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# GANPAT UNIVERSITY
## B. Tech Sem.- IV Mechatronics Engineering
## CBCS Regular Examination: - May/June-2012
## 2MC404 Dynamics of Machines

[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 insensitiveness in the governor using suitable diagram. [4]

**(B)** The arms of a Proell governor are each 300 mm long. The upper arms are pivoted on the axis of rotation, while the lower arms are pivoted at a radius of 40 mm. Each ball weights 5 N and is attached to 100 mm long extension of the lower arm. The governor rotates at 169.78 rpm with neglecting the obliquity. At the minimum radius of 160 mm, the extensions of the lower arms are parallel to the governor axis. Find the weight of the sleeve. [8]

**OR**

**Que: 1**

**(A)** Define the power of a governor. Derive the following equation using usual notations for governor power: [4]

$$Power = \left(\frac{C^2 - 1}{C}\right)^2 (m + m_2)gh$$

**(B)** The controlling force curve of a spring controlled governor is straight line. The weight of each governor ball is 40 N and the extreme radii of rotation are 120 mm and 180 mm. If the values of the controlling force at the above radii be respectively 200 N and 360 N and the friction of the mechanism is equivalent to 2 N at each ball, find: [8]

(1) The extreme equilibrium speeds of the governor
(2) Equilibrium speed
(3) The coefficient of insensitiveness at radius of 150 mm.

**Que: 2**

**(A)** Define Gyroscope couple. Explain various axis and plane referred to gyroscope. [4]

**(B)** The turbine rotor of a ship has a mass of 200 kg rotates at 2000 rpm CW when viewed from the aft. The radius of gyration of the rotor is 0.30 m. Determine the followings: [8]

(1) The ship turns at a speed of 30 km/hr. Due to gyroscopic couple the bow rise and lower the aft with couple of 104.42 N.m. Find the radius of curvature at which the ship gets turning and show the direction of turning of ship.
(2) Show the effect of ship pitches when ship turns towards the starboard with the gyroscopic couple of 3769.74 N.m. Find the angular velocity of the precession.
(3) Explain the effect of gyroscopic couple when ship rolls with the magnitude of 376.974 N.m. Find the angular velocity of the precession.

**OR**

**Que: 2**

**(A)** Discuss the effect of Gyroscopic couple and Centrifugal couple on the stability of two wheel vehicle when taking a turn to right. [4]

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(B) The total mass of a four-wheel trolley car is 1800 kg. the car runs on rails of 1.6 m gauge and rounds a curve of 24 m radius at 36 Km/hr. The track is banked at 10°. The external diameter of the wheels is 600 mm and each pair with axle has a mass of 180 kg with radius of gyration of 240 mm. The height of the center of mass of the car above the wheel base is 950 mm. Determine the pressure on each rail allowing for centrifugal force and gyroscopic couple actions. [8]

**Que: 3**

(A) Explain the static and dynamic unbalance with their vibratory behaviour using suitable sketches. [3]

(B) Explain the external balancing with neat sketch for the case in which the plane of the disturbing mass lies on one end of the planes of the balancing masses. [3]

(C) A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C, and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. [5]

## SECTION – II

**Que: 4**

(A) Explain the Under cutting phenomenon for roller follower with neat sketch. [4]

(B) Determine the displacement, velocity, and acceleration for a 3-4-5 polynomial cam. The cam shaft rotates through an angle of 35°. The follower rise for 18 mm in 60° of cam rotation. The cam shaft rotates at 100 rad/sec. [8]

**OR**

**Que: 4**

(A) Derive the equations of displacement, velocity and acceleration for 3 degree polynomial cam for return condition. [6]

(B) For a 2-3 polynomial cam determine displacement, velocity and acceleration of follower which returns 20 mm in 90° of cam rotation, which the cam shaft turned through angle of 18°. The cam shaft rotates at 60 rpm. [6]

**Que: 5**

(A) Explain the path generation, function generator and motion generation. [4]

(B) Using Bloch's synthesis method, synthesize a four bar linkage that will, in one of its positions, satisfy the following values for the angular velocities and accelerations. [8]

$\omega_2 = 20$ rad/sec $\quad \dot{\omega}_2 = 0$ rad/sec$^2$

$\omega_3 = 8$ rad/sec $\quad \dot{\omega}_3 = 100$ rad/sec$^2$

$\omega_4 = 10$ rad/sec $\quad \dot{\omega}_4 = -150$ rad/sec$^2$

**OR**

**Que: 5**

(A) A Proell governor has equal arms of length 300 mm. The upper and lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80mm long and parallel to the axis when the radius of rotation of balls is 150mm and 200 mm. The mass of each ball is 10kg and the mass of the central load is 100Kg. Determine the range of speed of the governor. [6]

(B) The three conditions to be satisfied by a four bar linkage are: [6]

$\theta_2 = 60°$ $\quad \theta_4 = 90°$

$\omega_2 = 3$ rad/sec $\quad \omega_4 = 2$ rad/sec

$\alpha_2 = -1$ rad/sec$^2$ $\quad \alpha_4 = 0$ rad/sec$^2$

Determine the link, link length ratios using freudenstein's equation.

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**Que: 6** [2]

(A) Define the followings:
(1) natural frequency (2) Damping (3) Amplitude (4) Resonance

(B) Explain the deterministic and random vibration with neat sketch using proper illustrations. [2]

(C) For the system shown in **fig. (A)**, find the equivalent spring stiffness. [2]

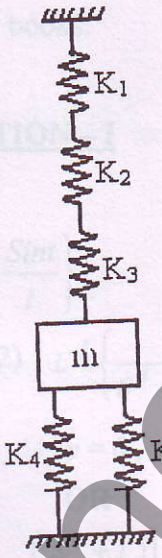


**Fig. (A)**

(D) Enlist the advantages of involute gears and cycloidal gears. [2]

(E) A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact. [3]

**END OF PAPER**