Ref. No.: EX/PG/CE/T/11A/6/2017

M. CIVIL ENGG. 1ST SEM EXAM – 2017

Subject: DYNAMICS OF STRUCTURE Time: Three (3) hours Full Marks: 100

Answer any four (4)

1. Use Laplace transform method to determine the response of an (i) undamped (ii) underdamped 1 – DOF system of natural frequency ω_n and mass m subject to a constant force F_0. Given
$\mathcal{L}^{-1}\frac{1}{s} = 1; \mathcal{L}^{-1}\frac{s}{s^2+\omega^2} = cos\omega t$ and $\mathcal{L}^{-1}\frac{1}{s-\alpha} = e^{\alpha t}$ 12.5 x 2

2. Define Response Spectrum. Develop the response spectrum for a SDOF system subjected to a half – sine wave of magnitude F_0 and time period $2t_0$. Assume any other relevant data as needed. 5 + 20

3. a) Develop the expression for transmissibility in a base excited system and plot the transmissibility *vs* frequency ratio for the same for different damping ratio.
b) A 45 – kg machine is placed at the end of a 1.6 m cantilever beam of elastic modulus 200 GPa and moment of inertia 1.6 x 10^{-5} m^4. As it operates the machine produces a harmonic force of magnitude of 25 N. At what operating speed will the machine's steady state amplitude be less than 0.2 mm? 15 + 10

4. Develop the element stiffness matrix and the element mass matrix of an Euler – Bernoulli beam element from the energy principle. Hence, write the assembled stiffness and mass matrix for a beam discretized using two numbers of 2 – node element. 10 + 10 + 5

5. Develop the Lagrange Equation from the Extended Hamiltonian Principle for a linear conservative dynamic system. Hence develop the governing differential equation for a transversely vibrating beam and obtain the fundamental frequency and mode shape for a beam simply supported at both ends. 10 + 10 + 5