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21/05/2014.
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Student Exam No._____

GANPAT UNIVERSITY

B. Tech. Semester: IV (Mechatronics Engineering)

CBCS Regular Examination May – June 2014

2MC404 Dynamics of Machines

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

Instruction:
1. Assume suitable data if necessary.
2. Answer to the two sections must be written in separate answer books.
3. Figures to the right indicate full marks of the questions.

Section - I

Que. 1 **Answer the following question.**

(A) Find the power of the porter governor when $\alpha \neq \beta$. [06]

(B) Each arm of a porter governor is 200 mm long and is pivoted on the axis of the governor. The radiuses of rotation of the balls at the minimum and maximum speeds are 120 mm and 160 mm respectively. The mass of the sleeve is 24 kg and each ball is 4 kg. Find the range of speed of the governor. Also, determine the range of speed if the friction at the sleeve is 18 N. [06]

OR

Que. 1 **Answer the following question.**

(A) Sketch a Hartnell governor. Describe its function and derive a relation to find the stiffness of the spring. [06]

(B) Each ball of a porter governor has a mass of 6 kg and mass of the sleeve is 40 kg. The upper arms are 300 mm long and are pivoted in the axis of rotation whereas the lower arms are 250 mm long and are attached to the sleeve at a distance of 40 mm from the axis. Determine the equilibrium speed of the governor for radius of rotation of 150 mm for 1% change in speed. Also, find the effort and the power for the same speed change. [06]

Que. 2 **Answer the following question.**

(A) Discuss the gyroscopic effect on sea vessels. [06]

(B) Two 20° involute spur gears mesh externally and give a velocity ratio of 3. The module is 3 mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine the (i) Minimum number of teeth on each wheel to avoid interference, (ii) Contact ratio. [05]

OR

Que. 2 **Answer the following question.**

(A) The rotor of the turbine of a ship has a mass of 2500 kg and rotates at a speed of 3200 rpm counter-clockwise when viewed from stern. The rotor has radius of gyration of 0.4 m. Determine the gyroscopic couple and its effect when, [06]

(i) The ship steers to the left in a curve of 80 m radius at a speed of 15knots. (1 knot = 1860 m/h),

(ii) The ship pitches 5° above and 5° below the normal position and the bow is descending with its maximum velocity-the pitching motion is simple harmonic with a periodic time of 40 seconds,

(iii) The ship rolls and at the instant, its angular velocity is 0.4 rad/sec clockwise when viewed from stern.

Also, find the maximum angular acceleration during pitching.

(B) Define following terms with figure: - (1) Pitch Circle, (2) Pitch Diameter (3) Clearance (4) Addendum (5) Backlash (6) Angle of Action [05]

[12]

Que. 3 **Atteempt any three.**

(A) Define Arc of Contact & deduce the expression to find its magnitude.

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

(C) Explain the working of a Hartung Governor with a neat sketch.

(D) Explain controlling force diagram for spring controlled governor.

Section - II

Que. 4 **Answer the following question.**

(A) Derive Freudenstein's equation for 4- bar mechanism. [04]

(B) A shaft carries a four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at a radii of 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 planes A and X are 100 mm and between X and Y 400 mm. If the balancing masses revolve at a radius of 110 mm, find their magnitude and angular positions. [08]

OR

Que. 4 **Answer the following question.**

(A) What is the need of balancing? Give four examples of practical problems where balancing is done. [04]

(B) Synthesis a four bar mechanism to generate the function $y = 2x^{1.5} - x$ in the interval of $0 \leq x \leq 4$. The input crank length is 50 mm. The input crank is to rotate from 30° to 75° while output link moves from 90° to 180°. Use three accuracy points with Chebyshev's spacing. [08]

Que. 5 **Answer the following question.**

(A) Synthesis a four bar mechanism using Freudenstein's equation to satisfy in one of its positions. The specification of position θ, velocity ω and acceleration α are as follow: [07]

$\theta = 60°$; $\omega_2 = 5$ rad/sec; $\alpha_2 = 2$ rad/sec^2

$\emptyset = 90°$; $\omega_4 = 2$ rad/sec; $\alpha_4 = 7$ rad/sec^2

(B) Define the following terms: [04]

1. Periodic motion 2. Amplitude of vibration
3. Resonance 4. Frequency

OR

Que. 5 **Answer the following question.**

(A) Explain balancing of single rotating mass by a single mass rotating in a same plane. [04]

(B) Synthesis a four bar mechanism to generate the function $y = 5\text{Sin}x$ in the interval of $0° \leq x \leq 90°$. The input crank angle is varied from 30° to 150° while output link moves from 60° to 120°. Use three accuracy points with Chebyshev's spacing. The input crank length is 40 mm. [07]

[12]

Que. 6 **Attempt any three.**

(A) Explain static balancing and dynamic balancing.

(B) Enlist various methods of equations of motion of a spring mass system.

(C) Classify synthesis problems and explain in detail.

(D) What is synthesis? How it is differ from analysis?

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