TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of BUILDING & Civil engineering

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN CIVIL ENGINEERING

DCE 2301 : TRANSPORTATION ENGINEERING I

END OF SEMESTER EXAMINATION

SERIES: APRIL 2025

TIME: 2 HOURS

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of five questions.

Attempt Question ONE and any OTHER TWO questions .

Do not write on the question paper.

QUESTION ONE(20 Marks) (Compulsory)

The following data to a field study:

(i) Alignment soil consisting of black cotton soil of average 0.8 m thickness overlying decomposed phonolite, the C.B.R. of black cotton soil ranging between 2% and 5% and that of phonolite 15-30%.

(ii) The traffic count and axle load surveys show that the initial daily number of commercial

Vehicles and equivalent factors are as follows:

Buses – 240 E.F. – 1

Medium goods vehicles – 430 E.F. – 2

Heavy goods vehicles – 360 E.F. -8

(iii) The design period is 15 years and the annual growth rate is 5%.

(iv) Stone suitable for asphalt concrete, dense bitumen macadam and lean concrete is abundant. The stone can be used as graded crushed stone (GCS) for sub-base.

Design a flexible pavement using Standard pavement structures Type 12, 13 and 14 and Table 1, 2 & 3 below. (20 Marks)

QUESTION TWO (20 Marks)

(a) Outline the historical development of roads. (10 Marks)

(b) With the aid of a sketch, describe the Macadam road construction. (10 Marks)

QUESTION THREE (20 Marks)

(a) In regard to geometric design, briefly explain the following:

i) Meeting sight distance

ii) Passing sight distance (6 Marks)

(b) With aid of a sketch, outline procedure for setting out vertical curves. (14 Marks)

QUESTION FOUR (20 Marks)

(a) Briefly explain THREE objectives of preliminary survey. (6 Marks)

(b) Briefly explain FIVE elements of detailed survey during planning of transportation systems. (10 Marks)

(c) In regards to sub-surface exploration, outline the FOUR elements of reporting results. (4 Marks)

TABLE 1: SUBGRADE CLASSES

CLASS	S1	S2	S3	S4	S5	S6
CBR (%)	2-5	5-10	7-13	10-18	15-30	>30

TABLE 2: TRAFFIC CLASSIFICATION – 1

CLASS	**CUMULATIVE NUMBER OF STANDARD AXLES**
T1	25 – 60 million

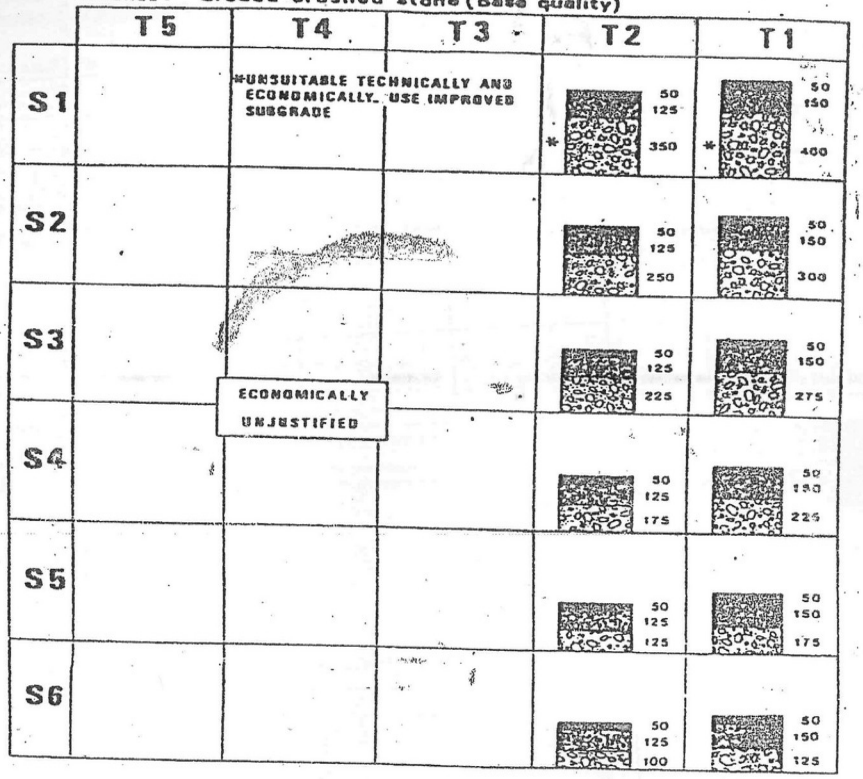
T2	10 – 25 million
T3	3 – 10 million
T4	1 – 3 million
T5	0.25 – 1 million

TABLE 4: TRAFFIC CLASSIFICATION- 2

CLASS	**ESA/Day in 1 Year**
T1	2,500 – 6,000
T2	1,000 – 2,500
T3	300 – 1,000
T4	100 -300
T5	25 - 100

STANDARD PAVEMENT STRUCTURE TYPE 12

BASE : Dense bitumen macadam
SUBBASE : Graded crushed stone (Base quality)



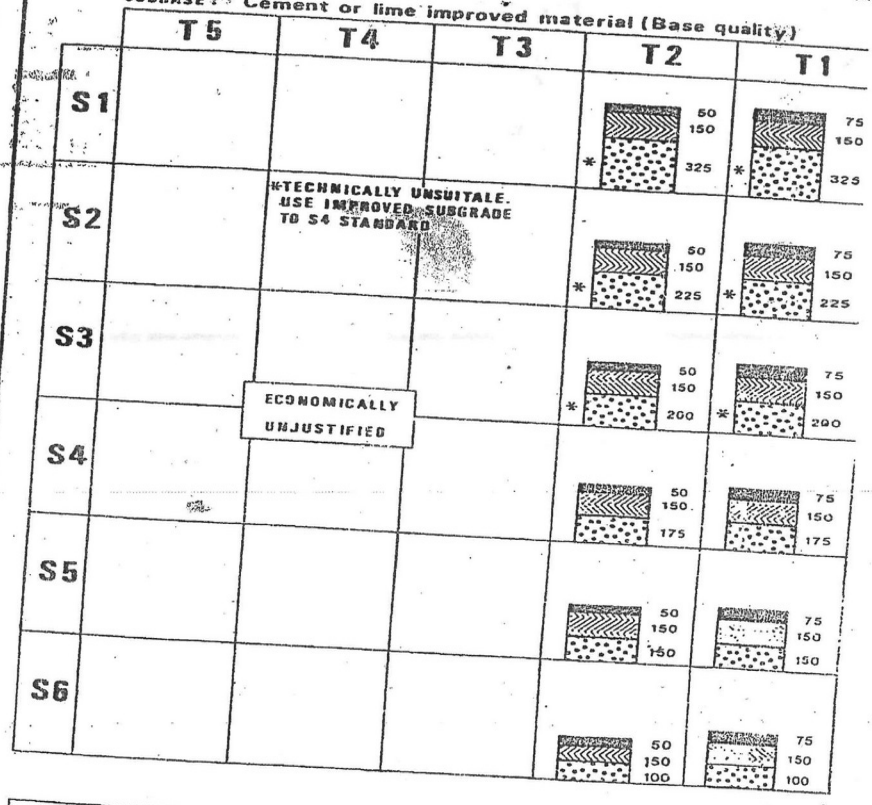
SUBGRADE		TRAFFIC	
CLASS	CBR (%)	CLASS	ESA x 10^6
S1	2 - 5	T1	25 - 60
S2	5 - 10	T2	10 - 25
S3	7 - 13	T3	3 - 10
S4	10 - 18	T4	1 - 3
S5	15 - 30	T5	0.25 - 1
S6	> 30		

IMPROVED SUBGRADE (Reproduced from Table 6.2.1)

Native Subgrade Class		S1						S2			S3	
Improved Subgrade	Material	S2	S3		S4			S3	S4	S4	S5	
	Thickness (mm)	400	350	425	275	325	450	300	200	150	300	150	350
New Class		S2	S2	S3	S2	S3	S4	S3	S3	S4	S4	S4	S5

STANDARD PAVEMENT STRUCTURE TYPE 1B

BASE : Lean concrete
SUBBASE : Cement or lime improved material (Base quality)



SUBGRADE CLASS	CBR (%)	TRAFFIC CLASS	ESA x 10 6
S1	2 - 5	T1	25 - 60
S2	5 - 10	T2	10 - 25
S3	7 - 13	T3	3 - 10
S4	10 - 18	T4	1 - 3
S5	15 - 30	T5	0·25 - 1
S6	> 30		

IMPROVED SUBGRADE (Reproduced from Table 6.3.1)

Native Subgrade Class		S1			S2			S3		
Improved Subgrade	Material	S2	S3	S4	S3	S4	S4	S5		
	Thickness (mm)	400	350	425	275	325	450	300	200	350	300	150	350
New Class		S2	S2	S3	S2	S3	S4	S3	S3	S4	S4	S4	S5

STANDARD PAVEMENT STRUCTURE TYPE 4

BASE : Lean concrete
SUBBASE : Graded crushed stone

	T5	T4	T3	T2	T1
S1		*TECHNICALLY UNSUITABLE. USE IMPROVED SUBGRADE		50 / 200 / * 350	75 / 200 / * 300
S2				50 / 200 / 250	75 / 200 / 250
S3		ECONOMICALLY UNJUSTIFIED		50 / 200 / 225	75 / 200 / 225
S4				50 / 200 / 175	75 / 200 / 175
S5				50 / 200 / 150	75 / 200 / 150
S6				50 / 200 / 100	75 / 200 / 100

SUITABILITY STILL TO BE ASCERTAINED

SUBGRADE CLASS	SUBGRADE CBR (%)	TRAFFIC CLASS	TRAFFIC ESA x 10^6
S1	2 - 5	T1	25 - 60
S2	5 - 10	T2	10 - 25
S3	7 - 13	T3	3 - 10
S4	10 - 18	T4	1 - 3
S5	15 - 30	T5	0·25 - 1
S6	> 30		

IMPROVED SUBGRADE (Reproduced from Table 6.11)

Native Subgrade Class		S1				S2			S3		
Improved Subgrade	Material	S2	S3		S4	S3	S4	S4	S5		
	Thickness (mm)	400	250	425	275	325	450	300	280	250	300	150	350
New Class		S2	S2	S3	S2	S3	S4	S3	S3	S4	S4	S4	S5