

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2025
Department of Computer Science and Engineering
CSE 1101

Structured Programming

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the immediate right column of the questions indicate full marks.
iii) The rightmost column indicates course outcomes.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) A multifile C program contains a source file named "main.c". Describe the steps of compiling this file and state the name of file extensions produced from "main.c". (12) [CO1]
b) Explain why %f works for both float and double in 'printf' but %lf is required for double input in 'scanf'. (08) [CO1]
c) Explain the output of the following functions: (15) [CO3]
i) `int fun1(int a, int b){if (a == 0) return b;
return fun1(a/10, b*10+a%10);}`
ii) `int fun2(int a, int b){
return b ? fun2(a ^ b, (a & b) << 1) : a}`
Hints: use (a, b) pair like (5, 0), (0, 5), (16, 0), (16, 2), etc to understand the output.
Hence compute for `int x = fun1(123, 0)` and `int y = fun2(216, 14)`.
2. a) What is cyclic property of data type in C language? Determine and explain the output of the following C program. (10) [CO1]

```
int main(){  
    unsigned char b = 80, c = 20, d = 2;  
    unsigned char y = -400, z = 20, w = 30;  
    unsigned char a = b*c/d;  
    unsigned char x = y/z*w;  
    printf("%d %d", a, x);  
    return 0;  
}
```

- b) Why 'goto' statement should be avoided in a program? Draw the iteration tables for the variables of the following program. (13) [CO1]

```
#include <stdio.h>  
int main(){  
    int sum = 0, i, j;  
    for(i = 0, j = 9; i < j; i++, --j)  
    {  
        int k = 1, c = 1, d = 1;  
        while(k ^ 4){  
            c*=i; d*=j; k++;  
        }  
        sum+=c+d;  
    }  
    printf("%d\n", sum);  
    return 0;  
}
```

- c) $\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots$. Design the following functions to evaluate $\sin(x)$ upto n^{th} term: (12) [CO3]

```
float sin(float x, int n);  
float power(float x, int p);  
int fact(int p); and  
int main();
```

3. a) Write a C program with a function named 'printGrades' that takes variable number of student records. Each record consists of <roll, name, m1, m2, m3 (marks of 3 subjects)>. The function will compute average mark of each student and print <roll, grade> pairs using switch...case, grade = A(avg≥80), B(avg≥70 but avg<80), C(60≤avg≤69), F(avg<60) (15) [CO3]
- b) You are given 2 files: today.dat <dd mm yyyy>, and student.txt <roll, dd mm yyyy (DoB), gpa>. You have to create a file eligible.txt <roll age gpa> where age must be ≥18 and gpa ≥ 4.50. Now, write a C program to perform the task. The program is executed by the command: (15) [CO3]
- ./ main today.dat student.txt eligible.txt
- c) Write an example program showing proper use of # and ## operators with macro arguments. (05) [CO2]
4. a) Explain the following terms using a single example code: (09) [CO1]
(i) Scope, (ii) Longevity, (iii) Visibility.
- b) The following main() function computes the sum of the n natural number $(1 + 2 + 3 + \dots + n)$. Define necessary macros to make the C program executable. (08) [CO3]

```

ashol()
Shuru_koro
    purno n, i, sum = 0;
    bolo("n koto?");
    poro("%d", &n);
    shobar_jonno(i, n) jog_koro;
    bolo("l theke %d porjonto jog = %d\n", n, sum);
Shesh_koro

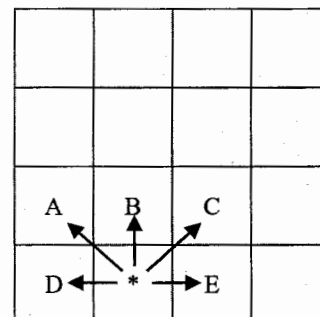
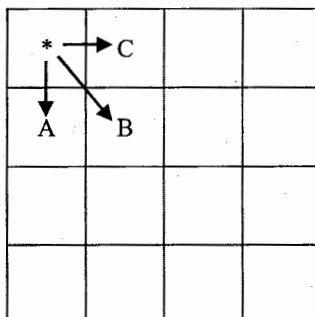
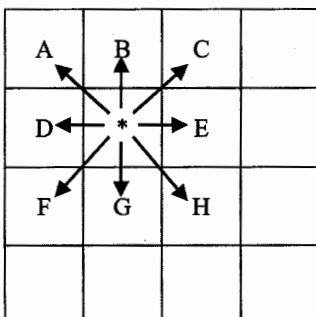
```

- c) A simple calculator can only perform addition and subtraction of 2 numbers, but it can work in 2 modes - normal mode and complex mode. In the complex mode, a complex number is represented by 2 consecutive real numbers. Normal operations are defined in "normal.c" and for complex operations "complex.c". "main.c" file includes only "main.h". Design all the necessary C files and header files for the program. (18) [CO3]

SECTION B

(Answer ANY THREE questions from this section in Script B)

5. a) "All strings are character arrays, but all character arrays are not strings"- justify the statement. (05) [CO2]
- b) Suppose, you are given a long text log where each entry is separated by the delimiter "|" and each entry contains a timestamp followed by a message. Write a C program to extract each log entry and to detect whether the message contains any keyword from a given list (e.g., "error", "warning", "critical"), ignoring case. For every keyword, count how many entries contain it as a substring and print the final frequency table, ensuring that partial matches inside larger words (e.g., "critically") are also detected. (17) [CO2]
- c) You are given an $N \times N$ integer matrix where each cell represents height. Write a C program using only 2-dimensional arrays to identify all "peaks", defined as cells whose values are strictly greater than all of their 8-directional neighbours. For edge and corner cells, only compare against valid neighbours that fall inside the matrix bounds. Finally, output the total number of peaks and average value of those peaks. (13) [CO2]



Valid 8-directional neighbours

6. a) Describe how the compiler determines the amount by which a pointer moves, how this affects memory addressing for `int*`, `char*`, and `int(*) [N]`? (07) [CO2]
 b) What will be the output of the following C program? Explain the output. (12) [CO2]

```
#include <stdio.h>
char *c[] = {"CSE 1101", "MCQ", "TEST", "QUIZ"};
char **cp[] = {c+3, c+2, c+1, c};
char ***cpp[] = cp;
int main()
{
    printf("%s", **++cpp);
    printf("%s", *--*++cpp+3);
    printf("%s", *cpp[-2]+3);
    printf("%s", cpp[-1][-1]+1);
    return 0;
}
```

- c) Create a command interpreter in C that processes user input commands. The program (16) [CO2] should support the following commands (commands should be taken input as string):
- `add <num1><num2>`: Add two numbers and display the result.
 - `sub <num1><num2>`: Subtract the second number from the first and display the result.
 - `mul <num1><num2>`: Multiply two numbers and display the result.
 - `div <num1><num2>`: Divide the first number by the second and display the result.

Use an array of pointers to function to call the appropriate function for each command.

7. a) Explain the memory layout differences between a structure and a union in C. (10) [CO1]
 b) There is a structure called `employee` that holds information like employee code, name, date of joining. Write a program to create an array of structures and enter some data into it, then ask the user to enter current date. Display the names of those employees whose tenure is 3 or more than 3 years according to the given current date. (15) [CO2]
 c) Consider the following code snippet. Assume that the objects of the type `short`, `float`, and `long` occupy 2 bytes, 4 bytes, and 8 bytes, respectively. What is the memory requirement for variable `t` considering alignment (32-bit processor) and without considering alignment? Explain your answer. (10) [CO1]

```
struct
{
    short s[5];
    union
    {
        float y;
        long z;
    } u;
} t;
```

8. a) What is garbage collection? Explain memory leak with an example. (08) [CO1]
 b) Suppose, we have the following two statements in a C program (12) [CO1]

```
int *x = malloc(sizeof(int));
int *y = malloc(sizeof(int));
```

For each of the following expressions, write "true" if the expression is always true, "false" if the expression is always false, or "unknown" if the expression could be either true or false depending on what happens when the program is executed.

- `(x < y)`,
- `(x == y)`,
- `((int)x) + sizeof(int) == ((int)y)`,
- `(x == NULL)`.

Explain each case with correct answer.

- c) Write a C program that asks the user to enter a filename and then attempts to open the file for reading. Implement proper error handling in this case. (05) [CO3]
 d) Suppose, you have 4 files (`Test1.c`, `Test2.c`, `Test3.c`, `Test.h`). Write an efficient makefile for these files using dependencies, variables, and proper comments. (10) [CO3]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2025
Department of Computer Science and Engineering
CSE 1107

Discrete Mathematics

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the immediate right column of the questions indicate full marks.
iii) The rightmost column indicates course outcomes.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define the followings with suitable examples: (10) [CO1]
 - i) Proposition.
 - ii) Logical connective.
 - iii) Tautology.
- b) Reduce the following logical expressions using logical equivalence laws: (10) [CO2]
 - i) $(p \rightarrow q) \wedge (p \vee r)$.
 - ii) $\neg(p \vee \neg q) \vee (p \wedge q)$.
- c) A smart home alarm system works as follows: (15) [CO3]

The alarm sounds if and only if either the motion sensor or the door sensor is triggered, but not both. Where, p : The motion sensor is triggered; q : The door sensor is triggered; r : The alarm sounds.

 - i) Translate the description into a logical expression using p, q, r .
 - ii) Construct the truth table for your expression.
 - iii) Is the system logically consistent? Explain your answer.
2. a) Translate each of the following statements into logical expression using predicates, quantifiers and logical connectives. Let $C(x)$ denotes “ x is in the correct place”, $E(x)$ denotes the predicate “ x is in excellent condition”, and $T(x)$ denotes the predicate “ x is a tool” and suppose that the domain consists of all tools. (15) [CO4]
 - i) Something is not in the correct place.
 - ii) All tools are in the correct place and are in excellent conditions.
 - iii) Everything is in the correct place and is in excellent condition.
 - iv) Nothing is in the correct place and is in excellent condition.
- b) Use the Euclidian Algorithm to compute GCD of $gcd(414, 662)$ and using your (10) [CO2] result of GCD, find the integers x and y such that $gcd(414, 662) = 414x + 662y$.
- c) What is graph? Show that, “An undirected graph has an even number of vertices of (10) [CO1] odd degree”.
3. a) A digital encryption system uses keys based on modular arithmetic. Let the encryption (10) [CO1] be computed using a public key, $n = 77$, an integer message, m , and the encryption rule: $c = m^5 \pmod{77}$.
 - i) Compute the encryption of message, $m = 12$.
 - ii) Briefly explain why modular arithmetic ensures data security in simple cryptosystem.
- b) Use the mathematical induction to prove that for all integers $n \geq 1$: (10) [CO2]
$$1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}$$
- c) Solve the following general number theory problem using CRT: (15) [CO3]

A number x leaves remainders 1, 2, and 3 when divided by 2, 3, and 5 respectively.

 - i) Express this information as a system of congruences.
 - ii) Use CRT to find the smallest positive integer satisfying the system.
 - iii) Verify your answer by direct substitution into each congruences.
4. a) Define the following terms with examples: (05) [CO1]
 - i) Simple graph
 - ii) Degree of a vertex
 - iii) Complete graph
 - iv) Bipartite graph
- b) Represent the following graph using both adjacency list and adjacency matrix: (10) [CO3]

Vertices: $V = \{A, B, C, D\}$; Edges: $E = \{AB, AC, BD, CD\}$.

- c) A municipality wants to install a low-cost communication cable network connecting (20) [CO4] following administrative hubs: A(City Hall); B(Health Center); C(Fire Station); D(Water Supply Office); E(Transport Control Unit).

The Cost (in millions of Taka) of laying cables between these hubs is given below:

Edge	Cost	Edge	Cost
A-B	2	B-D	5
A-C	6	B-E	4
A-D	3	C-D	1
A-E	7	C-E	5

The municipality authority wants a layout that (i) Connects all five hubs, (ii) Avoids cycles, and (iii) Minimizes total cabling cost. Now design your cable network following these guidelines.

SECTION B

(Answer ANY THREE questions from this section in Script B)

5. a) Consider the following zero-one matrix. (15) [CO1]

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

i) Now, check whether this relation is Partial Ordering or not. If yes, then draw its Hasse Diagram.

ii) Also, check whether it is Total Ordered set or not. If not, then provide an example of two elements that are incomparable.

- b) Prove that $\lfloor 2x \rfloor = \lfloor x \rfloor + \lfloor x + \frac{1}{2} \rfloor$ whenever x is real number. (10) [CO1]

- c) What is the importance of finding growth of a function? Give a Big-O estimate for $(x^2 + x(\log x)^3) \cdot (2^x + x^3)$ (10) [CO2]

6. a) Solve the recurrence relation $a_{n+2} = -4a_{n+1} + 5a_n$ for $n \geq 0$ with initial condition $a_0 = 2, a_1 = 8$. (10) [CO2]

- b) Define Isomorphism of Semigroups. If $G = \{1, -1, i, -i\}$ then show that $[G; *]$ is abelian group where ' $*$ ' is complex multiplication. (10) [CO3]

- c) A young pair of rabbits is placed on an island. A pair of rabbits does not breed until they are 2 months old, each pair of rabbits produces another pair each month. Find a recurrence relation along with its closed form for the number of pairs of rabbits on the island after n months if all the rabbits are alive. (15) [CO4]

7. a) Create a sequence that models the monthly savings of a student who deposits a fixed amount each month and earns 2% interest per month on total savings. Provide a recursive formula and explain why it fits the scenario. (12) [CO4]

- b) A student claims that "Every subgroup of a cyclic group must be cyclic". Evaluate this claim. Provide a formal justification and at least one example. (10) [CO2]

- c) Use generating function to solve the recurrence relation: $a_k = 2a_{k-1} + 3a_{k-2} + 4^k + 6$ with initial conditions $a_0 = 2, a_1 = 60$. (13) [CO1]

8. a) How many bit strings of length 10 contains at least three 1s and at least three 0s? (10) [CO3]

- b) Let P be the set of all non-negative real number. Define "&" on P by $a \& b = \frac{a+b}{1+a*b}$. Prove that $[P; \&]$ is a monoid. (10) [CO2]

- c) Consider the function $f(x) = x^2$. Analyze whether the function is injective or surjective over each domain: (15) [CO2]

i) $f: \mathbb{Z} \rightarrow \mathbb{Z}$

ii) $f: \mathbb{R} \rightarrow \mathbb{R}$

iii) $f: \mathbb{R} \rightarrow [0, \infty]$

Explain your answer in each case.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2025
Department of Computer Science and Engineering
HUM 1107

English and Human Communication

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the immediate right column of the questions indicate full marks.
iii) The rightmost column indicates course outcomes.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Make sentences on the following structures using the verbs given in bracket. (14) [CO3]
i) Subject + Intransitive verb + Adverbial of place. (stand as verb)
ii) Subject + Linking verb + Adjective complement. (sound as verb)
iii) Subject + Linking verb + Noun complement. (remain as verb)
iv) Subject + Transitive verb + Gerund as object. (enjoy as verb)
v) Neither + Subject + nor + Subject + Verb + Adverb. (contribute as verb)
vi) Subject + Transitive verb + Objective + Noun complement. (name as verb)
vii) Subject + Transitive verb + Objective + Objective. (cost as verb)
- b) Change the words as directed and make sentences with the changed words: (12) [CO2]
Grow (noun), Curiosity (adjective), History (adverb), Content (noun), Different (verb), Sport (noun adjective).
- c) Write the antonym of the following words and make sentences with them: (09) [CO2]
Reverse, Current, Precious.
2. a) Transform the following sentences as directed. (14) [CO3]
i) I let him go. (Passive)
ii) I can not but planting trees there. (Affirmative)
iii) Pele is greater than I thought. (Positive)
iv) The moonbeam is wonderful to look as. (Exclamatory)
v) Walk fast or you can not catch the train. (Simple)
vi) Father wants me to be an engineer. (Compound)
vii) I lost the book yesterday. (Complex)
- b) Frame sentences expressing the following notions/emotions. (12) [CO3]
(i) Revolt, (ii) Confusion, (iii) Creepy, (iv) Regret, (v) Sympathy, (vi) Proposal.
- c) Make sentences using the following phrases and idioms: (09) [CO1]
Fair game, A sign of, Very few, Up and doing, Well to do, Show off.
3. a) Frame wh question with the underline words from the following sentences: (14) [CO3]
i) Monir doesn't like what Avi says about you.
ii) I found your brother on the platform.
iii) Her strength lies in her honesty and chastity.
iv) Infection on his vocal chord made him silent.
v) The river is very deep.
vi) He runs the car 30 miles per hour.
vii) He struck him in the head.
- b) Make sentences using the following words as directed: (12) [CO1]
Accessory (as noun), Above (as adverb), Back (as verb), Measure (as noun), Round (as adjective), Red (as noun adjective).
- c) Make a new word with each of the following prefixes and suffixes and use them in sentences. (09) [CO3]
A ..., De ..., Be ..., ful, ry, ness.
4. a) Correct the following sentences: (14) [CO2]
i) She was in no way to be blamed.
ii) Three years passed since I saw you last.
iii) What are you thinking?
iv) It is this book I have been looking for.
v) It is me who did the work.
vi) How a sad accident it was.
vii) One of the students are brave.

- b) Make sentences using the following modals as directed. (12) [CO3]
- i) May (To express guess about the present).
 - ii) Should (To express duty in the past).
 - iii) Could (To express opportunity in the past which was not executed).
 - iv) Need (To express unnecessary action in the past).
 - v) Had better (To express preference).
 - vi) Be going to (To express intention).
- c) Complete the sentences with subordinate clauses as directed. (09) [CO1]
- i) remains a mystery. (Noun clause)
 - ii) The fame with his name is (Noun clause)
 - iii) Habib works in the factory, (Adjective clause)
 - iv) Democracy is notion (Adjective clause)
 - v), you may join the party. (Adverb clause of time)
 - vi), our all efforts will vain. (Adverb clause of condition)
 - vii), you can not explain this. (Adverb clause of concession)

SECTION B

(Answer ANY THREE questions from this section in Script B)

5. a) Read the passage carefully and answer the questions that follow: (20) [CO2]

Volcanoes are geological structures that form when molten rock, ash, and gases escape from deep beneath the Earth's Surface. This molten rock, known as magma, collects in chambers until pressure forces it upward through cracks or vents, resulting in an eruption. Some eruptions are explosive, sending ash and lava high into the atmosphere, while others are effusive, producing slow-moving lava flows. The type of eruption depends largely on magma compositions and gas content.

Volcanoes play a significant role in shaping Earth's landscapes by creating mountains, islands, and fertile soil. They are commonly found along tectonic plate boundaries, such as the Pacific Ring of Fire, where plates collide or move apart. While volcanic activity can be destructive to nearby communities, volcanoes also have long-term environmental benefits. For example, volcanic ash enriches soil with minerals, supporting agriculture and ecosystems.

Scientists monitor volcanoes using seismographs, satellite imagery, and gas sensors to detect early warning signs of eruptions. This monitoring is crucial for risk assessment and disaster preparedness, helping protect lives and property in vulnerable regions.

Questions:

- i) What forces magma upward to cause a volcanic eruption?
- ii) What geological feature is known as the "Pacific Ring of Fire"?
- iii) Name one long-term environmental benefit of volcanic activity?
- iv) What tools do scientists use to monitor volcanoes?

- b) Make a precis of the above passage (Question 5. a) with a suitable title. (15) [CO2]

6. a) Write a contrast paragraph on "Individual Study and Group Study". (20) [CO3]

- b) Amplify the idea "A man is known by the company he keeps". (15) [CO3]

7. a) Write a report to the Editor of a newspaper on "The Hostel Facilities of your University". (20) [CO3]

- b) Prepare a CV for the post of an Assistant Engineer. (15) [CO1]

8. a) Write a composition on: (35) [CO3]

'Modern Technology in our Daily Life'.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2025
Department of Computer Science and Engineering
Math 1107

Differential and Integral Calculus

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the immediate right column of the questions indicate full marks.
iii) The rightmost column indicates the course outcomes.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define continuity and differentiability of a function at an interval. Also, define continuity and differentiability of a function at a particular point. (04) [CO1]
- b) If the function is defined by: (10) [CO2]

$$f(x) = \begin{cases} -2 \sin x, & -\pi \leq x \leq -\frac{\pi}{2} \\ a \sin x + b, & -\frac{\pi}{2} < x < \frac{\pi}{2} \\ \cos x, & \frac{\pi}{2} \leq x \leq \pi \end{cases}$$
 is continuous, then find the values of a and b .
- c) Evaluate $\lim_{x \rightarrow 0} \left(\frac{\sin x}{x} \right)^{\frac{1}{x}}$ (11) [CO2]
- d) A man is walking at the rate of 5 km per hour towards the foot of a building that is 16 m high. At what rate is he approaching the top when he is 12 m from the foot of the building? (10) [CO3]

2. a) Write the statement of Leibnitz's theorem. (02) [CO1]
- b) If $y = \tan^{-1} \frac{x}{a}$, find y_n . (12) [CO2]
- c) If $y^{\frac{1}{n}} + y^{\frac{1}{m}} = 2x$, then find the relations between y_{n+2} , y_{n+1} , and y_n . (12) [CO2]
- d) Show that of all rectangles of given perimeter, square has the largest area. (09) [CO3]

3. a) Write the statements of Euler's theorem and Mean value theorem. (04) [CO1]
- b) If $u = F(y - z, z - x, x - y)$, then find the value of $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$. (10) [CO2]
- c) Expand $\log(1 + x)$ in ascending powers of x . (10) [CO2]
- d) Evaluate $\cos 61^\circ$ by using Taylor's series. (11) [CO2]

4. a) Find the polar subtangent and polar subnormal of the curve $r = ae^{\theta \cot \alpha}$. (08) [CO3]
- b) Find the asymptotes of $x^3 + x^2y - xy^2 - y^3 + 2xy + 2y^2 - 3x + y = 0$. (14) [CO3]
- c) Find the radius of curvature at the origin to the curve $x^3 + y^3 = 3axy$. (13) [CO3]

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. Evaluate the following integrals:
 - a) $\int (3x + 1)\sqrt{2x^2 - 3x + 4} dx$ (12) [CO2]
 - b) $\int e^x \cdot \frac{x^2 + 5x + 7}{(x + 3)^2} dx$ (11) [CO2]
 - c) $\int \frac{1}{2 + 3 \cot x} dx$ (12) [CO2]

6. a) Find the reduction formula for $\int \cos^m x \cos nx dx$ and hence evaluate $\int_0^{\pi/2} \cos^3 x \cos 2x dx$. (12) [CO2]
- b) State the fundamental theorem of integral calculus. (03) [CO1]

c) Evaluate $\int_0^\pi \log(1 + \cos x) dx$. (10) [CO2]

d) Determine the value of the following series: (10) [CO2]

$$\lim_{n \rightarrow \infty} \left[\frac{1^2}{n^3 + 1^3} + \frac{2^2}{n^3 + 2^3} + \frac{3^2}{n^3 + 3^3} + \dots + \frac{n^2}{n^3 + n^3} \right].$$

7. a) Define Beta and Gamma functions. Show that, $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$. (07) [CO1]

b) Evaluate $\int_0^\infty \frac{\log(1+p^2x^2)}{1+q^2x^2} dx$ by using differentiation under the sign of integration. (12) [CO2]

c) Write down Wallé's formula. Hence find the value of $\int_0^{\pi/2} \sin^7 x dx$. (06) [CO1]

d) Determine the value of the improper integral $\int_0^\infty \frac{\log x}{1+x^2} dx$. (10) [CO2]

8. a) Find the area of the region bounded by the parabolas $y^2 = 4ax$ and $x^2 = 4ay$. (10) [CO3]

b) Evaluate the whole length of the loop of the curve $3ay^2 = x(x - a)^2$. (10) [CO3]

c) Define Jacobian of two variables. (03) [CO1]

d) Evaluate $\iint_R \left(\frac{x-2y}{x+2y}\right)^3$ where R is bounded by $x - 2y = 1$, $x - 2y = 2$, $x + 2y = 1$, and $x + 2y = 3$. (12) [CO3]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2025
Department of Computer Science and Engineering
PHY 1107
Physics

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the immediate right column of the questions indicate full marks.
iii) The rightmost column indicates course outcomes.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is degrees of freedom? Discuss the law of equipartition of energy. (10) [CO1]
b) Write down the postulates of kinetic theory of gases. Show that for a cubical vessel of side l cm containing gas has the pressure $p = \frac{1}{3}\rho c^2$, where the symbols have their usual meanings. (15) [CO2]
c) Calculate the mean free path of a gas molecule, given that molecular diameter is 2×10^{-10} cm and the number of molecules per cc is 3×10^{20} . (10) [CO1]
2. a) Derive an expression for the change in entropy of a perfect gas. (10) [CO2]
b) Describe Carnot's cycle. Show how the work done in each operation is represented on pressure volume diagrams. Calculate the work done per cycle. (15) [CO3]
c) 100g of water at 0°C is mixed with an equal mass of water at 80°C. Calculate the resultant increase in entropy. (10) [CO1]
3. a) Discuss damped harmonic motion for an electrical circuit and show the conditions under which the discharge of the capacitor is dead beat, critically damped and oscillatory. (15) [CO2]
b) Derive an expression for power dissipation in damped harmonic motion. (10) [CO3]
c) An under damped harmonic oscillator has its amplitude reduced to $\frac{1}{10}$ th of its initial value after 100 oscillations. Its period is 1.25 sec. Calculate the damping constant and relaxation time, if the observed value of the first amplitude of the oscillator is 2.2cm. What would be its value in absence of damping? (10) [CO4]
4. a) Explain the terms: population inversion, stimulated emission, and optical pumping. (12) [CO1]
b) Discuss about the construction and working principle of a Ruby laser. Mention some advantages. (15) [CO3]
c) Calculate the number of photons emitted by the laser every second. Here a 5KW laser emits light of 600nm wavelength. (08) [CO4]

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Distinguish between classical mechanics and quantum mechanics. (10) [CO1]
b) Prove that the De-Broglie wavegroup associated with a moving body travels with the same velocity as the body. (10) [CO5]
c) Graphically show that stopping potential depends on frequency and is independent of intensity. (05) [CO3]
d) Calculate the De-Broglie wavelength of proton and alpha particle. (10) [CO4]
6. a) What is an expected value? Write down the properties of expected value. (06) [CO1]
b) Derive the Schrodinger equation: (13) [CO2]
$$\nabla^2\psi + \frac{8\pi^2m}{h^2}(E - V)\psi = 0$$

where the symbols have their usual meaning.

c) Write down physical significance of wave function. (06) [CO1]
d) Calculate the Bohr magneton. (10) [CO4]

7. a) Define dispersion, dispersive power and achromatism. (10) [CO1]
b) Prove that the diameter of the circle of least confusion is independent of the focal length of the lens. (15) [CO2]
c) Two thin lenses of focal lengths f_1 and f_2 separated by a distance d have an equivalent focal length of 50cm. The combination satisfies the conditions for minimum spherical aberration and is also achromatic. Find the values of f_1 , f_2 , and d . Assume that both the lenses are of the same material. (10) [CO4]
8. a) Two independent sources of light cannot produce interference fringes. Is it true? Give logic in favor of your statement. Show that the distance between any two consecutive bright or dark fringes is equal to the width of a fringe. (13) [CO2]
b) State and explain Huygens's principle and prove the law of reflection according to wave theory. Write down the advantages and disadvantages of Huygens's principle. (12) [CO3]
c) In Newton's ring experiment, the diameters of the n^{th} and $(n + 8)^{\text{th}}$ bright rings are 4.2mm and 7mm respectively. Radius of curvature of the lower surface of the lens is 2m. Determine the wavelength of light and the ring number n . (10) [CO4]