**20ME501**

**Hall Ticket Number:**

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| **III/IV B.Tech (Regular/Supplementary) DEGREE EXAMINATION** | | | |
| **December, 2023** | **Mechanical Engineering** | | |
| **Fifth Semester** | **Dynamics of Machines** | | |
| **Time:** Three Hours | | **Maximum: 7**0 Marks | |
| *Answer Question No. 1 Compulsorily.* | | | (14X1 = 14 Marks) |
| *Answer* ***ANY ONE*** *question from each Unit.* | | | (4X14=56 Marks) |

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| 1. | a) | Define piston effort. | CO1 | L1 | 1M |
|  | b) | What do you mean by a dynamically equivalent system? | CO1 | L2 | 1M |
|  | c) | Differentiate between a flywheel and governor. | CO1 | L1 | 1M |
|  | d) | When do you say that a governor is isochronous? | CO1 | L2 | 1M |
|  | e) | What is a gyroscopic couple? | CO2 | L1 | 1M |
|  | f) | When looking from the rear, the right side of a ship is known as\_\_\_\_\_\_\_\_\_\_\_. | CO2 | L1 | 1M |
|  | g) | Differentiate between static and dynamic balancing. | CO2 | L2 | 1M |
|  | h) | What do you mean by simple harmonic motion? | CO3 | L1 | 1M |
|  | i) | With reference to free vibration of an undamped system, what is the energy principle? | CO3 | L2 | 1M |
|  | j) | What is damping factor? | CO3 | L1 | 1M |
|  | k) | What do you mean by transient and steady state vibrations? | CO3 | L2 | 1M |
|  | l) | What do you mean by resonance? | CO4 | L1 | 1M |
|  | m) | Define magnification factor with reference to forced vibrations. | CO4 | L1 | 1M |
|  | n) | What is a seismic unit? | CO4 | L1 | 1M |
| **Unit -I** | | | | | |
| 2. | a) | Derive expressions for displacement, velocity and acceleration of the piston in a slider-crank mechanism. | CO1 | L1 | 6M |
|  | b) | The crank pin circle radius of a horizontal engine is 300 mm. The mass of the reciprocating parts is 250 kg. When the crank has travelled 60o from IDC, the difference between the driving and the back pressures is 0.35 N/mm2. The connecting rod length between centers is 1.2 m and the cylinder bore is 0.5 m. If the engine runs at 250 rpm and if the effect of piston rod diameter is neglected, calculate i) piston effort ii) thrust in the connecting rod, iii) crank effort and iv) turning moment on the crank shaft. | CO1 | L2 | 8M |
|  |  | **(OR)** |  |  |  |
| 3. | a) | With a neat diagram explain the principle and working of a centrifugal governor | CO1 | L1 | 6M |
|  | b) | Each arm of a porter governor is 250 mm long. The upper and lower arms are pivoted to links of 40 mm and 50 mm respectively from the axis of rotation. Each ball has a mass of 5 kg and the sleeve mass is 50 kg. The force of friction on the sleeve of the mechanism is 40 N. Determine the range of speed of the governor for extreme radii of rotation of 125 mm and 150 mm. | CO1 | L2 | 8M |
|  |  | **Unit -II** |  |  |  |
| 4. | a) | What is a gyroscopic couple? Derive an expression for the same. | CO2 | L2 | 6M |
|  | b) | A Ship is propelled by a turbine rotor having a mass of 6 tonnes and speed of 2400 rpm. The direction of rotation of the rotor is clockwise when viewed from the stern. The radius of gyration of the rotor is 450 mm. Determine the gyroscopic effect when,   1. The ship steers to the left in a curve of 60 m radius at a speed of 18 Knots (1 Knot = 1860 m/hr) 2. The ship pitches 7.5 degrees above and 7.5 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 18 seconds. | CO2 | L3 | 8M |
|  |  | **(OR)** | | | |
| 5. |  | A rotor has the following properties   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Mass | Magnitude | Radius | Angle | Axial distance from the 1st mass | | 1 | 9 Kg | 100 mm | 00 |  | | 2 | 7 Kg | 120 mm | 600 | 160mm | | 3 | 8 Kg | 140 mm | 1350 | 320 mm | | 4 | 6 Kg | 120 mm | 2700 | 560 mm |   If the shaft is balanced by two counter masses located at 100 mm radii and revolving in planes midway of planes 1 and 2, and midway of 3 and 4, determine the magnitude of the masses and their respective angular positions. | CO2 | L3 | 14M |
| **P.T.O**  **20ME501** | | | | | |
|  |  | **Unit -III** | |  |  |
| 6. |  | Determine the torsional natural frequency of the system shown in figure. Neglect the mass moment of inertia of the shaft. Take J = 0.0098 kg-m2, G = 83 GPa. | CO3 | L2 | 14M |
|  |  | **(OR)** |  |  |  |
| 7. | a) | Define logarithmic decrement. Derive an expression for the same | CO3 | L1 | 6M |
|  | b) | A vibrating system consisting of a mass of 2.27 kg and a spring of stiffness 17.5 N/cm is viscously damped such that the ratio of any consecutive amplitudes is 1 to 0.98. Determine i) the natural frequency of the damped system ii) the logarithmic decrement iii) the damping factor and iv) the damping coefficient. | CO3 | L2 | 8M |
|  |  | **Unit -IV** |  |  |  |
| 8. | a) | A weight attached to a spring of stiffness 525 N/m has a viscous damping device. When the weight is displaced and released, the period of vibrations is 1.80 seconds, and the ratio of consecutive amplitudes is 4.2 to 1.0. Determine the amplitude and phase when a force F = 2 cos3t N acts on the system. | CO4 | L2 | 7M |
|  | b) | The support of a spring mass system is vibrating harmonically with amplitude of 5 mm and a frequency of 1150 cycles/min. If the mass is 0.9 kg, spring stiffness is 1960 N/m and damping factor is 0.2, determine the amplitude of vibration of the mass. | CO4 | L3 | 7M |
|  |  | **(OR)** |  |  |  |
| 9. | a) | Write a short note on vibration measuring instruments. | CO4 | L1 | 6M |
|  | b) | A machine of 100 kg mass is supported on springs of total stiffness 700 kN/m and has an unbalanced rotating element, which results in a disturbing force of 350 N at a speed of 3000 rpm. Assuming a damping factor of 0.20, determine i) its amplitude of motion due to unbalance, ii) the transmissibility, and iii) the transmitted force. | CO4 | L3 | 8M |

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