**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(END SEMESTER EXAMINATION MO2022)**

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| **CLASS:** | **M.TECH.** | **SEMESTER: I** |
| **BRANCH:** | **CIVIL** | **SESSION: MO2022** |

**SUBJECT: CE503 STRUCTURAL DYNAMICS**

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| **TIME:** | **03 Hours** | **FULL MARKS: 50** |

**INSTRUCTIONS:**
**1. The question paper contains 5 questions each of 10 marks and total 50 marks.**
**2. Attempt all questions.**
**3. The missing data, if any, may be assumed suitably.**

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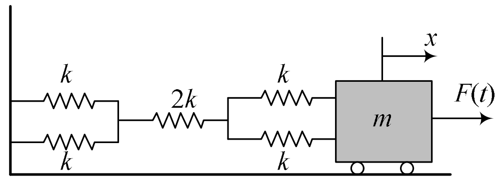
| Q.1(a) | Define natural frequency and critical damping. | [2] | CO1 | K1 |
| Q.1(b) | Derive the equation of motion for the following single degree of freedom (SDOF) system | [3] | CO1 | K4 |

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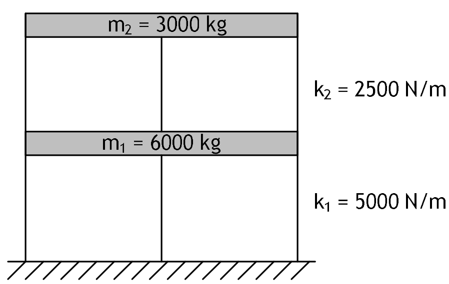
| Q.1(c) | A Heavy table is supported by flat steel legs. Its natural period in lateral vibration is 0.4 sec. When 4 kg plate is clamped to its surface, the natural period in lateral vibration is lengthened to 0.6 sec. What are the weight and effective stiffness of the table? | [5] | CO1 | K3 |
| Q.2(a) | Explain the resonance phenomena with respected to harmonic vibration of single degree of freedom (SDOF) system. | [2] | CO1 | K2 |
| Q.2(b) | What is the difference between the damped and undamped natural frequencies and natural time periods for a damping ratio of 0.5? | [3] | CO1 | K3 |
| Q.2(c) | Derive the equation of displacement for harmonic forced vibration response of underdamped SDOF system with zero initial velocity and zero initial displacement | [5] | CO1 | K2 |
| Q.3(a) | Write a short note on the modal super position method of solving multi degree of freedom system | [2] | CO2 | K2 |
| Q.3(b) | Proves the orthogonality properties of mode shapes. | [3] | CO2 | K3 |
| Q.3(c) | Determine the natural frequencies and mode shapes of the two-storey structure shown in the given figure | [5] | CO2 | K3 |

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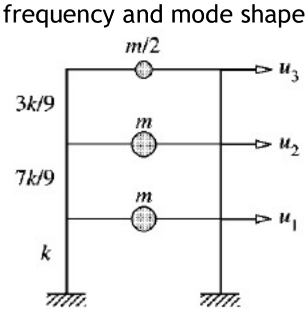
| Q.4(a) | Explain the Forward Cauchy Euler time stepping methods with suitable example. | [3] | CO3 | K2 |
| Q.4(b) | The floor masses and story stiffnesses of the three-storey frame, idealized as a shear frame, are shown in given figure, where m 100 kg, and k=168 N/m. determine frequency and mode shape for first mode by inverse vector iteration. | [7] | CO2 | K4 |




**PTO**

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| Q.5(a) | Write a short note on modal participation factor. | [2] | CO4 | K2 |
| Q.5(b) | Derive the equation of motion for single degree of freedom (SDoF) system subjected to earthquake loading. | [3] | CO4 | K3 |
| Q.5(c) | Derive the solution for undamped free vibration of multi degree of freedom (MDoF) system subjected to initial displacement $\{u_0\}$ and initial velocity $\{\dot{u}_0\}$. | [5] | CO2 | K4 |

**:::::23/11/2022:::::E**