Register Number:……..

KUMARAGURU
college of technology
character is life

**B.E., DEGREE EXAMINATIONS: APRIL / MAY 2023**

(Regulation 2018)

Fifth Semester

**MECHANICAL ENGINEERING**

U18MEI5205: Dynamics of Machinery

**COURSE OUTCOMES**

**CO1:** Analyze the static and dynamic force in mechanical systems. Evaluate the fluctuation of energy stored in flywheel.
**CO2:** Determine the unbalanced force in reciprocating and rotating mass
**CO3:** Apply the fundamental concepts of vibrating system to predict the natural frequency
**CO4:** Estimate the frequency of damped and forced vibrating systems
**CO5:** Calculate the speed range of governors.
**CO6:** Determine the gyroscopic couple.

**Time: Three Hours** **Maximum Marks: 100**

**Answer all the Questions:-**
**PART A (10 x 2 = 20 Marks)**
**(Answer not more than 40 words)**

| | | | |
|---|---|---|---|
| 1. | State D-Alembert's principle | CO1 | [$K_1$] |
| 2. | List the applications of flywheel. | CO1 | [$K_2$] |
| 3. | List the impact of rotating unbalance on machineries. | CO2 | [$K_2$] |
| 4. | Discuss the difference between rotating unbalance and reciprocating unbalance force. | CO2 | [$K_2$] |
| 5. | Discuss the impact of stiffness on the amplitude and frequency of the vibratory system whose mass is relatively constant. | CO3 | [$K_3$] |
| 6. | List the different types of damping used. | CO3 | [$K_2$] |
| 7. | Specify the importance of vibration isolation. | CO4 | [$K_2$] |
| 8. | Identify the desirable property of the vibration isolation materials. | CO4 | [$K_2$] |
| 9. | Discuss the impact of hunting on the stability of the governor. | CO5 | [$K_2$] |
| 10. | Discuss the effect of the gyroscopic couple on a 2 wheeled vehicle when taking a turn. | CO6 | [$K_2$] |

**Answer any FIVE Questions:-**
**PART B (5 x 16 = 80 Marks)**
**(Answer not more than 400 words)**

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| 11. | Twenty numbers of 1 cm diameter holes are to be punched every minute in a 1.5 cm steel plate whose resistance to shear is 353.16 MPa. The actual punching takes place one fifth of the interval between two successive operations. The speed of the flywheel is 300 rpm. Design a suitable CI rimmed flywheel with the coefficient of fluctuation of speed 0.01 and the maximum velocity of the rim equal to 60m/s. | 16 | CO1 | [$K_3$] |
| 12. | A shaft has three eccentrics of mass 1 kg each. The central plane of the eccentrics is 50 mm apart. The distances of the centers from the axis of rotation are 20, 30 and 20 mm and their angular positions are 120° apart. Find the amount of out-of-balance force and couple at 600 rpm. If the shaft is balanced by adding two masses at a radius of 70 mm and at 100 mm from the central plane of the middle eccentric, find the amount of the masses and their angular positions. | 16 | CO2 | [$K_3$] |
| 13. | A shaft 50 mm diameter and 3 m long is simply supported at the ends and carries three loads of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from the left support. The Young's modulus for shaft material is 200 GN/$m^2$. Find the frequency of transverse vibration and critical speed of the shaft. Neglect the self-weight of the shaft. | 16 | CO3 | [$K_2$] |
| 14. | A machine has a mass of 100 kg and unbalanced reciprocating parts of mass 2 kg which move through a vertical stroke of 80 mm with simple harmonic motion. The machine is mounted on four springs, symmetrically arranged with respect to center of mass, in such a way that the machine has one degree of freedom and can undergo vertical displacements only.<br>Neglecting damping, calculate the combined stiffness of the spring in order that the force transmitted to the foundation is 1 / $25^{th}$ of the applied force, when the speed of rotation of machine crank shaft is 1000 rpm.<br>When the machine is supported on the springs, it is found that the damping reduces the amplitude of successive free vibrations by 25%. Find | 16 | CO4 | [$K_2$] |

1. Force transmitted to foundation at 1000 rpm.,
2. Force transmitted to the foundation at resonance
3. Amplitude of the forced vibration of the machine at resonance.

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|---|---|---|---|---|
| 15. | The arms of a Porter governor are each 200 mm long and are pivoted on the axis of rotation. The weight of each ball is 40 N and that of the sleeve is 200 N. The radius of rotation of the balls is 125 mm when the sleeve begins to rise and reaches a value of 150 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent to 20 N of load at the sleeve, determine how the speed range is modified. | 16 | CO5 | [$K_2$] |
| 16. | A rear engine automobile is travelling along a track of 100 m mean radius. Each of the four wheels has a moment of inertia of 2 kg.m$^2$ and an effective diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of 1.25 kg.m$^2$. The engine axis is parallel to the rear axle and the crankshaft rotates in the same direction as the wheels. The gear ratio of engine to back axle is 3:1. The automobile mass is 1500 kg and its center of gravity is 0.5 m above the road level. The width of track of the vehicle is 1.5 m.<br>Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface if it is not banked. | 16 | CO6 | [$K_2$] |

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