ALLAMA IQBAL OPEN UNIVERSITY, ISLAMABAD
(Department of Mathematics)

WARNING

1. **PLAGIARISM OR HIRING OF GHOST WRITER(S) FOR SOLVING THE ASSIGNMENT(S) WILL DEBAR THE STUDENT FROM AWARD OF DEGREE/CERTIFICATE, IF FOUND AT ANY STAGE.**
2. **SUBMITTING ASSIGNMENT(S) BORROWED OR STOLEN FROM OTHER(S) AS ONE'S OWN, WILL BE PENALIZED AS DEFINED IN "AIOU PLAGIARISM POLICY".**

Course: Discrete Mathematics (MATH 3005) **Semester: Spring, 2026**

Level: BS

Please read the following instructions for writing your assignments.
(AD, BS, BEd, MA/MSc, MEd) (ODL Mode)

1. All questions are compulsory and carry equal marks but within a question, the marks are distributed according to its requirements.
2. Read the question carefully and then answer it according to the requirements of the question.
3. Avoid irrelevant discussion/information and reproducing from books, study guide or allied material.
4. Hand written scanned assignments are not acceptable.
5. Upload you typed (in Word or PDF format) assignments on or before the due date.
6. Your own analysis and synthesis will be appreciated.
7. Late assignments can't be uploaded at LMS.
8. The students who attempt their assignments in Urdu/Arabic may upload a scanned copy of their hand written assignments (in PDF format) on University LMS. The size of the file should not exceed 5 MB.

Total Marks: 100 **Pass Marks: 50**

ASSIGNMENT No. 1
(Unit 1 to 5)

Question 1 **(20)**

(a) Construct the truth table for $(p \vee q) \wedge \neg p$.
(b) Draw a digraph representing the relation $R = \{(1,2),(2,3),(1,3)\}$ on the set $\{1,2,3\}$. Is this relation transitive?

Question 2 **(20)**

(a) Is the expression $p \leftrightarrow q$ logically equivalent to $(p \rightarrow q) \wedge (q \rightarrow p)$? Justify your answer using a truth table.
(b) Given the premises $p \rightarrow q$ and $q \rightarrow r$, Use Hypothetical Syllogism to derive a conclusion. What inference is valid?

Question 3 **(20)**

(a) Let $S = \{1,2,3,4,5,6\}$, and define a relation R on S by: $aRb \Leftrightarrow a \equiv b \pmod 3$. Prove R is an equivalence relation? Find the equivalence classes of each element of set. S and define a partition of S induced by R.
(b) What is a strongly connected component (SCC) in a digraph? Explain how SCCs are related to equivalence classes?

Question 4 **(20)**

(a) Use the rule of Disjunctive Syllogism to deduce a conclusion from the premises: $p \vee q, \neg p$.

(b) What is a proposition? Give two examples of statements that are propositions and two that are not? Identify the atomic propositions and logical connectives in the statement: "If it is raining and cold, then I will stay home."

Question 5 **(20)**

(a) Prove the associativity of relation composition.

(b) Explain how equivalence relations are used in at least two applied fields, such as automata theory, topology, or computer science?

Total Marks: 100 **Pass Marks: 50**

Assignment No. 2

(Units 6 to 9)

Question 1 **(20)**

(a) Show that the exponential function $f(x) = e^x$ is injective but not surjective when $f : \mathbb{R} \to \mathbb{R}$.

(b) Show between a bijection between explicitly $\mathbb{N}$ and $\mathbb{Z}$.

Question 2 **(20)**

(a) For which values of n does $n^2 > 2^n$Provide at least two examples and explain.

(b) What are the main advantages of using the hexadecimal number system in digital electronics?

Question 3 **(20)**

(a) Multiply the binary numbers 101_2 and 110_2. Show each intermediate step and convert the result to a decimal.

(b) Explain how file permissions in UNIX/Linux systems use octal numbers. Give an example of what chmod 755 means in octal and binary?

Question 4 **(20)**

a) Find the 8-bit one's complement and two's complement of the decimal number 23.

b) Using 8-bit two's complement arithmetic, compute 12 − 27. Show the binary encodings, the two's complement of the subtrahend, the addition step, and interpret the result in decimal.

Question 5 **(20)**

(a) Decode the IEEE 754 single-precision bit pattern
0 10000010 10100000000000000000000
into its decimal value. Identify sign, unbiased exponent, and significand.

(b) If a function $f : A \to B$ Is bijective? What can you say about its inverse $f^{-1} : B \to A$? Describe mathematically how to find it.