Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
ME SEMESTER – I (OLD) EXAMINATION – SUMMER 2017

Subject Code: 712002N   **Date:09/05/2017**
Subject Name: Structural Dynamics
Time: 02:30 P.M. to 05:00 P.M.   **Total Marks: 70**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 **(a)** Define the term (i) degree of freedom (ii) time period (iii) **07**
natural frequency (iv) dynamic magnification factor (v)
static and dynamic loading (vi) harmonic loading (vii)
resonance

(b) A spring mass model consist of 20 kg mass and spring of **07**
stiffness 2000 N/m was tested for viscous damped
vibration. The test recorded two consecutive amplitude is
1.0 cm and 0.8 cm respectively. Determine (i) natural
frequency of undamped system (ii) logarithmic decrement
(iii) damping ratio (iv) damping coefficient (v) damped
natural frequency.

Q.2 **(a)** Write the differential equation for the free undamped single **07**
degree of freedom system and derive the equation of
motion.

(b) A SDOF system consists of 3.0 m high column of 500 mm **07**
diameter which supports the heavy mass of 7500 kg at its
top. The system is subjected to a harmonic force of
1500sin50t N. Consider damping ratio as 0.5 and E = 2 ×
10^5 N/mm^2. Calculate the maximum dynamic amplitude
and also state whether the system will have resonance or
not?

OR

(b) What is damping? Define underdamped, critically damped **07**
and over damped system. Show that the damping can be
neglected for frequency calculations.

Q.3 **(a)** Define mathematical model. Also draw the one suitable **07**
example of single degree, two-degree and three-degree of
freedom system each and its mathematical model.

(b) A simply supported beam having a span of 5 m, uniform **07**
mass of 1200 kg/m and flexural rigidity of 2000 kN-m^2.
Assuming the deflection/shape function as $\psi(x) = \sin(\pi x/L)$), determine the natural frequency of beam.

OR

Q.3 **(a)** A uniform cantilever chimney of length L has mass per unit **07**
length is m and flexural rigidity EI. Assuming the
deflection/shape function as $\psi(x) = (1-\cos(\pi x/2L))$,
determine the natural frequency of chimney.

(b) (i) Differentiate between consistent mass matrix and lumped mass matrix. **07**
(ii) Explain in brief Logarithmic decrement.

Q.4 **(a)** A single spring mass system has spring constant of 2000 **07**
N/m and mass of 20 kg. If it is loaded by a periodical load
for which a single period is as shown in the Figure 1, derive
the equation of the response using Fourier series.

(b) A single spring mass system has spring constant of 750 **07**
N/m and mass of 7.5 kg. If it is loaded by an impulsive
load as shown in the Figure 2, derive the equation of the
response after completion of the impulse.

OR

Q.4 **(a)** A single spring mass system has spring constant of 2500 **07**
N/m and mass of 25 kg. If it is loaded by a periodical load
for which a single period is as shown in the Figure 3, derive
the equation of the response using Fourier series.

Q.4 **(b)** A single spring mass system has spring constant of 3000 **07**
N/m and mass of 30 kg. If it is loaded by an impulsive load
as shown in the Figure 4, derive the equation of the
response after completion of the impulse and find the
responses at t= 1 second.

Q.5 **(a)** A two storey shear building model has the stiffness as 200 **07**
kN/m, and 100 kN/m and masses as 1000 kg, and 500 kg
from support respectively. Evaluate the stiffness matrix,
mass matrix and natural frequency of building.

(b) Show that the modes of vibration of the above shear **07**
building satisfy the orthogonality properties.

OR

Q.5 **(a)** A two storey building has the stiffness as 50000 N/m at **07**
each storey and mass as 500 kg and 250 kg, respectively
from ground level respectively. Calculate the frequencies
and mode shape of the building.

(b) If in the above building, if the upper floor is pulled by 10 **07**
mm in the horizontal direction and left to vibrate, derive the
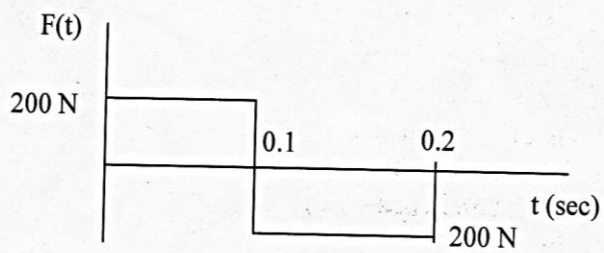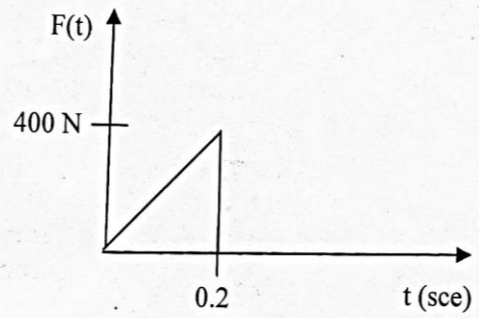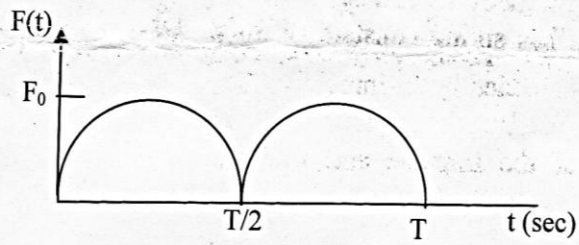displacement function of all the floors.

F(t)

200 N

0.1   0.2
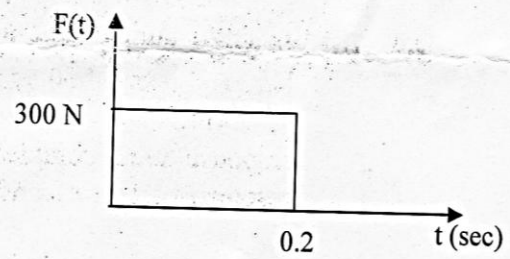
t (sec)

200 N

Fig.1

F(t)

400 N

0.2   t (sce)

Fig.2

F(t)

F₀

T/2   T   t (sec)

Fig.3

F(t)

300 N

0.2   t (sec)

Fig.4

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