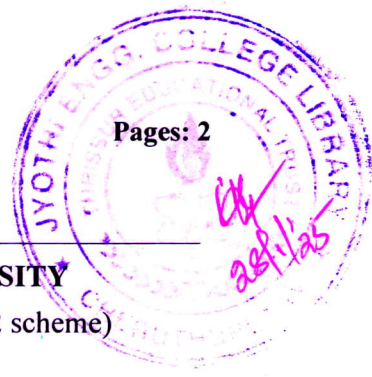


Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
M.Tech Degree S1 (R, S) Examination December 2024 (2022 scheme)



**Course Code & Name: 221TCE010 - ANALYSIS AND DESIGN OF PAVEMENT
 SYSTEMS**

(Relevant IRC codes/charts are permitted)

Max. Marks: 60

Duration: 2.5 Hours

PART A

Answer all questions. Each question carries 5 marks

Marks

- | | | |
|---|--|-----|
| 1 | Differentiate between Marshall and Superpave methods of mix design. | (5) |
| 2 | Describe the effect of moisture on the mechanical properties of pavement material. | (5) |
| 3 | Discuss the similarities and differences between the Asphalt Institute and IRC methods of flexible pavement design | (5) |
| 4 | In certain design processes, the structural design of a proposed new bituminous pavement was by mistake performed using the concrete pavement design. Comment on the conceptual mistake, if any were made. | (5) |
| 5 | Explain the need and requirements of joints in cement concrete pavements. Explain the need for spacing in concrete pavements. | (5) |

PART B

Answer any 5 questions. Each question carries 7 marks

- | | | |
|---|--|-----|
| 6 | What are the various factors affecting the design of highway pavements? Explain in detail the effect of traffic. | (7) |
| 7 | Calculate the design volume for a particular highway section if the design period is 20 years. The current AADT is 5000 vehicles/ day, the average truck factor is 1.9, the directional distribution factor is 0.6, the lane distribution factor is 0.8 and the traffic is expected to grow at 5 % per annum for the first 10 years, 6% per annum for the next 7 years and 8% per annum for the rest of the design period. | (7) |
| 8 | A pavement structure is comprised of the following layers – 5.75-inch asphalt concrete surface, E= 400,000 psi, 23 inches of the granular base, E = 20,000 psi, | (7) |

- and a subgrade having an $E = 20,000$ psi, and a subgrade having an $E = 10,000$ psi. All layers are assumed to have $\mu = 0.5$. Calibrate the horizontal tensile strain at the bottom of the Asphalt concrete layer and the vertical compressive strain at the top of the subgrade layer under the centreline of a 40,000-pound wheel load, 150 psi pressure.
- 9 A stage construction is planned for a full-depth asphalt pavement with a sub-grade resilient modulus of 5000 psi. The design period is 30 years and is divided into 3 stages. The first 5 years, the middle 10, and the last 15 years. The first 5 years of traffic on the design lane is 30,000 equivalent to 18 kips. Single-axle load applications and the annual growth rate is 3.5%. If the damage ratios at the end of each stage are 0.5, 0.75, and 1 respectively, determine the thickness of HMA to be placed at each stage by the AI method. (7)
- 10 Explain in detail the PCA method of rigid pavement design (7)
- 11 A rigid pavement has the following design: (7)
- Thickness 9 inches; uniform slab dimensions 40 ft (contraction joints) by 11 ft Longitudinal distributed steel No.3 wires spaced at 6 inches. The bars at the longitudinal joint are 0.5 inches round by 36 inches long spaced 30 inches centre to centre. Modulus of sub-grade reaction 200 pci
- Determine the complete stresses in the pavement for a 9,000-pound dual wheel, tire pressure 100 psi. The temperature differential is 1.5°F / inch of the slab.
- 12 Design a tie bar system for a cement concrete pavement. (7)
- The slab thickness is 20cm, slab width is 3.35m. No. of lanes to be tied is 2, and the coefficient of friction between slab and subgrade is 1.5, the unit weight of the slab is 2400kg/m^3 , allowable working stress in steel is 1400kg/cm^2 . The maximum permissible bond stress in plain bars is 17.5 kg/cm^2 and in deformed bars is 24 kg/cm^2 .
