Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

FIRST SEMESTER M.TECH (STRUCTURAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: **STRUCTURAL DYNAMICS** [CIE – 545]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.

1A.	For the system shown in Fig. Q1A formulate the equation of motion using D'Alembert's method	**5**
1B.	A one storey building is idealized as a rigid girder supported by weightless columns. In order to evaluate the dynamic properties of this structure a free vibration test is made, in which the roof system (rigid girder) is displaced laterally by a hydraulic jack and then released. During the jacking operation, it is observed that a force of 25 kN is required to displace the girder by 6 mm. After the instantaneous release of this initial displacement, the maximum displacement on the return swing is 4 mm and the period of this displacement cycle is 1.3 sec. Determine weight of the girder, natural frequency, damping constant, damping ratio, damped frequency, logarithmic decrement and amplitude after 4 cycles	**5**
2A.	Derive the expression for response for the free vibration of an over damped SDOF system with the following initial boundary conditions i) at t = 0 V = V_o and $\dot{V}$ = $\dot{V}o$ ii) at t = 0 V = 75 mm and $\dot{V}$ = 9 mm/ sec	**5**
2B.	A simple beam supports at its center a machine having a weight of 170 kN. The beam is made of two beams of clear span 4.6 m and each I = 7×10^7 mm^4. The motor runs at 380 rpm and its rotor is out of balance to the extent of 27 kg and at a radius of e = 28 mm. What will be the amplitude of the steady state response if the equivalent viscous damping is assumed 15% of the critical?. E = 220 kN/ mm^2	**5**
3A.	Using simpson's rule for numerical evaluations of Duhamel's integral determine the dynamic response of SDOF system subjected to a blast loading shown in Fig. Q3A. The physical properties are W = 53.33 kN and K = 5000 kN/m. Take $\Delta\tau$ = 0.01 sec	**5**
3B.	A basic SDOF system with the following properties W = 2700 N and K = 180 kN/m is subjected to a half sine wave impulse of amplitude P_0 = 2.3 kN and duration t_1 = 0.15 sec. Determine (i) the maximum response and the time at which it occurs (ii) maximum spring force and (iii) response at t = 0.2 sec.	**5**

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4A.	For the three storey shear building shown in Fig. Q4A, obtain the natural frequencies and the modes of vibration. Use classical method.	**7**
4B.	Write a note on orthogonality relationship	**3**
5A.	The two degrees of freedom system shown in Fig.Q5A is subjected to a single harmonic force $p_2 = 5 \sin \bar{\omega} t$. Its undamped vibration mode shapes and frequencies are shown below. Determine the study state response of each of the masses as a function of frequency at t = 2 seconds. Take $\bar{\omega} = 1.2\ \omega$. Use mode super position method. $\Phi = \begin{pmatrix} 1 & 1 \\ 0.6 & -1.2 \end{pmatrix}$ $\omega = \begin{Bmatrix} 13 \\ 28 \end{Bmatrix}$ rad /sec	**6**
5B.	Using the Hermitian polynomial as shape functions evaluate the consistence mass coefficient m_{23} for a beam (Fig. Q5B) having the following non-uniform mass distribution. $m(x) = m\ (1 + \bar{x}/L)$.	**4**
6A.	Treating the simply supported beam of uniform cross section as continuous systems obtain expression for frequency and vibration shape.	**5**
6B.	Using modified Rayleigh's methods determine the fundamental frequency of the system shown in Fig. Q6B.	**5**

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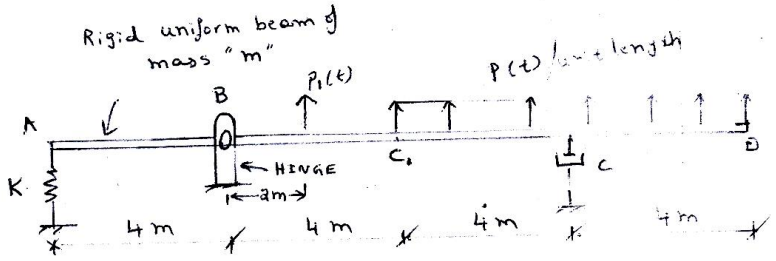

Fig. Q1A

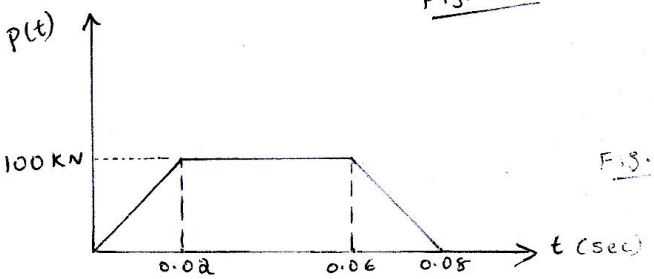

Fig. Q3A

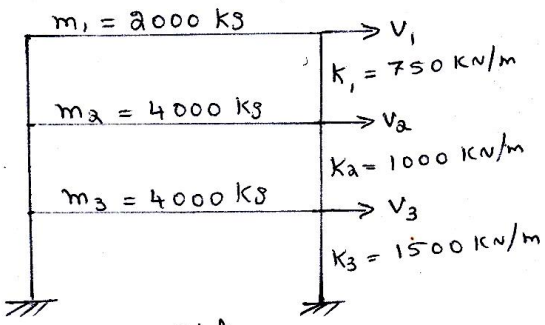

Fig. Q4A

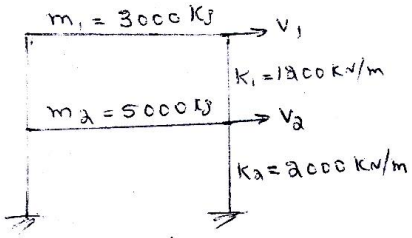

Fig. Q5A

Fig. Q5B

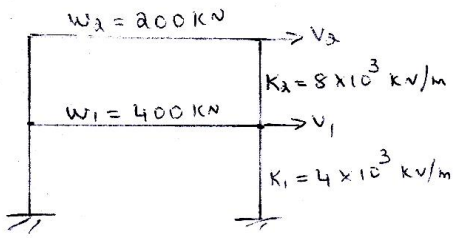

Fig. Q6B