UGANDA MARTYRS UNIVERSITY

FORT PORTAL CAMPUS

FACULTY: ENGINEERING AND APPLIED SCIENCE

DEPARTMENT: DEPARTMENT OF CIVIL ENGINEERING

COURSE CODE: **BCE3102:** COURSE NAME: **HIGHWAY DESIGN AND TRAFFIC MANAGEMENT**

FINAL ASSESSMENT

ACADEMIC YEAR 2023/2024 SEMESTER I

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

Date of Examination: 12TH DECEMBER 2023

Time allowed: 3 hours (9:00Am – 12:00Pm)

Instructions to Candidates:

Read the following before answering the examination questions.

1) **Section A** is compulsory
2) Answer any **three (3)** questions in Section B.
3) Attach all question papers on the answer booklets.
4) All Questions carry equal marks.
5) Show all the necessary workings.
6) Start each question on a fresh page.
7) Read other instructions on the answer booklet.
8) Do **NOT** write anything on this question paper.

You should have the following in this Examination.

Answer Booklet, Drawing instruments, graph papers, non-programmable calculator and IEE Tables for the current ratings and voltage drops, 17th edition.

SECTION A (25 Marks)

1. The most bottom component/layer of a flexible pavement, is.
   (A) Sub□grade (B) Sub□base (C) Base (D) Base course
2. Which test is used to simulate long□term aging of asphalt in the laboratory?
   (A) RFTO (B) PAV (C) TFO (D) Rotational Viscosity Test
3. Which of the following penetration grades according to ASTM D946 is for a so asphalt cement?
   (A) 40□50 (B) 60□70 (C) 120□150 (D) 200□300
4. Trichloroethylene is used in carrying out which test on asphalt cement sample?
   (A) Solubility Test (B) Soundness Test (C) Deleterious Test (D) Ductility Test
5. The most suitable equipment for compacting clayey soils is a
   (A) Smooth Wheeled Roller (B) Sheep Foot Roller (C) Pneumatic Roller (D) Vibrator
6. Which of the following viscosity grades according to ASTM D3381 is for a so asphalt cement?
   (A) AC□40 (B) AC□20 (C) AC□5 (D) AC□2.5
7. Which of the following according to AR viscosity grading specification is for a hard graded asphalt cement?
   (A) AR□16000 (B) AR□8000 (C) AR□2000 (D) AR□1000
8. Asphalt binder is produced in several grades or classes. There are four methods for classifying asphalt binders. Which of the following emerged from Strategic Highway Research Program (SHRP)?
   (A) performance grading (PG) (B) Penetration grading (C) viscosity grading
   (D) viscosity of aged `residue grading
9. The combination of aggregates of different grading to meet specifications is known as?
   (A) Sieving (B) Grading (C) Blinding (D) Blending

10. Which of the following is not associated with the asphalt penetration test?
(A) A load of 100g (B) Duration of 5 sec (C) Temperature of 60°C (D) Temperature of 77°F

11. A cutback prepared from intermediate volatile kerosene is known as.
(A) Rapid Cure (RC) (B) Medium Cure (MC) (C) Slow Cure (SC) (D) None of the Above

12. The mixture of asphalt cement (bitumen), water and an emulsifying agent.
(A) Cutback (B) Tar (C) Asphaltenes (D) Emulsion

13. Write the following acronyms in full as used in highway engineering: (1/2 mark each)
i. AASHTO_____
ii. SUPERPAVE _____

SECTION B

Question Two (25 marks)

a) Define a pavement and explain how it distributes loads to accomplish its purpose (3 marks)
b) What is a mix design? (2 marks)
c) List down any four methods used in design of densely graded hot mix asphalt and their underlying basic principles. (7 marks)
d) State the factors that determine the performance of aggregates in road surface construction. (3marks)
e) State the desired qualities of aggregates for their use as surfacing materials in pavement construction. (4 marks)
f) What is the significance of the following aggregate tests?
   i. Abrasion Test (2 marks)
   ii. Toughness Test (2 marks)
   iii. Relative Density Test (2 marks)

Question Three (25 marks)

a) Distinguish between penetration grade bitumen and cutbacks (2 marks)
b) Briefly describe the laboratory procedure of determining the softening point of bitumen (3 marks).
c) What is soil stabilization? (2 marks).
d) What is the significance of stabilization in road pavement construction? (4 marks).
e) List down any 3 materials used on soil stabilization (3 marks)
f) Define compaction of soils (3 Marks)
g) Give four objectives behind compaction of soils in road bases and subbases (4 marks)
h) Write short notes on the following with respect to stabilization.
   a. Lime Stabilization (2 marks)
   b. Mechanical Stabilization (2 marks)

Question Four (25 marks)

a) List down any 4 defects of a gravel road (4 marks)
b) Briefly explain the Mechanism for corrugation formation on a gravel road (3 marks).
c) State any three environmental problems associated with aggregate production for road

construction. (3 marks)

d) Briefly explain four mechanical ways in which aggregates for road construction are reduced to the desired sizes during production. (4 marks).

e) Write short notes on the following properties of Bitumen.
   i. Penetration (2 marks)
   ii. Viscosity (2 marks)
   iii. Softening Point (2 marks)
   iv. Oxidation (1 mark)

f) Distinguish between cationic and anionic emulsified bitumen. (2 marks)

g) Define Marshall stability and Marshall flow (2 marks).

Question Five (25 marks)

a) Describe the Marshall Mix Design Procedure of Premix for road surface treatment. (7 marks).

b) Define Equivalent Axle load factor in terms of damage (1 mark)

c) Define a pavement (2 marks)

d) With illustration of flexible pavement, write short notes on the basic layers constituting it. (4 marks).

e) Give two key differences between a flexible pavement and a rigid pavement. (2 marks)

f) Explain how the following factors affect the performance of a flexible pavement.
   i. Traffic (3 marks)
   ii. Construction materials used (2 marks)
   iii. Environment (2 marks)
   iv. Construction and maintenance (2 marks)

Question Six (25 marks)

a) List down the various prerequisites to earthwork construction in highway engineering (5 marks)

b) State any 3 factors that affect soil-lime reactivity during lime stabilization (3 marks)

c) What is the role of bitumen in hot mix asphalt? (2 marks)

d) Briefly explain fatigue and rutting as defects/distresses in paved roads (7 marks)

e) Explain how surface texture and presence of deleterious materials in aggregates affect the performance of Hot Mix Asphalt (4 marks)

f) List down three qualities of good mechanically stabilized materials (3 marks)

g) What is a structural number in relation to flexible pavement design (1 mark)

END