phase angle versus frequency ratio using appropriate graph.

(B) Explain transmissibility curves with neat sketch.

(C) Explain critical speed of a shaft having a single rotor with damping using neat sketch.

(D) Explain free torsional vibrations of a single rotor system with neat sketch.

***********END OF PAPER*********