Register No.: …… Name: ……..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SECOND SEMESTER M.TECH DEGREE EXAMINATION (R,S), MAY 2024

GEOMECHANICS AND STRUCTURES

(2021 Scheme)

Course Code: **21GS203**

Course Name: **Dynamics of Soil and Design of Machine Foundations**

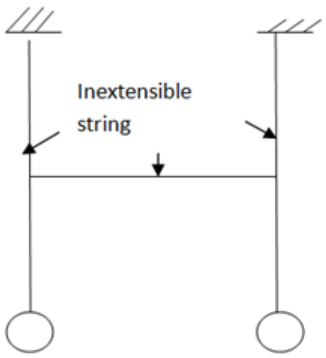
Max. Marks: **60** **Duration: 3 Hours**

Use of IS:2974(Part I) and IS: 2974 (Part II) are permitted

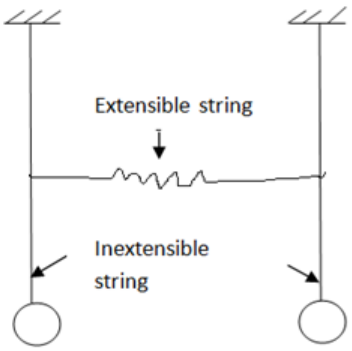
PART A

(Answer all questions. Each question carries 3 marks)

1. Define degree of freedom. Find the degree of freedom for the following systems. Justify your answers.



(i)Two simple pendulums connected by inextensible strings



(ii)Two simple pendulums connected by extensible string

2. Describe different types of damping.
3. Explain different modes of vibration of a foundation block by clearly specifying the coupled and uncoupled motions.
4. How will you calculate unbalanced forces and moments in a single cylinder reciprocating type machine?
5. Sketch a typical hammer foundation and explain the important components.
6. How will you find the dynamic stresses on elastic pad and soil for the design of hammer foundations?
7. Differentiate between active and passive isolation.
8. Explain force transmissibility and motion transmissibility.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Derive the frequency equation for a two mass two spring system executing free vibration. (6)

OR

10. A mass attached to a spring of stiffness of 5 N/mm has a viscous damping device. When the mass was displaced and released, the period of vibration was found to be 2.0 seconds and the ratio of consecutive amplitudes was 10/3. Determine the amplitude and phase angle when a force F= 3 Sin4t acts on the system. The unit of the force is Newton. (6)

MODULE II

11. A block vibration test was performed on a concrete block 1m x 1m x 1m, using vertical excitation. The unit weight of concrete is 24 kN/m^3. The following are the test results;

Frequency in rpm	600	700	800	900	950	1100	1125
Amplitude in mm	0.12	0.32	0.64	2.4	2.08	1.68	1.36

(6)

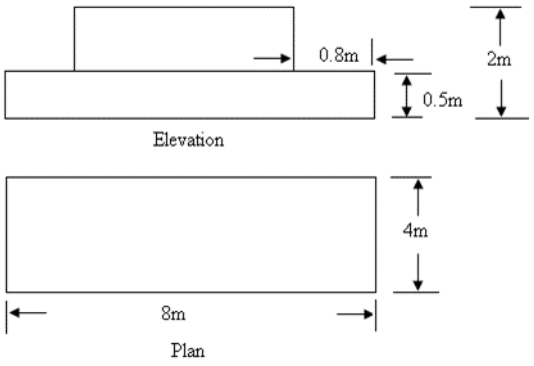
Determine coefficient of elastic uniform compression, damping factor and also the damping coefficient.

OR

12. Explain the effect of dynamic load on bearing capacity of foundations on cohesionless soil based on the test conducted on a surface footing. (6)

MODULE III

13. A concrete block shown in figure is used as a foundation for a reciprocating engine operating at 500 rpm and mounted symmetrically with respect to foundation. The weight of the engine is 10 kN. It is likely that the operation of the machine exerts the following.



(6)

Unbalanced vertical force= 1.8sinωt kN

Unbalanced moment= 6sinωt kNm

Cu= 4.5 x 10^4 kN/m^3

G= 4.8 x 10^4 kN/m^2

μ= 0.34

γ_{soil}= 17 kN/m^3

$\gamma_{concrete}$= 24 kN/m^3

Determine the natural frequencies and amplitudes of the block.

OR

14. Starting from fundamentals, derive the expression for natural frequencies and amplitudes of a block foundation subjected to a vertical force Pzsinωt, horizontal force $P_x$sinωt and a moment $M_y$sinωt at the combined centre of gravity of machine foundation. (6)

MODULE IV

15. Explain the mechanism of a reciprocating type machine with a neat sketch. Also give expression for unbalanced forces and moments in a two cylinder engine. (6)

OR

16. The following data refers to a single cylinder reciprocating machine: crank radius = 150 mm, length of connecting road = 350 mm, operating speed = 1500rpm, weight of reciprocating part = 50N and weight of rotating part = 10N. Calculate the maximum unbalanced force generated by the machine. (6)

MODULE V

17. Explain IS code method for design of hammer foundations. (6)

OR

18. A forging hammer, weighing 20 kN has the following specifications:
Weight of tup without die = 12 kN, Maximum tup stroke = 900 mm
Weight of upper half of die = 5 kN, Area of piston = 0.15 m^2
Steam pressure = 700 kN/m^2, Weight of anvil block = 400 kN
Total weight of anvil and frame = 500 kN, Base area of anvil = 2.1m x 2.1m ,
Permissible amplitude for anvil=1.5mm, Permissible amplitude for foundation=1.2mm
It is proposed to use a pine wood pad of thickness 0.5m below the anvil. The modulus of elasticity of pad material is 6 x 10^5 kN/m^2 and the allowable stress in the pad is 4,000 kN/m^2. C_u = 2.6 x 10^4 kN/m^3. The soil at the site is sandy in nature and allowable soil pressure is 250 kN/m^2. Design a suitable foundation. (6)

MODULE VI

19. A machine of mass 100 kg is suspended on springs of total stiffness of 784 N/mm. The machine produces an unbalanced disturbing force of 392 N at a speed of 50cps. Assuming a damping factor of 0.2, determine;
(i)The amplitude of motion due to unbalance
(ii)The transmissibility
(iii)Transmitted force (6)

OR

20. Explain different methods of vibration isolation. (6)

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