BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
FIRST SEMESTER 2022– 2023
Dynamics of Structures – Mid-Semester Examination

Course No: CE G552 **Date: 31-10-2022**
Duration: 90 Mins. (Open book) **Max. Marks: 30**

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1. Using the energy method, prove that the natural period of oscillation of fluid in a U-tube manometer is $T_n = 2\pi\sqrt{\frac{l}{2g}}$; where *l* is the length of the fluid column. **[6]**

2. A cantilever beam of total mass ***m*** is distributed over the length "***l***" of the beam. Determine the effective mass of the system at free end and find its natural frequency. The maximum deflection ($u_{\max}$) under the load due to a concentrated force ***P*** applied at the free end is $\frac{PL^3}{3EI}$. Where *EI* is the flexural rigidity of the beam. **[7]**

3. Prove that the displacement resonant frequency, velocity resonant frequency, and acceleration resonant frequency are $\omega = \omega_n\sqrt{1-2\xi^2}$, $\omega = \omega_n$ and $\omega = \omega_n \Big/ \sqrt{1-2\xi^2}$ respectively. Also show that the maximum values of displacement response factor (R_d), velocity response factor (R_v), and acceleration response factor (R_a) at their respective resonant frequencies are $1 \Big/ 2\xi\sqrt{1-\xi^2}$, $1 \Big/ 2\xi$ and $1 \Big/ 2\xi\sqrt{1-\xi^2}$. **[6]**

4. An SDOF system with mass 3 kg and stiffness 192 N/m is subjected to complex harmonic force $5e^{i\omega t}$. Find the frequency response function (FRF) $H(\omega)$, and displacement $u(\omega)$ at ω = 5 rad/s. Also find the amplitude and phase of the response. Assume damping ratio ξ =5 %. **[5]**

5. An electric motor of mass 50 kg is mounted on an isolator of mass 1000 kg and the natural frequency of total assembly is 150 cycles/minute with a damping factor of 0.1. If there is an unbalance in the motor that results in a harmonic force $F = 100\sin 31.4t$, determine the amplitude of vibration of the block and the force transmitted to the floor. **[6]**