

Second Midterm Exam
Academic Year 1446 Hijri- First Semester

| Exam Information معلومات الامتحان | | |
|-----------------------------------|----------------------|------------|
| Course name | Discrete Mathematics | |
| Course Code | 151 Math | |
| Exam Date | 2024-11-06 | 1446-05-04 |
| Exam Time | 12: 00 PM | |
| Exam Duration | 2 hours | ساعتان |
| Classroom No. | | |
| Instructor Name | | |

| Student Information معلومات الطالب | | |
|------------------------------------|--|--|
| Student's Name | | |
| ID number | | |
| Section No. | | |
| Serial Number | | |

General Instructions:

- Your Exam consists of 8 PAGES (except this paper)
- Keep your mobile and smart watch out of the classroom.
- Calcolator does not allowed.

- عدد صفحات الامتحان 8 صفحة. (باستثناء هذه الورقة)
- يجب إبقاء الهواتف والساعات الذكية خارج قاعة الامتحان.
- لا يسمح باستخدام الآلة الحاسبة.

هذا الجزء خاص بأستاذ المادة

This section is ONLY for instructor

| # | Course Learning Outcomes (CLOs) | Related Question (s) | Points | Final Score |
|---|---------------------------------|--------------------------------|--------|-------------|
| 1 | C.L.O 1.1 | QI(1--8) QIII(A), QIV(B) | | |
| 2 | C.L.O 1.2 | QI(9-10) QII(A) | | |
| 3 | C.L.O 2.2 | QII(B), QIII(B) | | |
| 4 | C.L.O 2.3 | QIV(A) | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |

| Questions | Q(I) (1—8) | Q(I) (9-10) | Q(II) (A) | Q(II) (B) | Q(III) (A) | Q(III) (B) | Q(IV) (A) | Q(IV) (B) | Total |
|-----------|---------------|----------------|--------------|--------------|---------------|---------------|--------------|--------------|-------|
| Marks | | | | | | | | | |

Question I:

| Question Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----------------|---|---|---|---|---|---|---|---|---|----|
| Answer | | | | | | | | | | |

Choose the correct answer, then fill in the table above: (5 points)

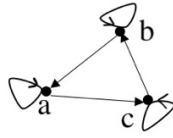
1- For the equivalence relation on \mathbb{Z} defined by $a \equiv b \pmod{8}$:

- (a) $[2]=[8]$.
- (b) $[2]=[10]$.
- (c) $[1]=[8]$.
- (d) $[2]=[-10]$.

2- If $\{\{0\}, \{-1\}, \{1\}, \{2\}\}$ is a partitions of $\{-1, 0, 1, 2\}$, then the ordered pairs in the equivalence relations produced by this partitions is:

- (a) $\{(0,0), (1,1), (-1,-1), (2,2)\}$.
- (b) $\{(-1,1), (1,1), (0,1), (0,0), (1,-1), (1,2), (2,1), (2,2)\}$.
- (c) $\{(-1,-1), (-1,0), (-1,1), (-1,2), (0,-1), (0,0), (0,1), (0,2), (1,-1), (1,0), (1,1), (1,2), (2,-1), (2,0), (2,1), (2,2)\}$.
- (d) None of the previous.

3- The directed graph below represented a relation R which is:



- (a) Reflexive, symmetric, antisymmetric and not transitive.
 - (b) Reflexive and transitive but not symmetric and not antisymmetric.
 - (c) Reflexive and antisymmetric only.
 - (d) Reflexive and symmetric but not antisymmetric and not transitive.
-

4- The graph K_4 is considered as:

- (a) 4-regular complete.
 - (b) 3-regular not bipartite.
 - (c) 3-regular bipartite.
 - (d) None of the previous.
-

5- $\forall n > 3$, the degree sequence of vertices in $K_{3,n}$ is:

- (a) $\underbrace{n, n, n, \dots, n}_{n \text{ times}}, 3, 3, 3.$
 - (b) $n, n, n, 3, 3, 3.$
 - (c) $\underbrace{3, 3, 3, \dots, 3}_{n \text{ times}}.$
 - (d) $n, n, n, \underbrace{3, 3, 3, \dots, 3}_{n \text{ times}}.$
-

6- There exists a graph with vertices of degrees

- (a) 3, 3, 2, 1.
 - (b) 6, 4, 3, 2.
 - (c) 3, 2, 2, 1.
 - (d) None of the previous.
-

7- The number of edges in the complementary graph of C_{10} is

- (a) 35.
 - (b) 20.
 - (c) 25.
 - (d) 45.
-

8- In a poset $(P(A), \subseteq)$, where $A = \{0,1,2\}$, then $\{0\}$ and $\{1\}$ is

- (a) Comparable.
 - (b) Incomparable.
-

9- If $M_S = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ and $M_R = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$, then $M_{S \cap R} =$

- (a) $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ (c) $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$
-

10- If $R = \{(x, y) | y = x^2 - 3\}$, and $S = \{(x, y) | y = 2x\}$, where R and S are defined on \mathbb{Z} , then $R \circ S$ is defined as

- (a) $\{(x, y) | y = (2x^2 - 3)^2\}$.
- (b) $\{(x, y) | y = 2x^2 - 3\}$.
- (c) $\{(x, y) | y = 4x^2 + 3\}$.
- (d) $\{(x, y) | y = 4x^2 - 3\}$.

Question II: (3+6 = 9 points)

(A) Let $R = \{(1,2), (2,3), (4,1)\}$ be a relation on a set $\{1, 2, 3, 4\}$. Find

(i) R^2 .

(ii) R^{-1} .

(iii) $R \circ R^{-1}$.

(iv) $R - R^{-1}$.

(B) Let R be the relation defined on the set \mathbb{Z} , such that:

$$x, y \in \mathbb{Z}, \quad xRy \Leftrightarrow x + y \text{ is even.}$$

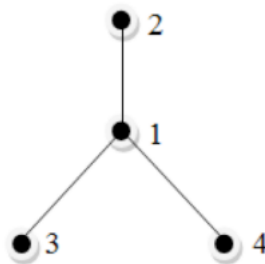
(i) Show that R is an equivalence relation.

(ii) Find the equivalence class $[2]$ and $[5]$.

(iii) Is $[7] \cap [10] = \emptyset$ or not. (Justify your answer.)

Question III: (3.25+3=6.25 points)

(A) Let T be a partial ordering relation defined on the set $A = \{1, 2, 3, 4\}$ shown in the given Hasse diagram



(i) List all ordered pairs of T .

(ii) Decide whether T is totally ordering on A , or not. (justify your answer)

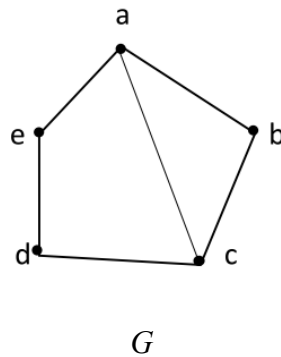
(B) Let S be a relation defined on the set \mathbb{N} :

$$a, b \in \mathbb{N}, \quad a S b \Leftrightarrow \frac{a}{b} \text{ is an odd integer.}$$

Show that S is a partial ordering relation on \mathbb{N} .

Question IV: (2.25+2.5=4.75 points)

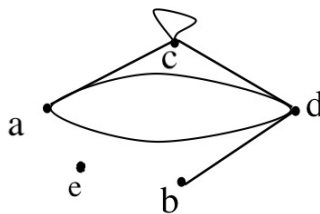
(A) Answer the following questions about the following graph G :



(i) Is the graph G bipartite? Justify your answer.

(ii) Draw the complementary graph of G .

(B) For the graph below, find the following:



(i) Find $\deg(a), \deg(c)$.

(ii) Find $N(A)$, where $A = \{c, d\}$.

(iii) Does the graph have isolated vertex? Pendant vertex? If so, name them.

Good Luck