MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING, APPLIED SCIENCES & TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE

MODULE: MATHEMATICAL FOUNDATION TO COMPUTER SCIENCE

CODE: BCOS 115

SESSIONAL EXAMINATIONS

APRIL 2024

DURATION: 3 HOURS

EXAMINER: D. MHINI

INSTRUCTIONS

1. *Answer **All questions** in Section A*
2. *Answer **any three** questions in Section B.*
3. *Start a new question on a fresh page*
4. *Total marks 100*

Additional material(s): *Non-programmable electronic scientific calculator.*

SECTION A

(*Answer **ALL** questions from this Section)* **[40]**

A1 (a) List four situations from everyday life in which graphs arise naturally.

(b) Draw the graphs:

(i) K_8;

(ii) C_9;

(iii) $K_{4,4;}$

(iv) $K_{1,8}$.

(c) Define and draw an Eulerian digraph. **[4, 4, 2]**

A2 (a) Construct a circuit for each Boolean Polynomial

(i) $(A \vee B) \wedge [A' \vee (C \wedge B')]$

(ii) $[A' \wedge (C \wedge B) \vee C] \wedge [D \vee (A' \wedge B)]$

(b) Prove that $(a + b)' = a' * b'$

[2, 4, 4]

A3. Define the following structures:

(a) Boolean Algebra;

(b) Digraph;

(c) Critical path;

(d) Binary operation.

[5, 2, 2, 1]

A4. (a) Prove that $\sqrt{2}$ is irrational.

(b) State the absorption law of sets.

(c) How many committees of 4 members can be formed from 9 people?

(d) Which of the following sets are different? $\emptyset$; $\{0\}$; $\{\emptyset\}$ **[3, 2, 3, 2]**

SECTION B

(*Answer any **THREE** questions from this Section)* **[60]**

B5. (a)State the Principal of duality and find the dual of

$$(A \cap B) \cup (A \cap B').$$

(b) Show that the Petersen graph is orientable.

(c) Draw Venn diagram to represent the following:

(i) $A - B$;

(ii) $(A \cap B) \cup (A \cap C)$.

[4, 10, 3, 3]

B6 (a) Prove that $(A_1 - A_2) \cap (A_1 - A_3) = A_1 - (A_2 \cup A_3)$ where A_1, A_2 and A_3 are any sets**.**

(b) Define a relation.

(c) Prove De Morgan's laws

$$(A \cup B)' = A' \cap B' \ ;$$

$$(A \cap B)' = A' \cup B'.$$

(d) Let the function $f: \mathbb{R} \longrightarrow \mathbb{R}$ be defined by;

$$f(z) = \begin{cases} 3z - 1; & if\ z > 3; \\ z^2 + y\,; & if\ 2 \leq z \leq 3; \\ 2z + 3; & if\ z < -2. \end{cases}$$

Find:

(i) $f(2)$;

(ii) $f(4)$;

(iii) $f(-1)$;

(iii) $f(-3)$.

(e).Let $A = \{1,2\}$ construct that set $\rho(A) \times A$ where $\rho(A)$ is the power set of A.

[5, 1, 6, 4, 4]

B7 (i) Draw the graph G corresponding to each adjacency matrix.

$$(a)\ A = \begin{bmatrix} 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix}.$$

$$(b)\ A = \begin{bmatrix} 1 & 3 & 0 & 0 \\ 3 & 0 & 1 & 1 \\ 0 & 1 & 2 & 2 \\ 0 & 1 & 2 & 0 \end{bmatrix}.$$

(ii) Table 1 shows a list of activities required for a new IT product launch.

Table 1.

ACTIVITY	DURATION(weeks)	IMMEDIATE PREDECESSORS
A	6	-
B	3	-
C	4	-
D	4	C
E	9	A
F	8	A, B ,D
G	10	A, B, D
H	15	C
I	5	E, F

(a) Draw the network diagram for this project.

(b) What is the critical path and the minimum time for completion of the project?

[5, 5, 8, 2]

B8 (a) (i) Define a function**.**

(ii) State the principle of duality.

(b) Prove that $p \longrightarrow (q \wedge r) \equiv (p \longrightarrow q) \wedge (p \longrightarrow r)$ is logically equivalent.

(i) Simplfy $\frac{(n+2)!}{n}$

(ii) Prove $\binom{n+1}{r} = \binom{n}{r-1} + \binom{n}{r}$

(c) Construct a spanning tree of the following graph G

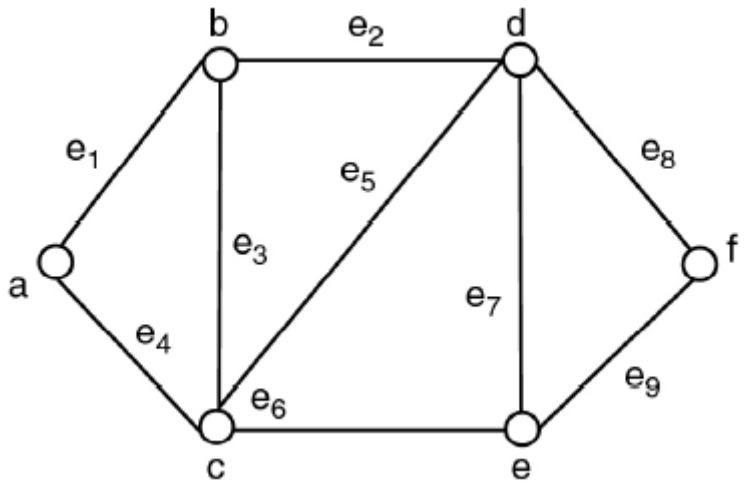

Fig 1:

[1, 1, 5, 3, 5, 5]

END OF EXAMINATION PAPER