(ii)	Viscoelastic material subjected to sinusoidal oscillatory shear stress.	5	3	2	1

(OR)

b.	Write the constitutive relation of Burger's model and sketch its creep and recovery behaviour.	10	3	2	1
28. a.	When do top-down cracking and bottom up cracking occurs in bituminous layer. Explain, how the fatigue damage of the bituminous mixture is measured in the laboratory scale?	10	2	3	1

(OR)

b.	Explain clearly the step by step process involved in the production of bituminous mixture in the hot mix asphalt mixing plant.	10	2	3	1
29. a.	Explain the step by step design process involved in the design of flexible pavement with bonded layer.	10	2	4	3

(OR)

b.	Explain the step by step design methodology involved in the design of flexible pavement with granular base and subbase layer.	10	2	4	3
30. a.	List out various types of failures in flexible pavement. Explain the causes and give remedial measures.	10	2	5	2

(OR)

b.	The following are the 12 deflection in mm measured using Benkelman beam. 1.46, 1.52, 1.56, 1.76, 1.96, 1.75, 1.68, 1.74, 1.96, 1.42, 1.56, 1.62 The temperature during all the observation is found to be 43°C. Calculate the characteristic deflection for determining overlay thickness. Use sub grade moisture correction factor of 2.	10	3	5	2

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Reg. No.														

B.Tech. DEGREE EXAMINATION, MAY 2022
Seventh Semester

18CEE401T – PAVEMENT ANALYSIS AND DESIGN
(For the candidates admitted from the academic year 2018-2019 to 2019-2020)

Note:
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part - B** should be answered in answer booklet.

Time: 2½ Hours

Max. Marks: 75

PART – A (25 × 1 = 25 Marks)

	Marks	BL	CO	PO
Answer **ALL** Questions				
1. The ratio of z/a = 0, where 'z' is the depth and 'a' is the radius represents the stress at _____. (A) Surface (B) Subgrade (C) Base (D) Any depth	1	2	1	1
2. In a flexible pavement, which of the following is true? (A) The vertical compressive stress is maximum at the lowest layer (B) The vertical compressive stress decreases with the depth of the layer (C) Stress induced is independent of the depth of the pavement (D) Due to the vertical stress, fatigue occurs in pavement	1	2	1	2
3. In the stress-strain analysis, the layered structure are assumed as (A) Non linear-elastic (B) Linearly elastic (C) Non linear-plastic (D) Linear-plastic	1	1	1	1
4. The critical stress and strain in the layered structure are determined for (A) Vehicle load or axle load as a whole (B) Vehicle load (C) Axle load (D) Wheel load	1	1	1	1
5. Which of the below mentioned layer has least elastic modulus? (A) Surface layer (B) Base layer (C) Sub base layer (D) Subgrade layer	1	1	1	1
6. Which of the below material dissipates more energy? (A) Elastic (B) Viscous (C) Viscoelastic solid (D) Viscoelastic fluid	1	1	2	1
7. Which of the below is a characteristic function of viscoelastic material? (A) Recovery in the material (B) Stress and strain are out of phase by 90° (C) The network done is zero (D) All energy is dissipated	1	2	2	2

8. The constitutive relation $\tau = \mu\dot{\varepsilon}$ where τ is the shear stress, μ is the viscosity and $\dot{\varepsilon}$ is the strain rate describes — 1 2 2 2

(A) Non-Newtonian material (B) Elastic material
(C) Newtonian material (D) Viscoelastic material

9. The vertical tangential and radial stress at a point in the pavement layer is 96.6, 5.5 and 5.5 kPa. If the modulus of elasticity and Poisson's ratio is 70 MPa and 0.5, the value of vertical strain is — 1 2 2 1

(A) 0.0013 (B) 0.013
(C) 0.0026 (D) 0.026

10. The stress strain plot of viscoelastic material due to sinusoidal shearing is — 1 2 2 1

(A) Circular in shape (B) Straight line
(C) Parabolic (D) Elliptical

11. Maxwell model is best captures for — 1 1 3 1

(A) Elastic behavior (B) Viscous behavior
(C) Viscoelastic solid behavior (D) Viscoelastic fluid behavior

12. As the bitumen ages, its — 1 1 3 1

(A) Viscosity decreases (B) Viscosity increases
(C) Flow properties remains unchanged (D) Modulus decreases

13. The elastic and the viscous modulus of binder is 60 and 80 MPa. Its phase angle is — 1 2 3 1

(A) 53.13° (B) 36.87°
(C) 45.12° (D) 30.28°

14. Dense bituminous concrete layer is used in — 1 1 3 1

(A) Subgrade layer (B) Base layer
(C) Sub base layer (D) Surface layer

15. The key factor that governs the selection of aggregate for pavement layer is — 1 1 3 1

(A) Gradation of aggregate (B) Specific gravity
(C) Toughness (D) Water absorption

16. Which of the below option describes the resilient modulus of soil? — 1 1 4 1

(A) It is the ratio of deviatoric stress to total strain (B) It is the ratio of deviatoric stress to recoverable strain
(C) It is the ratio of confinement pressure to total strain (D) It is the ratio of confinement pressure to recoverable strain

17. The design CBR of the pavement is — 1 1 4 3

(A) 80^{th} percentile CBR (B) 50^{th} percentile CBR
(C) 90^{th} percentile CBR (D) 75^{th} percentile CBR

18. As per IRC method of pavement design, which of the layer demands cumulative damage analysis? — 1 1 4 3

(A) Bituminous layer (B) Subgrade layer
(C) Unbonded base layer (D) Bonded base layer

19. If a front axle of truck of single axle single wheel weights 70 kN and rear axle of single axle dual wheel weighs 90 kN, what is the vehicle damage factor? — 1 2 4 3

(A) 3.94 (B) 2.95
(C) 1.35 (D) 1.6

20. Crack relief layer is provided in between — 1 1 5 3

(A) Subgrade and granular sub base (B) Granular base and granular sub base
(C) Granular base and bituminous layer (D) Cement treated base and bituminous layer

21. The standard axle load and type as per IRC37 is _____. — 1 1 4 3

(A) 80 kN single axle dual wheel (B) 80 kN single axle single wheel
(C) 120 kN single axle single wheel (D) 120 kN single axle dual wheel

22. Falling weight deflectometer uses for — 1 1 5 2

(A) Trapezoidal loading (B) Impact loading
(C) Impulse loading (D) Sinusoidal loading

23. The thickness of the existing pavement for overlay design is estimated using — 1 1 4 1

(A) Percentage of cracked surface (B) IRI
(C) Friction (D) Deflection

24. Reflection crack occurs in — 1 1 4 1

(A) Flexible overlay over rigid pavement (B) Rigid pavement
(C) Subgrade layer (D) Sub base layer

25. Corrugation in flexible pavement indicates — 1 1 4 1

(A) Deformation in the transverse direction (B) Longitudinal cracks
(C) Block cracks (D) Longitudinal deformation

PART – B (5 × 10 = 50 Marks) — Marks BL CO PO

Answer **ALL** Questions

26. a. A homogeneous half space is subjected to circular load of diameter 280 mm and a pressure of 320 kPa. The material has an elastic modulus of 70 MPa and Poisson's ratio of 0.4. Determine the vertical stress, radial stress and tangential stress at a depth of 100 mm from the surface and exactly at the centre of loading. — 10 3 1 1

(OR)

b. Sketch the cross section of bituminous layer and explain the function of each layer. — 10 1 1 1

27. a. Explain the response of the viscoelastic material to the following loading conditions.

(i) Viscoelastic solid material subjected to constant strain for time 't'. — 5 3 2 1