KUMARAGURU
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B.E DEGREE EXAMINATIONS: NOV/DEC 2024
(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.	Highlight the significance of inertia force analysis in a reciprocating mass system?	CO1	[K_2]
2.	How to calculate the coefficient of fluctuation of speed in a flywheel?	CO1	[K_2]
3.	List the differences between static and dynamic balancing.	CO2	[K_1]
4.	List the differences between primary and secondary unbalanced forces in the reciprocating mass.	CO2	[K_1]
5.	Define logarithmic decrement.	CO3	[K_1]
6.	Describe the energy transfer in a system undergoing free vibration.	CO3	[K_2]
7.	List the features of viscous damping.	CO4	[K_1]
8.	How can you determine the frequency of a system undergoing forced vibrations?	CO4	[K_2]
9.	What factors affect the speed range of a Hartnell governor?	CO5	[K_2]
10.	How is a gyroscope used in navigation systems?	CO6	[K_2]

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

11.	A 5 kW induction motor running at 900 rpm operates a riveting machine, it has a flywheel fitted to it of mass 100 kg and radius of gyration 0.4. Each riveting takes 1 second and requires 10 kW determine:	16	CO1	[K_2]

    i.   The number of rivets closed per hour

    ii.   The fall in speed of the flywheel after the riveting operation.

12.	A single cylinder horizontal engine runs at 120 rpm with a stroke of 400 mm. The mass of the revolving parts assumed concentrated at the crankpin is 100 kg and mass of the reciprocating parts is 150 kg. Determine the magnitude of the balancing mass to be placed opposite to the crank at a radius of 150 mm which is equivalent to all the revolving and $2/3^{rd}$ of the reciprocating parts. If the crank turns $30°$ from the inner dead centre, find the magnitude of the unbalanced force due to the balancing mass.	16	CO2	[K$_3$]

13. A machine mounted on springs and fitted with a dashpot has a mass of 60 kg. There are three springs, each of stiffness 12 N/mm. The amplitude of vibrations reduces from 45 to 8 mm in two complete oscillations. If the damping force varies with velocity, determine the
    i.   damping coefficient
    ii.   ratio of frequencies of damped and undamped vibrations
    iii.   periodic time of damped vibrations
        16   CO4   [K$_2$]

14. A torsional system consists of engine, flywheel and propeller. The mass moment of inertia of engine, flywheel and propeller are 30, 90 and 50 kg.cm^2 respectively. Find the frequencies of torsional vibrations and the positions of the nodes. Also, find the amplitudes of vibrations. Assume the shear modulus as 84 GPa.
        16   CO3   [K$_2$]

15. A single-cylinder vertical diesel engine has a mass of 400 kg and is mounted on a steel chassis frame. The static deflection owing to the weight of the chassis is 2.4 mm. The reciprocating masses of the engine amounts to 18 kg and the stroke of the engine is 160 mm. A dashpot with a damping coefficient of 2 N/mm/s is also used to dampen the vibrations. In the steady state of the vibrations, determine the
    i.   Amplitude of the vibrations if the driving shaft rotates at 500 rpm
    ii.   Speed of the driving shaft when the resonance occurs.
        16   CO4   [K$_3$]

16. a) A porter governor has equal arms of 200 mm long and pivoted on the axis of rotation. The mass of each ball is 3 kg and the mass on the sleeve is 15 kg. The radius of the rotation of the ball is 120 mm when it begins to lift and 160 mm at the maximum speed. Determine the range of speed. Include the effect of friction at the sleeve is equivalent to 10 N.
        8   CO5   [K$_2$]

   b) 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 the stern. The rotor has a radius of gyration of 0.4 m. determine the gyroscopic couple and its effect when
    i.   The ship steers to the left in a curve of 80 m radius at a speed of 18 knots (1 knot = 1860 m/h)
    ii.   The ship pitches 5 degrees above and 5 degrees 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/s clockwise when viewed from the stern.
        8   CO6   [K$_3$]

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