CODE:GR20D5013	GR 20	SET - 4

M.Tech I Year II Semester Regular Examinations, October/November 2021

STRUCTURAL DYNAMICS
(Structural Engineering)

Time: 3 hours **Max Marks: 70**

Instructions:

1. Question paper comprises of **Part-A** and **Part-B**
2. **Part-A** (for 20 marks) must be answered at one place in the answer book.
3. **Part-B** (for 50 marks) consists of **five questions with internal choice,** answer all questions.

PART – A
(Answer ALL questions. All questions carry equal marks)

10 * 2 = 20 Marks

1. a.	What is meant by damped, undamped and critical damped conditions?	CO1	K1	**[2]**
b.	Define logarithmic decrement in vibration analysis.	CO1	K2	**[2]**
c.	Write a formula for SDOF with damping under free vibrations.	CO2	K1	**[2]**
d.	What is meant by Duhamel's Integral?	CO2	K2	**[2]**
e.	List the types of loading conditions in structural dynamics.	CO3	K1	**[2]**
f.	Define degree of freedom and list the types.	CO3	K1	**[2]**
g.	What is meant by continuous system?	CO4	K2	**[2]**
h.	Write steps involved in Holzer method.	CO4	K1	**[2]**
i.	Write the process of pile driving.	CO5	K1	**[2]**
j.	List different types of dynamic loads.	CO5	K1	**[2]**

PART – B
(Answer ALL questions. All questions carry equal marks)

5 * 10 = 50 Marks

2. A simply supported rectangular beam has a span of 1 m. It is 100 cm wide and 10 mm deep. It is connected at mid span of a beam by means of a linear spring having a stiffness of 100 kg/cm and a mass of 300 kg is attached at the other end of spring. Determine the natural frequency of the system. Take E = 2.1×10^6 kg/ cm^2. **[10]** CO1 K4

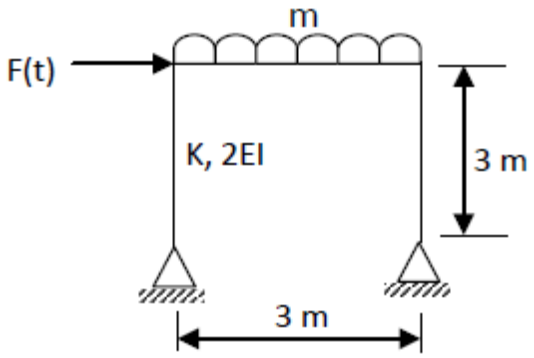
OR

3. Determine the natural frequency and natural period of the system consisting of a mass of 100 kg attached to a horizontal cantilever beam through the linear spring. The cantilever beam has a thickness of 0.8 cm and a width of 1.2 cm. Take E = 2.1×10^6 kg/ cm^2, L = 70 cm and K = 10 kg/cm. **[10]** CO1 K4

4. Derive an expression for the steady state response of an SDOF damped system subjected to harmonic excitation force. **[10]** CO2 K2

OR

5. The frame is subjected to an exciting force *F(t) = 200 sin20t* as shown in figure below. Assuming 6% of critical damping, determine: (i) Steady state response vibration. (ii) Maximum dynamic stress in the columns. CO2 K2 **[10]**

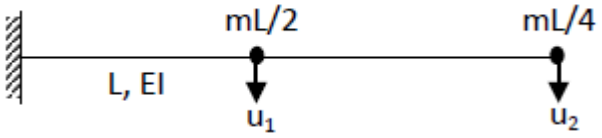


6. Explain different methods used for analysing the multi degree of freedom system and illustrate with an example. CO3 K2 **[10]**

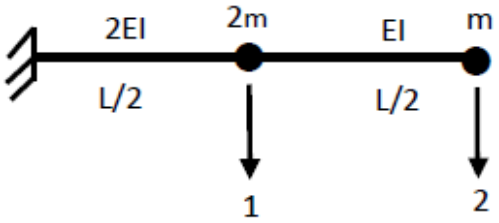
OR

7. **(a)** Explain about orthogonal properties of normal modes in MDOF system. CO3 K2 **[10]**

(b) Derive the equation of motion for the free vibration of the cantilever beam with the degree of freedom as shown in figure below, M, L and EI are the mass per unit length, length and flexural rigidity of the beam respectively. CO3 K2

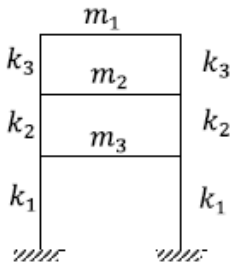


8. Using Stodola's method, calculate the natural frequencies and mode shapes for the system shown below. CO4 K4 **[10]**



OR

9. Compute the natural frequencies and corresponding mode shapes for the following frame using Holzer method. CO4 K4 **[10]**



$m_1 = 110 \times 10^3\ kg$ $k_1 = 20 \times 10^6\ N/m$

$m_2 = 160 \times 10^3\ kg$ $k_2 = 50 \times 10^6\ N/m$

$m_3 = 30 \times 10^3\ kg$ $k_3 = 50 \times 10^6\ N/m$

10. Explain the concept of foundations for industrial machinery with suitable example. **[10]**

CO5 K2

OR

11. Explain the effect of pile driving, blasting, earth quake loads on a structure. **[10]**

CO5 K2

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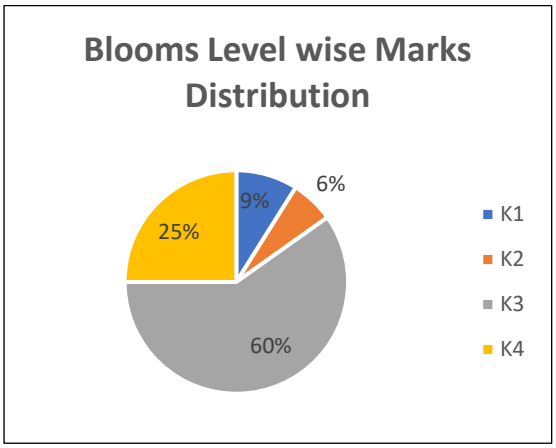

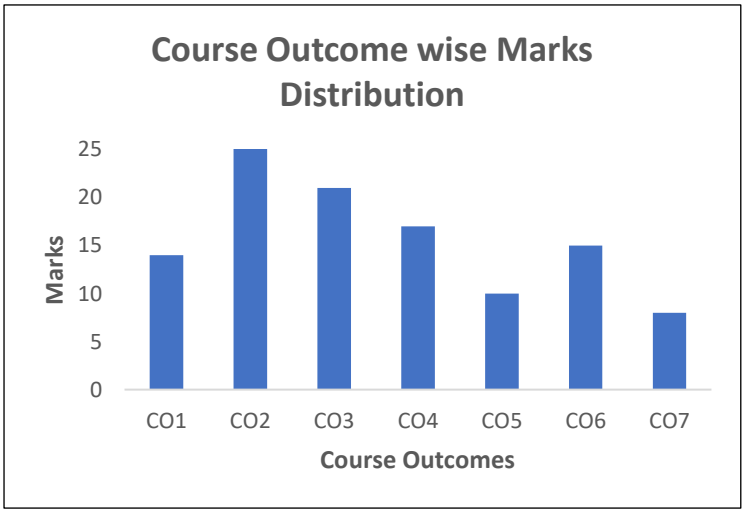

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M.Tech I Year II Semester Mid-I Examination, July 2021

STRUCTURAL DYNAMICS

(M.Tech. Structural Engineering)

Total Time: 90 min **Total Marks: 20**

	Subjective *(Answer all questions. All questions carry equal marks)* **15 marks**	
1	One of the construction companies hires you to determine the dynamic properties of a frame system for which it has lost the original blue prints. Being a civil engineer, you were assigned to do a free vibration test of the frame system. Supplied with a hydraulic jack, you were able to apply a jacking force to displace the frame. With a jacking force of 134 kN, you noted down that the frame has displaced 0.76 cm. On the first return swing after release, the frame did not come back to the release point but rather it stopped at 0.64 cm towards it. You recorded time between the release and the first return as 2 sec. Determine the following a. Weight of the frame b. Natural frequency c. Logarithmic decrement d. Damping ratio e. Damping frequency f. Amplitude of the frame after 6 cycles CO1 K1 OR Answer all the questions a) What are Elements of Vibratory System? b) Classify Vibrations c) What is Phase angle? d) Represent SHM vectorially e) State D'Alembert's Principle CO1 K1	**[5]**
2	a) Derive differential equation of motion for free vibrations of undamped SDOF system using Energy method. (3) CO2 K2 b) Expression for equivalent stiffness of springs in series and parallel (2) CO 2 K1 **OR** (a) What is logarithmic decrement? Develop an expression for the same. (2) CO 2 K2 (b) Discuss about critically damped, over damped and under damped systems (3) CO2 K2	**[5]**
3	Obtain the expression for dynamic magnification factor for damped harmonic excitation. CO3 K2 OR a) Derive the equation of motion for the 3-degree of freedom system. CO 3 K2 b) Explain the idealization of masses CO3 K2	**[5]**

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CODE: **GR20D5013**

Objective

(Answer all questions. All questions carry equal marks) **5 marks**

1. The number of cycles completed in a unit time is called? CO 1 K1
   a) Frequency b) Time Period c) Amplitude d) Resonance
2. When frequency of the exciting force is equal to the natural frequency of the system it is called? CO1 K1
   a) Frequency b) Time Period c) Amplitude d) Resonance
3. The number of independent coordinates which are required to define the motion of the body or system at given instant? CO1 K1
   a) Frequency b) Mode shapes c) Degrees of Freedom d) Degrees of redundancy
4. Simple Harmonic Motion is represented by an expression CO1 K1
   a) $x = X \sin \omega t$ b) $x = X \cos \omega t$ c) $x = X \sin \omega t \cos \omega t$ d) $a\omega$
5. Methods to analyse an undamped system is based on CO2 K1
   a) Newton's II Law b) D'Alembert's Principle c) Energy Method d) Rayleigh's Method
6. Critical damping coefficient Cc is equal to CO2 K1
   a) $2\sqrt{}$ km b) $2m\omega_n$ c) 2km d) C/ζ
7. The ratio of damping coefficient (c) to the critical damping coefficient is called CO2 K1
   a) Damping factor b) safety factor c) amplification factor d) mass factor
8. $\frac{2\pi\zeta}{\sqrt{1-\zeta^2}}$ is called CO2 K1

a) Logarithmic decrement b) logarithmic increment c) semi-logarithmic decrement d) damping ratio

9. The vibrations of a system that take place due to the application of an excitation (or) dynamic load are called CO 2 K1

a) forced vibrations b) free vibrations c) Resonance d) damped vibrations

10. Eigen values represent the _____of vibration in dynamic analysis CO3 K 1
    a) Natural frequency b) mode shapes c) time period d) amplitude

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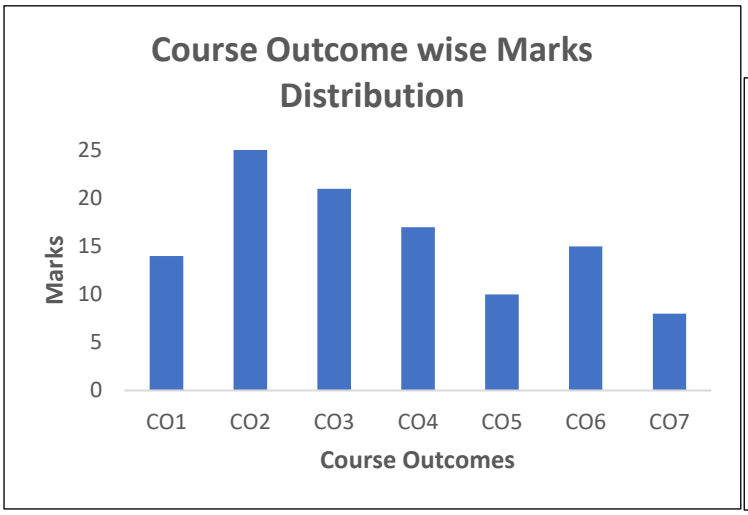

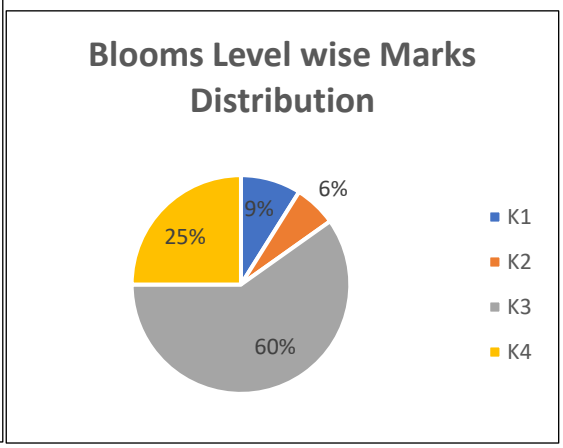

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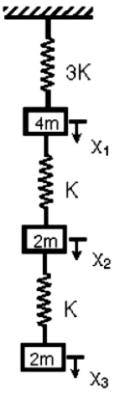
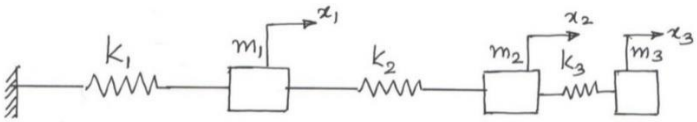
M.Tech I Year II Semester Mid-II Examination, Oct 2021

STRUCTURAL DYNAMICS

(M.Tech. Structural Engineering)

Total Time: 90 min **Total Marks: 20**

	Subjective *(Answer all questions. All questions carry equal marks)* **15 marks**	**15**
1	Derive the governing differential equation for transverse flexural vibration of a continuous system subjected to dynamic loading. Apply the above equation for a beam with both ends fixed. CO4 K2 OR Find the first three natural frequencies of vibrations and the corresponding mode shapes for a fixed beam of span 'L' if it's uniform cross section CO4 K2	**[5]**
2	For the multistory building shown in fig.. Obtain frequencies and modes of vibration using STODOLA method. Assume m = 5 x 10^4 kg, k= 5 x 10^4 kN/cm. CO 4 K4  **OR** Determine the Natural Frequencies of the system shown in figure below. Assume $m_1 = m_2 = m_3 = 1kg$; $K_1 = K_2 = K_3 = 1N/m$ .Use Holzer's Method. CO4 K4 	**[5]**
3	Discuss the (a) Orthogonal property of normal modes CO3 K2 (b) Normalization of modes CO 3 K2 OR Write short notes on a) dynamic effects of Wind Loads CO5 K2 b) dynamics effects of Moving Loads and Vibrations caused by Traffic CO5 K2	[5]

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CODE: **GR20D5013**

Objective

*(Answer all questions. All questions carry equal marks***)** **5 marks**

1. IS Code used for seismic analysis? CO 5 K1

   a) IS 1893 b) IS 456 c) IS 1983 d) IS 875

2. Which one is linear dynamic analysis? CO5 K1

   a) Equivalent static method b) Push over analysis c) Response spectrum method d) Time history method

3. IS Code for wind analysis? CO5 K1

   a) IS 875-Part III b) IS 875-Part II c) IS 875-Part I d) IS 875-Part IV

4. Wind Load Explanatory Hand Book CO5 K1

   a) SP 34 b) SP 64 c) SP 16 d) SP 40

5. Phenomenon which affects the design of a tall building is CO 5 K1

   a) Vortex shedding b) Gust c) Galloping d) Flutter

6. Single high pressure impulses acting directly on the exterior envelope over milliseconds causing localized damage is called CO5 K1

   a) Blast loads b) Seismic loads c) Impact loads d) Live loads

7. Design of machine foundations can be categorized into three approaches CO5 K1

   a) Static Analysis with Rule of Thumb b) Natural Frequency Analysis c) Forced Vibration Analysis d) Time history analysis

8. Only fundamental natural frequency and model vector of vibration are found in CO4 K1

   a) Stodola method b) Holzer method c) Wilson method d) Newmark method

9. A pattern of motion in which all parts of the system move sinusoidally with the same frequency and with a fixed phase relation is called CO4 K1

   a) Normal mode b) eigen value c) eigen vector d) General mode

10. The most general motion of a system is a superposition of its normal modes. CO3 K1

    a) True b) False c) if not orthogonal d) not always

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