Student Exam No._____

# GANPAT UNIVERSITY

## B. Tech. Semester: IV (Mechatronics) Engineering

## CBCS Regular Examination May – June 2013

## 2MC404/MC405 Dynamics of Machines

**Time:** 3 Hours **Total Marks:** 70

**Instruction:**
1. Assume suitable data if necessary.
2. Write your answer to the point and precisely.
3. Draw neat and clean sketch.
4. Use of calculator is permitted.

### Section - I

**Que. 1**

**(A)** Define the following terms: (i) Stability, (ii) Sensitiveness, (iii) Isochronisum, and (iv) Hunting. **(04)**

**(B)** A porter governor has equal arms each 225 mm long and pivoted on the axis of rotation. Each ball has a mass of 6 kg and mass of the sleeve is 30 kg. The radius of rotation of the ball is 140 mm when the governor begins to lift and 200 mm when the governor is at max. Speed. Find the range of speed, sleeve lift, governor effort and power of the governor in the case when the friction at the sleeve is neglecting. **(07)**

**OR**

**Que. 1**

**(A)** State the different type of Governors. What is the different between Centrifugal and Inertia Governors? **(04)**

**(B)** In spring loaded hartnell governor, the extreme radii of rotation of the balls are 90 mm and 125 mm. The ball arm and the sleeve arm of the bell crank lever are equal in length. The mass of each ball is 3 kg. If the speed at the two extreme position are 390 and 410 rpm. Find; (i) The initial compression of the central spring, and (ii) The spring constant. **(07)**

**Que. 2**

**(A)** Explain with sketch Gyroscopic effect on Naval Ship. **(05)**

**(B)** A ship is propelled by a turbine rotor having mass of 200 kg and speed of 2000 rpm. The direction of rotation of the rotor is clockwise when viewed from the stern. The radius of gyration of rotor is 0.30 m. Determine gyroscopic effect when (i) The ship is turn to left at a curve of 300 m radius at speed of 30 km/hr, (ii) The ship pitches with the bow rising at an angular velocity of 1 rad/sec, and (iii) Ship rolls at an angular velocity of 0.1 rad/sec. **(07)**

**OR**

**Que. 2**

**(A)** What do you mean by Gyroscopic Couple? Derive a relation for its magnitude. **(04)**

**(B)** A disc type rotor having radius of gyration 70 mm and a mass of 5 kg is mounted at the centre on a horizontal axle of 90 mm length between the bearings. The rotor spins about the axle at 900 rpm anti-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. **(04)**

(C) A solid circular steel disc 250 mm diameter and 50 mm thick is mounted with its polar axis on the line OX, of the three Cartesian axis OX, OY, and OZ. If at a particular instant the disc is spinning about OX at 12 rad/sec and the frame is rotated at 5 rad/sec about OY. Determine the magnitude and sense of the gyroscopic torque. Density of steel taken as 7800 kg/m$^3$. (04)

**Que. 3** **Atteempt Any Three.** (12)

(A) Define following terms for Governor: (i) Height of Governor, (ii) Sleeve Lift, (iii) Equilibrium Speed, and (iv) Mean Equilibrium Speed.

(B) Describe the classification of Synthesis problem.

(C) Synthesize a four bar faction generation to solve the equation: $Y = SinX$, $0 \leq X \leq \prod/2$.
Use 3precision point and chebyshev spacing.
Take $\theta_0 = 30°$, $\psi_0 = 60°$ and $\Delta\theta = 60°$ and $\Delta\psi = 90°$. Draw configuration.

(D) Derive the Freudenstein's equation for displacement analysis.

## Section – II

**Que. 4**

(A) Derive equation for primary and secondary unbalanced force of reciprocating masses with neat sketch. (04)

(B) 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 plane 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 plane 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. (07)

**OR**

**Que. 4**

(A) Explain two planes balancing with neat sketch. (04)

(B) The masses are placed on rotating shaft in different planes having following properties: (i) $m_1 = 6$ kg, $r_1 = 70$ mm, $\theta_1 = 30°$, (ii) $m_2 = 5$ kg, $r_2 = 80$ mm, $\theta_2 = 120°$, (iii) $m_3 = 4$ kg, $r_3 = 90$ mm, $\theta_3 = 210°$. The shaft is 900 mm long and the plane containing mass $m_2$ is at middle of the shaft. The planes containing mass $m_1$ and mass $m_3$ are at equal distance of 200 mm from plane of mass $m_2$ on both sides. The planes of counter masses are to be placed at the distance of 100 mm from both the end of the shaft. The radial distance of the counter masses is 60 mm for both. Determine the magnitude of counter masses and their angular positions. (07)

**Que. 5**

(A) Justify the statement, "Some energy is dissipated in each cycle of vibration due to damping" using proper illustratation. (04)

(B) For a given system as shown in **Fig. (A)** Following data is given. (04)
Take $k_1 = 1500$ N/m; $k_2 = 800$ N/m; $k_3 = 250$ N/m and $k_4 = 300$ N/m.
Find the mass "m", if the system has a natural frequency of 8 Hz.

(C) Derive the equation of motion of a simple pendulum. Also find the natural frequency of the system. Take, Mass m = 3 kg, Length of pendulum L = 2m, Neglect the mass of the rod. (04)

**OR**

**Que. 5**

(A) Distinguish clearly between (i) Linear and Non-linear Vibration, and (ii) Undammed and Damped Vibration. (04)

(B) Explain the equation of motion simple spring mass system having single degree of freedom using Newton's second law of motion. **(04)**

(C) Explain basic terms used in vibratory system: (i) Periodic motion, (ii) Time period, (iii) Amplitude, (iv) Frequency, (v) Natural frequency, (vi) Resonance, (vii) Degree of freedom, (viii) Damping. **(04)**

**Que. 6** **Atteempt Any Three.** **(12)**

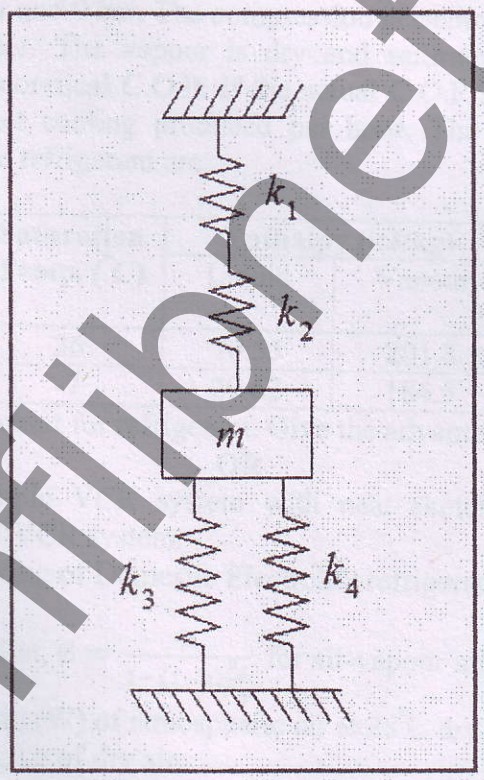
**(A)** Derive expression for the length of the arc of contact.

**(B)** 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, arc of contact and the contact ratio.

**(C)** State and prove the law of Gearing.

**(D)** Derive the following expressions, (i) Variation in tractive force, (ii) Swaying couple, (iii) Hammer blow.

**FIGURE**

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