Logic and Problem Solving
Informatics College Pokhara
Module: MA4001NI

Tutorial 2 week- 21

1. Answer the following questions:
   (i) Why is R = {(1, 1), (2, 2), (3, 3)} not reflexive on {1, 2, 3, 4}?
   (ii) Why is R = {(1, 2), (2, 1), (3, 1)} not symmetric on {1, 2, 3, 4}?
   (iii) Why is R = {(1, 2), (2, 3), (1, 3), (2, 1)} not transitive on {1, 2, 3, 4}?
   (iv) Is {(1, 1), (2, 2), (3, 3)}; Reflexive? Symmetric? Transitive on {1, 2, 3, 4}?
2. Let B is a set equals to {11,12,13,4,5} and R be the relation as
   R $(11,11),(11,12),(11,13),(11,4),(11,5),(12,12),(12,4),(12,5),(13,13),$
   $(13,4),(13,5),(4,4),(4,5),(5,5)\}.$
   Determine, if the relation is reflexive, symmetric and antisymmetric or not.
3. If A = {2, 3, 4, 6, 8, 9, 12, 18} for all a, b in A, aRb iff a divides b.
   List the element of R as a set of order pairs.
4. Let set A = {a, b, c, d}, and R be a relation defined on A. List the elements represented by the given matrix and check all the properties of the relation.

$$\text{Matrix of R} = \begin{bmatrix} 1 & 1 & 0 & 1 \\ 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

5. Given $f(x) = x^2 - 5x + 1$ and $g(x) = 2x + 1$, find $(f\, og)\,(2)$ and $(g\, of)\,(-2)$.
6. Given $f(x) = \frac{x}{x+1}$ and $g(x) = 9x - 3$, find $f^{-1}(x), g^{-1}(x), (f\, og)\,(x)$ and $(g\, o\, f)\,(x)$.
7. Let $f(x) = x^2 + 7x - 18$ and $h(x) = 2(x^{\frac{1}{2}} + 1)$. Evaluate $(foh)(4)$
8. Find $g(x)$ when $(f \circ g)(x) = 5x - 3$ and $f(x) = x - 1$
9. M&M plain candies come in various colours. The distribution of colours for plain M&M candies is

Colour	Purple	Yellow	Red	Orange	Green	Blue	Brown
Percentage	20	20	20	10	10	10	10

   Suppose you have a large bag of plain M&M candies and you choose one candy at random. Find
   a. P(green candy or blue candy). Are these outcomes mutually exclusive? Why?
   b. P(yellow candy or red candy). Are these outcomes mutually exclusive? Why?
   c. P (not purple candy)
10. You roll two fair dice, one green and one red.
   a. Are the outcomes on the dice independent?
   b. Find P(5 on green die and 3 on red die).
   c. Find P(3 on green die and 5 on red die)
   d. Find P((5 on green die and 3 on red die) or (3 on green die and 5 on red die))

11. You roll tow fair dice, one green and one red.
    a. What is the probability of getting a sum of 6?
    b. What is the probability of getting a sum of 4?
    c. What is the probability of getting a sum of 6 or 4? Are these outcomes mutually exclusive?
12. You draw two cards from a standard deck of 52 cards without replacing the first one before drawing the second.
    a. Are the outcomes on the two cards independent? Why?
    b. Find P(ace on 1^{st} card and king on 2^{nd})
    c. Find P(king on 1^{st} card and ace on 2^{nd})
    d. Find the probability of drawing an ace and a king in either order.
13. You draw two cards from a standard deck of 52 cards, but before you draw the second card, you put the first one back and reshuffle the deck.
    a. Are the outcomes on the two cards independent? Why?
    b. Find P(ace on 1^{st} card and king on 2^{nd})
    c. Find P(king on 1^{st} card and ace on 2^{nd})
    d. Find the probability of drawing an ace and a king in either order.
14. Compute following:
    a. $P_{5,2}$
    b. $C_{7,7}$
15. There are three nursing positions to be filled at Lilly hospital. Position 1 is the day nursing supervisor; position 2 is the night nursing supervisor; and position 3 is the nursing coordinator position. There are 15 candidates qualified for all three of the positions. Determine the number of different ways the positions can be filled by these applications.
16. The ski club with ten members is to choose three officers captain, co-captain & secretary, how many ways can those offices be filled?
17. The company Sea Esta has ten members on its board of directors. In how many different ways can it elect a president, vice-president, secretary and treasurer?
18. Suppose you are asked to list, in order or preference, the three best movies you have seen this year. If you saw 10 movies during the year, in how many ways can the three best be chosen and ranked?

LONDON METROPOLITAN UNIVERSITY

MARKING SCHEME

1st Sit Class Test 2 Marking Scheme — Year Long 2023 2024

Module Code:	**MA4001NP**
Module Title:	**Logic and Problem Solving**
Module Leader:	Mr. Prabin Banstola

Date:	19th July 2024
Day / Evening:	**Day**
Start Time:	**03:15 PM**
Duration:	**1 Hour 15 minutes**
Exam Type:	**Unseen Examination.**
Material Supplied:	**Exam Question Paper and Answer Booklet.**
Materials Permitted:	**Writing Instruments and a Calculator.**
Warning:	**Candidates are WARNED that possession of UNAUTHORIZED materials in an examination is a serious assessment offence.**
Instructions to Candidates:	**Please Note:** Inclusive of this cover page, this test paper consists of **3 pages and 5 Questions.** The student must complete ali Questions. This test accounts for **25%** of your total module marks. You are to return this paper, BEFORE you leave the testing room. **DO NOTE TURN THE PAGE OVER UNTIL INSTRUCTED**

MARKING SCHEME

Marks will be awarded for correctness and appropriate presentation of the answers.
Answer ALL questions.

1. Answer the following questions.
   a) Define equivalence relation and equivalence classes. **[4 marks]**

   b) The relation R defined on the set A = {1, 2, 3, 4, 5, 6} is known to be
   R = {(1,1), (1, 4), (2, 2), (2, 5), (2, 6), (3, 3), (4, 1), (4, 4), (5, 2), (5, 5), (5, 6), (6, 2), (6, 5), (6, 6)}.
      i. Check whether R is an equivalence relation or not. **[3 marks]**
      ii. Hence, if possible, find the equivalence classes of R and write the condition for the equivalence classes to form partitions on set A. **[3 marks]**

Solution:

<u>(a)</u> <u>Equivalence relation</u>
A relation on a set A is an ***equivalence relation*** if it is reflexive, symmetric, and transitive. 2 marks
<u>Equivalence class</u>
Let R be an equivalence relation on set A. For each a∈A we denote the **equivalence class** of a as [a] defined as:
[a]= {x∈A I xRa} 2 marks

<u>(b)</u> (i)

Reflexive: Yes, since for all x∈A, (x,x)∈R. 1 mark
Symmetric: Yes, since (x, y). ∈R and (y, x)∈R. 1 mark
Transitive: Yes, since (x, y) ∈R and (y,z)∈R implies (x, z) ∈R. 1 mark
Equivalence relation: R is Reflexive, Symmetric and Transitive.so R is equivalence relation.
(ii) R is equivalence relation. Hence it is possible to find the equivalence class.

Now,
[1] = {1, 4}
[2]= {2, 5, 6}
[3]= {3}
[4] = {1, 4}
[5] = {2, 5, 6}

[6] = {2, 5, 6}

MARKING SCHEME

2 marks

Necessary condition:

Disjoint and their union must be A. 1 mark.

2. Let f(x)= $\frac{x+3}{x-2}$ and g(x)= $\frac{1}{x}$
   a) Find (fog)(x). **[3 marks]**
   b) Find the domain of (fog)(x) . **[4 marks]**
   c) Find the domain of f(x) . **[3 marks]**

Solution:

a) (fog)(x)=f(g(x))

$=f(\frac{1}{x})$

$=\frac{1+3x}{1-2x}$ 3 marks

b)` For the domain of (fog)(x)

Here,

(fog)(x)= $\frac{1+3x}{1-2x}$

This function is defined for 1-2x $\neq 0$

2x $\neq 1$

X $\neq \frac{1}{2}$ and g(x) is not defined for 0

Hence, the domain of (fog)(x) is the set of real number except 0 and $\frac{1}{2}$. 4 marks

c) Also, f(x)= $\frac{x+3}{x-2}$ this function is defined for x-2$\neq 0$

x $\neq 2$

Hence the domain of f(x) is the set of all real number except 2. 3 marks

3. Answer the following questions:

   a) All the letters of the word **'AMCOTE'** are arranged in different possible ways. What is the number of such arrangements in which no two vowels are adjacent to each other? **[5 marks]**

Solution

We note that there are 3 consonants and 3 vowels E, A and O. Since no two vowels have to be together, the possible choice for vowels are the places marked as '<u>X</u>'.

<u>X</u> M <u>X</u> C <u>X</u> T <u>X</u>, 1 mark

These vowels can be arranged in 4P3 ways 1 mark

3 Consonant's can be arranged in 3! ways. 1 mark

Hence, the required number of ways = 3! × 4P3 = 144 2 marks

b) If P(n ,r)=840 and C(n ,r)=35 ,then find r! and r. **[5 marks]**

Solution:

Using formula and calculation 3 marks

For correct r!=24 and r=4. 2 marks

4. Let X be the random variable which represents the number of tails when three Coins are tossed simultaneously.
   a) List the Sample Space **[1 mark]**
   b) Construct the probability distribution for X. **[3 marks]**
   c) Calculate the expected value for X. **[3 marks]**
   d) Calculate variance for X. **[3 marks]**

Solution:

a) Sample Space = {HHH,HHT,HTH,HTT,THH,THT,TTH,TTT} **1 mark**

b) Probability distributions for X: **3 marks**

X	0	1	2	3
P(x)	1/8	3/8	3/8	1/8

For mean and variance:2 marks for calculation of X. P(x) and X^2. P(x)

X	P(x)		X. P(x)	X^2. P(x)
0	1/8		0	0
1	3/8		3/8	3/8
2	3/8		3/4	3/2
3	1/8		3/8	9/8
			$\sum[X.P(x)]$ =1.5	$\sum[X^2.P(x)]$=3

c) The expected value for X=$\sum[X.P(x)]$ =1.5 = 3/2 2 marks

d) Variance for X.= $\sum[X^2.P(x)]$-$[\sum[X.P(x)]]^2$=0.75 = 3/4 2 marks

5. Suresh and Hari are asked to solve a problem. The probability of Suresh solving it is $\frac{2}{3}$ and that of Hari solving it is $\frac{3}{4}$.Find the probability that.
   a) Both can solve the problem. **[2 Marks]**
   b) Hari solves it but Suresh cannot. **[2 Marks]**
   c) None of them can solve. **[2 Marks]**
   d) At least one of them will solve it. **[2 Marks]**
   e) Only one of them can solve. **[2 Marks]**

Solution:

a) $\frac{1}{2}$ = 0.5 **[2 Marks]**

b) $\frac{1}{4}$ = 0.25 **[2 Marks]**

c) $\frac{1}{12}$ = 0.083 **[2 Marks]**

d) $\frac{11}{12}$ = 0.9166 **[2 Marks]**

MARKING SCHEME

e) $\frac{5}{12}$

[2 Marks]

END OF THE MARKING SCHEME

LONDON METROPOLITAN UNIVERSITY

MARKING SCHEME

Year Long 2023 2024

1st Sit Class Test 2 Marking Scheme

Module Code:	**MA4001NP**
Module Title:	**Logic and Problem Solving**
Module Leader:	Mr. Prabin Banstola

Date:	19th July 2024
Day / Evening:	**Day**
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MARKING SCHEME

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   R = {(1,1), (1, 4), (2, 2), (2, 5), (2, 6), (3, 3), (4, 1), (4, 4), (5, 2), (5, 5), (5, 6), (6, 2), (6, 5), (6, 6)}.
   i. Check whether R is an equivalence relation or not. **[3 marks]**
   ii. Hence, if possible, find the equivalence classes of R and write the condition for the equivalence classes to form partitions on set A. **[3 marks]**

Solution:

(a) Equivalence relation
A relation on a set A is an ***equivalence relation*** if it is reflexive, symmetric, and transitive. 2 marks
Equivalence class
Let R be an equivalence relation on set A. For each a∈A we denote the **equivalence class** of a as [a] defined as:
[a]= {x∈A | xRa} 2 marks

(b) (i)
Reflexive: Yes, since for all x∈A, (x,x)∈R. 1 mark
Symmetric: Yes, since (x, y) ∈R and (y, x)∈R. 1 mark
Transitive: Yes, since (x, y) ∈R and (y,z)∈R implies (x, z) ∈R. 1 mark
Equivalence relation: R is Reflexive, Symmetric and Transitive.so R is equivalence relation.
(ii) R is equivalence relation. Hence it is possible to find the equivalence class.

Now,
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[2]= {2, 5, 6}
[3]= {3}
[4] = {1, 4}
[5] = {2, 5, 6}

[6] = {2, 5, 6}

MARKING SCHEME

2 marks

Necessary condition:

Disjoint and their union must be A. 1 mark.

2. Let f(x)= $\frac{x+3}{x-2}$ and g(x)= $\frac{1}{x}$
   a) Find (fog)(x). **[3 marks]**
   b) Find the domain of (fog)(x) . **[4 marks]**
   c) Find the domain of f(x) . **[3 marks]**

Solution:

a) (fog)(x)=f(g(x))

$=f(\frac{1}{x})$

$=\frac{1+3x}{1-2x}$ 3 marks

b) For the domain of (fog)(x)

Here,

(fog)(x)= $\frac{1+3x}{1-2x}$

This function is defined for 1-2x $\neq 0$

2x $\neq 1$

X $\neq \frac{1}{2}$ and g(x) is not defined for 0

Hence, the domain of (fog)(x) is the set of real number except 0 and $\frac{1}{2}$. 4 marks

c) Also, f(x)= $\frac{x+3}{x-2}$ this function is defined for x-2$\neq 0$

x $\neq 2$

Hence the domain of f(x) is the set of all real number except 2. 3 marks

3. Answer the following questions:
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Solution

We note that there are 3 consonants and 3 vowels E, A and O. Since no two vowels have to be together, the possible choice for vowels are the places marked as '<u>X</u>'.

<u>X</u> M <u>X</u> C <u>X</u> T <u>X</u>, 1 mark

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Hence, the required number of ways = 3! × 4P3 = 144 2 marks

b) If P(n ,r)=840 and C(n ,r)=35 ,then find r! and r. **[5 marks]**

Solution:

Using formula and calculation 3 marks

For correct r!=24 and r=4. 2 marks

4. Let X be the random variable which represents the number of tails when three Coins are tossed simultaneously.
   a) List the Sample Space **[1 mark]**
   b) Construct the probability distribution for X. **[3 marks]**
   c) Calculate the expected value for X. **[3 marks]**
   d) Calculate variance for X. **[3 marks]**

Solution:

a) Sample Space = {HHH,HHT,HTH,HTT,THH,THT,TTH,TTT} **1 mark**

b) Probability distributions for X: **3 marks**

X	0	1	2	3
P(x)	1/8	3/8	3/8	1/8

For mean and variance:2 marks for calculation of X. P(x) and X^2. P(x)

X	P(x)		X. P(x)	X^2. P(x)
0	1/8		0	0
1	3/8		3/8	3/8
2	3/8		3/4	3/2
3	1/8		3/8	9/8
			$\sum[X.P(x)]$ =1.5	$\sum[X^2.P(x)]$=3

c) The expected value for X=$\sum[X.P(x)]$ =1.5 2 marks

d) Variance for X.= $\sum[X^2.P(x)]$-$[\sum[X.P(x)]]^2$=0.75 2 marks

5. Suresh and Hari are asked to solve a problem. The probability of Suresh solving it is $\frac{2}{3}$ and that of Hari solving it is $\frac{3}{4}$.Find the probability that.
   a) Both can solve the problem. **[2 Marks]**
   b) Hari solves it but Suresh cannot. **[2 Marks]**
   c) None of them can solve. **[2 Marks]**
   d) At least one of them will solve it. **[2 Marks]**
   e) Only one of them can solve. **[2 Marks]**

Solution:

a) $\frac{1}{2}$ **[2 Marks]**

b) $\frac{1}{4}$ **[2 Marks]**

c) $\frac{1}{12}$ **[2 Marks]**

d) $\frac{11}{12}$ **[2 Marks]**

MARKING SCHEME

e) $\frac{5}{12}$

[2 Marks]

END OF THE MARKING SCHEME

MARKING SCHEME

LONDON METROPOLITAN UNIVERSITY

Re- SIT CLASS TEST 2 MARKING SCHEME: **Year Long 2023/2024**

Module Code:	**MA4001NP**
Module Title:	**Logic and Problem Solving**
Module Leader:	**Prabin Banstola**

Date:	**9th August 2024**
Day / Evening:	**Day**
Start Time:	**02:00 PM**
Duration:	**1** Hour **15** Minutes

Test Type:	**Unseen** Test
Materials permitted:	Non-Programmable Calculator
Warning:	Candidates are warned that possession of unauthorised materials in a test is a serious assessment offence.

Instructions to candidates:	**Please Note:** Inclusive of this cover page, this test paper consists of **2 pages and 5 Questions.** The student must complete all Questions. This test accounts for **25%** of your total module marks. You are to return this paper, BEFORE you leave the testing room. **DO NOT TURN PAGE OVER UNTIL INSTRUCTED**

MARKING SCHEME

Marks will be awarded for correctness and appropriate presentation of the answers.

Answer ALL questions.

1. Let $A = \{x : x \in N, 1 < x < 5\}$ and let R be the relation on A given by

   R= {(x, y): $x \in A$, $y \in A$; x - y is divisible by 2}

   a) List the elements of set A and relation R **[4 marks]**
   b) Construct digraph of R **[2 marks]**
   c) Construct matrix representation of R **[2 marks]**
   d) Check with reasons, whether R is reflexive, symmetric, transitive, equivalence, anti-symmetric, asymmetric and irreflexive or not. **[7 marks]**

Solution:

a) $A = \{x : x \in N, 1 < x < 5\}$ **1 mark**

$= \{2, 3, 4\}$ **1 mark**

$A \times A = \{(2,2), (2,3), (2,4), (3,2), (3,3), (3,4), (4,2), (4,3), (4,4)\}$

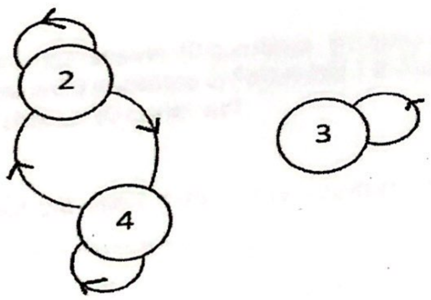
R= {(x, y): $x \in A$, $y \in A$; x- y is divisible by 2}

2 marks

R $= \{(2,2), (2,4), (3,3), (4,2), (4,4)\}$

2 marks

b) Di- graph of R



2 marks

c) Matrix:

$$M = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$$

1 mark

d) Reflexive- R is Reflexive since $\forall x \in A, (x,x) \in R$ **1 mark**

Symmetric-R is Symmetric since $\forall x, y \in A, (x,y) \in R \rightarrow (y,x) \in R.$ **1 mark**

Transitive- R is Transitive since if $(x,y) \in R$ and $(y,z) \in R \rightarrow (x,z) \in R$

Equivalence: R is Reflexive , Symmetric and Transitive. So, R is equivalence.

1 mark

Anti-symmetric-R is not Anti-symmetric since $(2,4) \in R$ and $(4,2) \in R$ but $2 \neq 4$. **1 mark**

Asymmetric: R is not Asymmetric since if $(2,4) \in R$, then $(4,2) \in R$. **1 mark**

Irreflexive: R is not Irreflexive since $\forall x \in A, (x,x) \in R$. **1 mark**

2. If f(x) = x^3 - 1 and g(x) = 2x - 3. Find,

   a) $f^{-1}(x)$ **[2 marks]**
   b) $g^{-1}(x)$ **[2 marks]**
   c) $(f^{-1} o\, g)(2)$ **[3 marks]**
   d) $(fo\, g^{-1})(1)$ **[3 marks]**

Solution:

a) $f^{-1}(x) = (x+1)^{1/3}$ **2 marks**
b) $g^{-1}(x) = \frac{1}{2}(x+3)$ **2 marks**
c) $(f^{-1} o\, g)(2) = 2^{\,1/3}$ **3 marks**
d) $(fo\, g^{-1})(1) = 7$ **3 marks**

3. A student must answer 10 questions, choosing at least 4 from each of Parts A and B. If there are 6 questions in Part A and 7 in Part B, in how many ways can the student choose 10 questions? **[5 marks]**

Solution:
The student can select questions as shown in the table given below:

Part A	Part B	Selection
4	6	C(6,4)×C(7,6)
5	5	C(6,5)×C(7,5)
6	4	C(6,6)× C(7,4)

3 marks

Therefore, the total number of ways can the student choose 10 questions

= C(6,4)×C(7,6)+ C(6,5)×C(7,5)+ C(6,6)× C(7,4) =105+126+35 **1 mark**

= 266 **1 mark**

MARKING SCHEME

4. Let X be the random variable which represents the number of tails when three coins are tossed simultaneously.

a)	List the Sample Space	**[1 mark]**
b)	Construct the probability distribution for X.	**[3 marks]**
c)	Calculate the expected value for X.	**[3 marks]**
d)	Calculate variance for X.	**[3 marks]**

Solution

a) Sample Space={HHH, HHT, HTH, HTT, THH, THT, TTH, TTT} **1 mark**

b) Probability distributions for X

X	0	1	2		3
$P(X)$	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{3}{8}$		$\frac{1}{8}$

3 marks

For Expected value and variance:

X	P(X)	X* P(X)	$X^2 *$ P(X)
0	1/8	0	0
1	3/8	3/8	3/8
2	3/8	6/8	3/2
3	1/8	3/8	9/8
	$\sum P(X) = 1$	$\sum X * P(X) = 1.5$	$\sum X^2 * P(X) = 3$

c) The expected value for X $= \sum X * P(X) = 1.5$ **3 marks**

d) Variance for X.= $\sum X^2 * P(X) - (\sum x * P(X))^2$

= **0.75** **3 marks**

5. The Records of 400 examinees are below:

Score\ Degree	B.A	B.SC	MBA	Total
Below 50	90	30	60	180
50 to 60	20	70	70	160
Above 60	10	30	20	60
Total	**120**	**130**	**150**	**400**

If an examinee is selected from this group of examinees, find the probability that

a) He is a MBA degree. **[1 mark]**

b) He is a B.SC degree, given that his score is above 60. **[3 marks]**

c) His score is below 50, given that he is a B.A degree. **[3 marks]**

d) His score is above 60, given that he is a B.SC degree. **[3 marks]**

Solution:

Given information:

Score	Educational qualification			Total
	B.A	B.SC.	MBA	
Below 50	90	30	60	180
50-60	20	70	70	160
Above 60	10	30	20	60
Total	120	130	150	400

Let M = MBA degree chosen.
Q = His score above 60 is chosen.
B = B. SC degree chosen
C = B. A degree chosen
R = His score below 50 chosen

If an examinee is selected from above group, then

a) Prob. that he is a MBA degree P(M) = 150/400 = 0.375 **1 mark**

b) Prob. of score above 60 P(Q) = 60/400
Prob. of score above 60 and B. SC degree=P(B∩Q) =30/400
Prob. of B.SC degree, given that his score is above 60
P(B/Q) = P(B∩Q)/P(Q)
= 30/400 / 60/400
= ½ **3 marks**

c) Prob of being BA degree P(C) = 120/400
Prob. that score below 50 and B.A degree = P(R∩C) = 90/400

Prob. that his score below 50 given that he is a B.A. degree = P(R/C) = P(R∩C)/ P(C)

= 90/400/120/400

= 90/120

= ¾ **3 marks**

d) Prob. of B.SC degree P(B)=130/400

Prob. that score above 60 and B.SC degree= P $(Q \cap B)$=30/400

Prob. that his score is above 60 given that he is a B.SC degree

= P(Q/B)

= P(Q∩B)/ P(B)

= 30/400/130/400

= 3/13 **3 marks**

END OF THE MARKING SCHEME

LONDON METROPOLITAN UNIVERSITY

MARKING SCHEME

1st Sit Class Test 2 Marking Scheme **Year Long 2023 2024**

Module Code:	**MA4001NP**
Module Title:	**Logic and Problem Solving**
Module Leader:	Mr. Prabin Banstola

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Day / Evening:	**Day**
Start Time:	**03:15 PM**
Duration:	**1 Hour 15 minutes**
Exam Type:	**Unseen Examination.**
Material Supplied:	**Exam Question Paper and Answer Booklet.**
Materials Permitted:	**Writing Instruments and a Calculator.**
Warning:	**Candidates are WARNED that possession of UNAUTHORIZED materials in an examination is a serious assessment offence.**
Instructions to Candidates:	**Please Note:** Inclusive of this cover page, this test paper consists of **3 pages and 5 Questions.** The student must complete all Questions. This test accounts for **25%** of your total module marks. You are to return this paper, BEFORE you leave the testing room. **DO NOTE TURN THE PAGE OVER UNTIL INSTRUCTED**

MARKING SCHEME

Marks will be awarded for correctness and appropriate presentation of the answers.

Answer ALL questions.

1. Answer the following questions.
   a) Define equivalence relation and equivalence classes. **[4 marks]**

   b) The relation R defined on the set A = {1, 2, 3, 4, 5, 6} is known to be
   R = {(1,1), (1, 4), (2, 2), (2, 5), (2, 6), (3, 3), (4, 1), (4, 4), (5, 2), (5, 5), (5, 6), (6, 2), (6, 5), (6, 6)}.

   i. Check whether R is an equivalence relation or not. **[3 marks]**

   ii. Hence, if possible, find the equivalence classes of R and write the condition for the equivalence classes to form partitions on set A. **[3 marks]**

Solution:

<u>(a) Equivalence relation</u>

A relation on a set A is an ***equivalence relation*** if it is reflexive, symmetric, and transitive. 2 marks

<u>Equivalence class</u>

Let R be an equivalence relation on set A. For each a∈A we denote the **equivalence class** of a as [a] defined as:

[a]= {x∈A | xRa} 2 marks

<u>(b)</u> (i)

Reflexive: Yes, since for all x∈A, (x,x)∈R. 1 mark

Symmetric: Yes, since (x, y) ∈R and (y, x)∈R. 1 mark

Transitive: Yes, since (x, y) ∈R and (y,z)∈R implies (x, z) ∈R. 1 mark

Equivalence relation: R is Reflexive, Symmetric and Transitive.so R is equivalence relation.

(ii) R is equivalence relation. Hence it is possible to find the equivalence class.

Now,

[1] = {1, 4}

[2]= {2, 5, 6}

[3]= {3}

[4] = {1, 4}

[5] = {2, 5, 6}

· [6] = {2, 5, 6} 2 marks

Necessary condition:

Disjoint and their union must be A. 1 mark.

2. Let f(x)= $\frac{x+3}{x-2}$ and g(x)= $\frac{1}{x}$
   a) Find (fog)(x). **[3 marks]**
   b) Find the domain of (fog)(x) . **[4 marks]**
   c) Find the domain of f(x) . **[3 marks]**

Solution:

a) (fog)(x)=f(g(x))

$=f(\frac{1}{x})$

$=\frac{1+3x}{1-2x}$ 3 marks

b) For the domain of (fog)(x)

Here,

(fog)(x)= $\frac{1+3x}{1-2x}$

This function is defined for $1\text{-}2x \neq 0$

$2x \neq 1$

$X \neq \frac{1}{2}$ and g(x) is not defined for 0

Hence, the domain of (fog)(x) is the set of real number except 0 and $\frac{1}{2}$. 4 marks

c) Also, f(x)= $\frac{x+3}{x-2}$ this function is defined for $x\text{-}2 \neq 0$

$x \neq 2$

Hence the domain of f(x) is the set of all real number except 2. 3 marks

3. Answer the following questions:

   a) All the letters of the word **'AMCOTE'** are arranged in different possible ways. What is the number of such arrangements in which no two vowels are adjacent to each other? **[5 marks]**

Solution

We note that there are 3 consonants and 3 vowels E, A and O. Since no two vowels have to be together, the possible choice for vowels are the places marked as '$\underline{X}$'.

$\underline{X}$ M $\underline{X}$ C $\underline{X}$ T $\underline{X}$, 1 mark

These vowels can be arranged in 4P3 ways 1 mark

3 Consonant's can be arranged in 3! ways. 1 mark

Hence, the required number of ways = 3! × 4P3 = 144 2 marks

b) If P(n ,r)=840 and C(n ,r)=35 ,then find r! and r. **[5 marks]**

Solution:

Using formula and calculation 3 marks

For correct r!=24 and r=4. 2 marks

4. Let X be the random variable which represents the number of tails when three Coins are tossed simultaneously.
   a) List the Sample Space **[1 mark]**
   b) Construct the probability distribution for X. **[3 marks]**
   c) Calculate the expected value for X. **[3 marks]**
   d) Calculate variance for X. **[3 marks]**

Solution:

a) Sample Space = {HHH,HHT,HTH,HTT,THH,THT,TTH,TTT} **1 mark**

b) Probability distributions for X: **3 marks**

X	0	1	2	3
P(x)	1/8	3/8	3/8	1/8

For mean and variance:2 marks for calculation of X. P(x) and X^2. P(x)

			X. P(x)	X^2. P(x)
X	P(x)		0	0
0	1/8		3/8	3/8
1	3/8		3/4	3/2
2	3/8		3/8	9/8
3	1/8		$\sum[X.P(x)]=1.5$	$\sum[X^2.P(x)]=3$

2 marks

c) The expected value for X=$\sum[X.P(x)]=1.5$ 2 marks

d) Variance for X.= $\sum[X^2.P(x)]-[\sum[X.P(x)]]^2=0.75$

5. Suresh and Hari are asked to solve a problem. The probability of Suresh solving it is $\frac{2}{3}$ and that of Hari solving it is $\frac{3}{4}$.Find the probability that.
   a) Both can solve the problem. **[2 Marks]**
   b) Hari solves it but Suresh cannot. **[2 Marks]**
   c) None of them can solve. **[2 Marks]**
   d) At least one of them will solve it. **[2 Marks]**
   e) Only one of them can solve. **[2 Marks]**

Solution:

a) $\frac{1}{2}$ [2 Marks]

b) $\frac{1}{4}$ [2 Marks]

c) $\frac{1}{12}$ [2 Marks]

d) $\frac{11}{12}$ [2 Marks]

e) $\frac{5}{12}$

MARKING SCHEME

[2 Marks]

END OF THE MARKING SCHEME