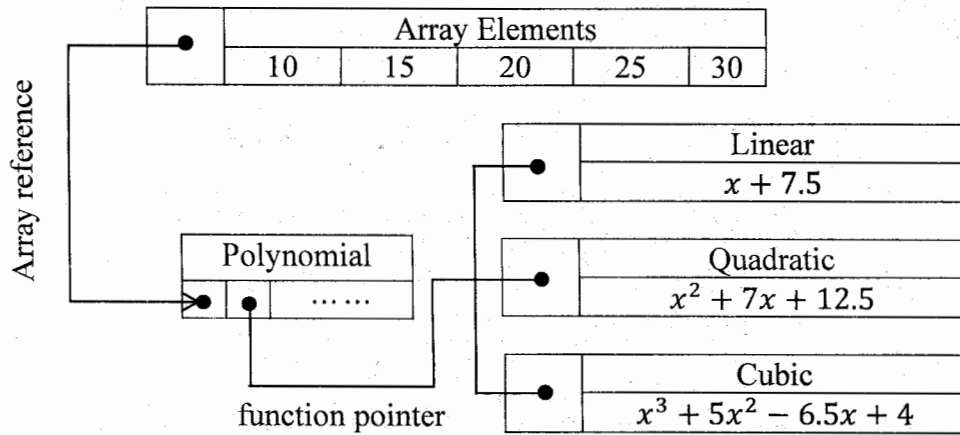


- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
 ii) Figures in the right margin indicate full marks.

SECTION A

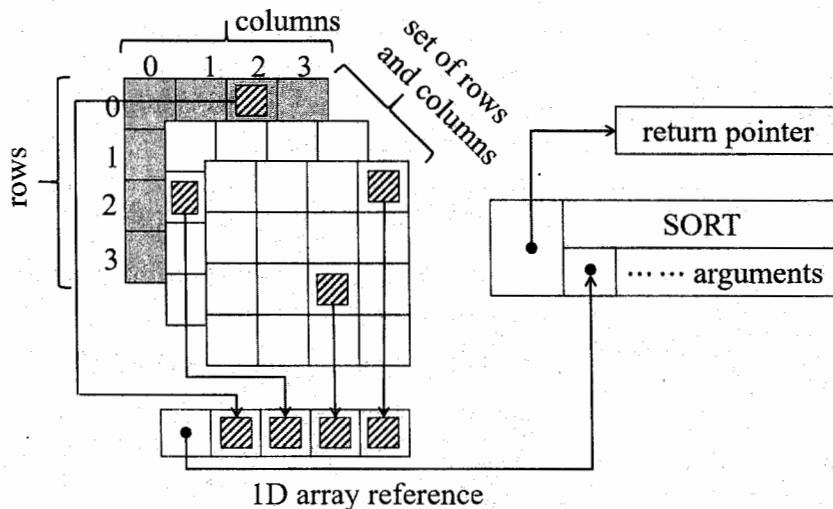
(Answer **ANY THREE** questions from this section in Script A)

1. a) What is scale factor of data type? Explain the significance of including prototype declarations before function calls in C programming. (07)
- b) Provide concise explanations on the following two concepts: (06)
 - (i) External Variables, (ii) Static Variables.
- c) Demonstrate the potential issues that may arise when employing global variables as parameters for passing values within functions in the context of C programming. (08)
- d) Design the system using the C programming language that requires the use function pointer as function argument. The system should simulate the following workflow and be capable of performing specific polynomial operations on elements. (14)



During the implementation of the system, it is essential to consider the following guidelines:

- i) The 'Polynomial' function must accept function pointer as an argument that is desired by the user of the system.
 - ii) The 'Polynomial' function should then call one of the three functions—'Linear', 'Quadratic', or 'Cubic'—on each element of the array based on the function reference passed to it.
2. a) Compare the use of if-else statement with the use of ? : operator. In particular, in what way can the ? : operator be used on place of an if-else statement? (07)
 - b) Develop an appropriate control structure that will examine the value of a floating-point variable called *temp* and print one of the following messages, depending on the value assigned to *temp*. (10)
 - (i) ICE, if the value of *temp* is less than 0, (ii) WATER, if the value of *temp* lies between 0 and 100, (iii) STEAM, if the value of *temp* exceeds 100.
 Can a switch statement be used in this instance?
 - c) Design a system that works with a 3-dimensional character array, wherein the following instructions (18) should be followed. Use pointer to access the values marked by in the 3D array and build a 1D array based on those values, as demonstrated in the provided diagram.



Now, construct a function named 'SORT' that has the capacity to return multiple values and takes the references of the 1D array as one of its formal arguments. The 'SORT' function should perform the following tasks:

- i) Sort the array in alphabetical order and return the sorted array.
- ii) Return a pointer variable that points to the sum of the ASCII values of the highest and lowest elements in the sorted array.

3. a) Explain the fundamental differences between character arrays and strings in C programming. (07)
 b) Differentiate between *malloc()* and *calloc()* with their declarations. (06)
 c) 'In an array of structures, although all structures are stored in non-contiguous memory locations, the elements of individual structures are stored in contiguous locations.'—justify the statement. (08)
 d) Consider a scenario where information is being stored using the following union. (14)

```
union a {
    int i;
    char ch[4];
    short int val;
}key;
```

The system being used utilizes an Intel CPU that adheres to the little-endian architecture. Given that **key.i** has a value of **123456** and the storage size of the int type is 4 bytes,

- i) Estimate the decimal value of **key.ch[0]** to **key.ch[3]** as well as the value stored in **key.val**.
 ii) Interpret the memory layout in which the values are stored.
4. a) What are bit fields in C programming? Discuss how bit fields can be used to optimize memory usage and to improve program performance. (10)
 b) Construct a program in C to encrypt a text file by adding the last three digits of your roll number as ASCII value with every character. (10)
 c) Suppose, we want to store information about all students in a specific university. The information we like to store are shown as follows: (15)

```
Name
Roll
Dept
Grade
If Dept = CSE
    Completed Math Credit
    Phone No
If Dept = Others
    Completed CSE Credit
    Home Town
```

Now, construct a user-defined data type using the nested combination of Structure and Union in such a way that will lead to the minimum wastage of memory while storing the information for each student. Provide a detailed justification for your answer.

SECTION B

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

5. a) Differentiate between function declaration and function definition. (06)
 b) Demonstrate the use of *strtok()* function to split a function into parts by delimiters like comma, space, dollar sign, and ampersand. (09)
 c) Construct a self-defined function to calculate the sum of the following series for first *n* terms. (08)
- $$\frac{1}{6} + \frac{1}{11} + \frac{1}{21} + \frac{1}{36} + \dots$$
- d) Write a program to solve the following series using recursion in C. (12)
- $$1^2 + 2^2 + 3^2 + \dots + n^2$$
6. a) Explain the potential risks associated with dynamic memory allocation and provide some recommendations to prevent such risks. (10)
 b) Construct a self-defined function that concatenate '*str1*' and '*str2*' with a space between them in '*str1*'. (11)
 c) Create a program in C which replaces a substring with another in a given line of text. For example, in the line "There are 30 bananas on a banana tree.", if substring banana is to be replace with apple, then the line should become "There are 30 apples on a apple tree.". (14)
7. a) What is meant by the following declaration involving pointers in C? (05)
- ```
int *(*k[5])(char(*a)[])
```
- b) Develop a program that reads an array of integers using pointer & prints its elements in reverse order. (09)  
 c) Construct a self-defined function that can return multiple values. (09)  
 d) Assume, we have two user-defined functions: (12)
- ```
float * one (double *a, int b); // function 1
float two (/* pass appropriate parameters */) // function 2
```
- Create a program to pass function "one" and character 'k' as parameters to function "two". How to call function "one" from inside the function "two"?
8. a) Illustrate the concept of segmentation fault error in C programming. How can you prevent it? (10)
 b) Construct a self-defined function in C to extract individual bytes from an unsigned int. (08)
 c) Create a C program that reads several different names and addresses into the computer, rearrange the names into alphabetical order, and then prints the alphabetized list. (12)
 d) What is the significance of EOF? (05)

TIME: 3 hours

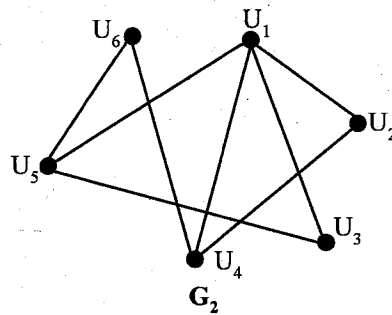
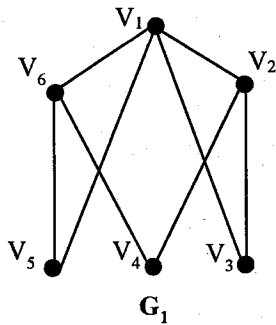
FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
 ii) Figures in the right margin indicate full marks.

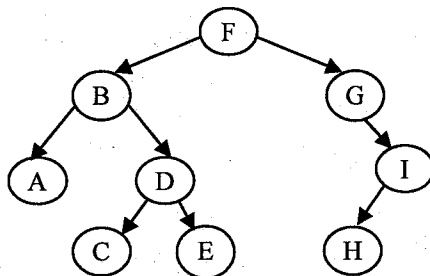
SECTION A

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

1. a) Let p and q be the propositions, “The election is decided” and “The votes have been counted”, respectively. Express each of the following compound propositions as English sentences: (10)
 - (i) $\neg p$; (ii) $p \vee q$; (iii) $\neg p \wedge q$; (iv) $q \rightarrow p$; (v) $p \Leftrightarrow q$.
- b) Prove the followings: (10)
 - (i) $(p \rightarrow q) \vee (p \rightarrow r)$ and $p \rightarrow (q \vee r)$ are logically equivalent.
 - (ii) $(p \vee q) \wedge (\neg p \vee r) \rightarrow (q \vee r)$ is a tautology.
- c) Translate each of the following statements into logical expressions using predicates, quantifiers and logical connectives. Let $C(x)$ denotes “ x is in the correct place”, let $E(x)$ denotes the predicate “ x is in excellent condition”, and Let $T(x)$ denotes the predicate “ x is a tool” and suppose that the domain consists of all tools. (15)
 - (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.
2. a) Explain the idea of induction using a suitable example and prove $\forall n \geq 1, 2^{2n} - 1$ is divisible by 3. (11)
- b) Prove the following identities: (i) $\sum_{i=0}^1 \frac{1}{(i+1)(i+2)} = \frac{n+1}{n+2}$, (ii) $\sum_{k=1}^n \frac{1}{k(k+1)} = 1 - \frac{1}{n+1}$. (14)
- c) What is inductive construction? How can you find an ordering of all the n -bit strings in such a way that two consecutive n -bit strings differed by only one bit? Explain. (10)
3. a) What is prime factorization? Use this technique to explain how to find both the GCD and LCM for the positive integers a and b . (12)
- b) Give a statement of the Chinese Remainder Theorem. Use this theorem to find a number when it is divided by 3, the remainder is 2; When it is divided by 5, the remainder is 3; and when it is divided by 7, the remainder is 2. (13)
- c) State and explain the “Fermat’s Little Theorem”. (10)
4. a) What are necessary conditions for two graphs to be isomorphic? Show that the following graphs are isomorphic. (12)



- b) What is a rooted tree? Find the pre-order, in-order and post-order traversal sequence results of the following tree. Using their corresponding traversal rules. (11)



- c) Distinguish between a graph and a tree. Draw the graph represented by the following adjacency matrices: (12)

$$(i) G_{A_1} = \begin{bmatrix} 1 & 2 & 0 & 1 \\ 2 & 0 & 3 & 0 \\ 0 & 3 & 1 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}, \quad (ii) G_{A_2} = \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

SECTION B

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

5. a) Use set builder notation to give a description of each of these sets: (15)
- (i) $\{0, 3, 6, 9, 12\}$.
 - (ii) $\{-3, -2, -1, 0, 1, 2, 3\}$.
 - (iii) $\{m, n, o, p\}$.
- b) Let n be a positive integer and S be a set of strings. R_n is a relation on S such that $sR_n t$ if and only if $s = t$ or both s and t have at least n characters. Is R_n an equivalence relation on S ? Explain? (10)
- c) Find the generating function of the sequence $1, a, a^2, a^3, \dots$ (10)
6. a) How many one-to-one functions are there from a set with M elements to one with n elements? (10)
- b) List the ordered pairs in the equivalence relation R produced by the partition $A_1 = \{9, 10\}$, $A_2 = \{11, 12, 13\}$, $A_3 = \{14, 15, 16, 17\}$ of $S = \{9, 10, 11, 12, 13, 14, 15, 16, 17\}$. (12)
- c) How many solutions does the equation $x_1 + x_2 + x_3 + x_4 = 20$ have, where x_1, x_2 and x_3 are nonnegative integers? (13)
7. a) Show that the sequence $\{a_n\}$ is a solution of the recurrence relation $a_n = 2a_{n-1} - a_{n-2} + 2$ if $a_n = n^2 - 3$. (12)
- b) Let R be a relation on set $A = \{1, 2, 3, 4\}$. Give examples of R , Satisfying the following criterion and Justify your answers: (12)
- (i) R is reflexive and Symmetric but not transitive;
 - (ii) R is reflexive and transitive but not symmetric;
 - (iii) R is a symmetric, antisymmetric but not reflexive.
- c) Find a recurrence relation for the number of bit sequences of length n with an even number of 0s. (11)
8. a) If $f: R - \left\{\frac{7}{3}\right\} \rightarrow R - \left\{\frac{4}{3}\right\}$ defined as $f(x) = \frac{4x-5}{3x-7}$, Prove that ' f ' is bijective function, also find the rule for f^{-1} . (12)
- b) If $G = \{1, -1, i, -i\}$ is a group under usual complex number multiplication, then prove that $H = \{1, -1\}$ is a normal subgroup of G , also prove that corresponding G/H is a quotient group. (13)
- c) Suppose that a person deposits \$10,000 in a savings account at a bank yielding 12% per year with interest compounded annually. How much will be in the account after 30 years. (10)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2022
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 right margin indicate full marks.

SECTION A

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

1. a) Make sentences using the following words as directed. (14)
Fast (as noun); Fast (as adjective); Fast (as verb); Fast (as adverb); Last (as verb); Last (as adverb); Last (as noun).
- b) Change the following words as directed and make sentences with the changed words. (12)
Act (into verb); Act (into adjective); Enemy (as noun), Live (into verb), Live (into adjective), Live (into adverb).
- c) Make sentences using the following phrases and idioms. (09)
Hand in glove; in a fix; out and out; Sine die; Carry out; Turn down.
2. a) Transform the following sentences as directed. (14)
- i) My teacher declined the request. (Negative).
 - ii) Nobody insulted him. (Affirmative).
 - iii) They will not help us. (Interrogative).
 - iv) Time flies very fast. (Exclamatory).
 - v) Study hard to succeed. (Complex).
 - vi) Study hard to succeed (Compound).
 - vii) This is more than innocence. (Positive).
- b) Frame sentences expressing the following notions / emotions: (12)
Threat, Determination, Regret, Irritation, Fear, Farewell.
- c) Make a new word with each of the following prefixes and suffixes and use them in sentences. (09)
De....., For....., Pro.....,en,.....ling,.....al.
3. a) Make sentences on the following structures. (14)
- i) Subject + Intransitive verb + adverbial of time.
 - ii) Subject + Linking verb + adjective complement + extension.
 - iii) Subject + Transitive verb + infinitive as object.
 - iv) Subject + Transitive verb + Gerund as object.
 - v) Subject + Transitive verb + object + adjective complement.
 - vi) Subject + Transitive verb + object + noun complement.
 - vii) Subject + Transitive verb + object + object.
- b) Make sentences using the following Modals as directed. (12)
- i) Could (To express inference).
 - ii) May (To express guess about the present).
 - iii) Must (To express logical deduction in the present).
 - iv) Need (To express unnecessary action in the past).
 - v) Had better (To express preference).
 - vi) Be going to (To express strong possibility).
- c) Supply a suitable word to fill in the gaps. (09)
- i) This is the mobile set ... I want.
 - ii) He lives with us ... he comes to Dhaka.
 - iii) Some laws ... in the long past need to be amended.
 - iv) I believe to ... been doing well.
 - v) In spite of ... earlier, he could not reach in time.
 - vi) He works ... to finish it.
4. a) Frame wh questions from the underlined parts of the following answers. (14)
- i) She lives with her mother.
 - ii) I took Azad's pen.
 - iii) I need your help.
 - iv) I reside in a hut.
 - v) He maintains his family with much hardship.
 - vi) The boy failed for his laziness.
 - vii) Dhaka is the capital of Bangladesh.

- b) Complete the sentences with subordinate clauses as directed. (12)
- i) is uncertain (Noun clause).
 - ii) I know nothing of (Noun clause).
 - iii) Tell me the way (Adjective clause).
 - iv) Strike (Adverb clause of time).
 - v), You need not come. (Adverb clause of cause).
 - vi), I would have helped you. (Adverb clause of condition).

- c) Correct the following sentences: (09)
- i) Jara avoids to speak to me.
 - ii) Atik denied to take the money.
 - iii) I have no other friend but you.
 - iv) When he saw the tiger, then he was afraid.
 - v) This is different than the other.
 - vi) No sooner had he returned but he was off again.

SECTION B

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

5. a) Read the passage and answer the following questions: (20)
- Jacob hated finishing things almost as much as he loved starting them. As a result, he had gotten into a million hobbies but he never stuck with any of them long enough to get any good. He begged his mother for months for a guitar, but after he finally got one, he found out that guitars don't play themselves. Moreover, the strings hurt his fingers, so now the five-hundred-dollar guitar lives under his bed.
- After reading an ad, Jacob decided that he wanted a Wonder-Sweeper 5000 metal detector, so that he could find buried pirate treasure. He didn't spend his money on ice-cream or candy. Thus, by spring time he had saved \$200, and he purchased the detector. He beeped it around the park for a while, but he soon found out that no pirates had ever set sail in his neighborhood, and if they had they didn't leave any treasure. He only found a key-ring and bottle caps so he buried the detector in his closet.
- Given Jacob's history with hobbies, it was no surprise that Jacob's father was reluctant to buy him a magician's kit for his birthday. Jacob was insistent and promised to use it well. His father was reminded of his own youth, when he quit football and started Karate practice before hardly getting his equipment dirty. So, when Jacob's birthday came around, he was surprised to find the magician's kit that he desired so badly with a big bow on it. When Jacob opened up the box and unwrapped the parts in the Kit, he imagined sawing his cat in half and putting it back together to the amazement of his friends and family. As he continued pulling fake coins, trick cards, foam balls out of the kit, a commercial on the TV caught his attention. "Hey kids! Have you ever wanted to go to space? Experience what it's like to be an astronaut? Well, now you can. "As the ad continued, Jacob walked away from his kit and stared at the TV longingly. "For only \$195 you can go to space camp and live like an astronaut for a whole weekend. "Jacob's cry rang throughout the house as he yelled, "Mom!" He now knew what his true purpose in life was.
- i) Describe Jacob.
 - ii) Why did his father buy the magician's kit for Jacob?
 - iii) Among the four hobbies of Jacob mentioned in the story, which one would you like to try and why?
 - iv) Do you think students should have hobbies? Give reasons for your answer.
- b) Make a *précis* of the above passage with a suitable title? (15)
6. a) Write a cause-and-effect paragraph on social anxiety in students. (15)
- b) Amplify the idea: "Act well your part, there all the honor lies." (20)
7. a) Prepare a CV with an application. (20)
- b) Suppose you are the MD of XYZ Solutions, Inc. Write a memo informing all the Department Heads about the Annual Bonus leave for Employees with outstanding performances. (15)
8. Write a free composition on any one of the following: (35)
- i) Has the internet made society better?
 - ii) Is fasting healthy?

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2022
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 right margin indicate full marks.

SECTION A

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

1. a) Define continuity and differentiability of a function at $x = a$. Discuss the differentiability of the function (14)

$$f(x) = \begin{cases} 1 & \text{for } x < 0 \\ 1 + \sin x & \text{for } 0 \leq x < \frac{\pi}{2} \\ 2 + \left(x - \frac{\pi}{2}\right)^2 & \text{for } \frac{\pi}{2} \leq x \end{cases}$$
 at $x = \frac{\pi}{2}$ and $x = 0$.
- b) Evaluate $\lim_{x \rightarrow 0} (\cos x)^{\cot^2 x}$. (11)
- c) Calculate y_n , if $y = \frac{1}{x^2 + a^2}$. (10)
2. a) By applying Leibnitz's theorem, construct the relations between y_{n+2}, y_{n+1} and y_n , if $y = \sin^{-1} x$. Also calculate $(y_n)_0$. (14)
- b) Write the statement of Mean value theorem. (03)
- c) If exists, explain the point of inflexion for the function $\sin x(1 + \cos x)$. (11)
- d) Expand $x^3 + 2x^2 - 1$ in power of $(x - 2)$. (07)
3. a) If $u = 2\cos^{-1} \frac{x+y}{\sqrt{x} + \sqrt{y}}$, then calculate $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ by applying Euler's theorem on homogeneous function. (10)
- b) If $\frac{x^2}{a^2 + u} + \frac{y^2}{b^2 + u} + \frac{z^2}{c^2 + u} = 1$, then justify that $u_x^2 + u_y^2 + u_z^2 = 2(xu_x + yu_y + zu_z)$. (13)
- c) Describe the tangent and normal to the curve $y(x - 2)(x - 3) - x + 7 = 0$ at the point where it cuts the x -axis. (12)
4. a) Discuss the polar subtangent and polar subnormal for the curve $r = e^\theta$. (10)
- b) Evaluate all possible asymptotes of the curve $x^3 - 2x^2y + xy^2 + x(x - y) + 2 = 0$. (13)
- c) Calculate the radius of curvature at origin for the curve $x^3 + y^3 = 3axy$. (12)

SECTION B

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

5. a) Calculate $\int \frac{1}{(2x+3)\sqrt{x^2+3x+2}} dx$. (12)
- b) Calculate $\int \frac{1}{13+3\cos x+4\sin x} dx$. (11)
- c) Calculate $\int \sqrt{\frac{x}{x-a}} dx$. (12)
6. a) Evaluate $\int_0^1 \log \sin\left(\frac{\pi\theta}{2}\right) d\theta$. (12)
- b) Evaluate $\int_0^{\frac{\pi}{2}} \frac{x \sin x \cos x}{(a^2 \cos^2 x + b^2 \sin^2 x)^2} dx$. (12)
- c) Evaluate $\lim_{n \rightarrow \infty} \left[\frac{1}{n} + \frac{1}{n+1} + \frac{1}{n+2} + \dots + \frac{1}{3n} \right]$. (11)
7. a) Calculate $\int_0^{\frac{\pi}{2}} \sin^{10} \theta \cos^9 \theta d\theta$ and hence find $\int_0^{\frac{\pi}{2}} \sin^{10} \theta d\theta$ by applying Beta and Gamma function. (12)
- b) Find the reduction formula for $\int \sin^m x \cos^n x dx$. (12)
- c) State walli's formula. (03)
- d) Evaluate $\int_0^1 \frac{\log(1+x)}{1+x^2} dx$. (08)

8. a) Define Gamma and Beta function. (04)
- b) Evaluate the double integral $\iint (x^2 + y^2) dx dy$ over the positive quadrant to the circle $x^2 + y^2 = a^2$ by applying the Jacobian transformation. (12)
- c) Using triple integration compute $\iiint_R (x^2 + y^2 + z^2) dx dy dz$ where R denotes the region bounded by $x = 0, y = 0, z = 0$ and $x + y + z = a, (a > 0)$. (10)
- d) Evaluate $\int_0^{\infty} \frac{\tan^{-1}(ax)}{x(1+x^2)} dx$. (09)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2022
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 right margin indicate full marks.

SECTION A

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

1. a) State the principle of Equipartition of energy. List the value of ratio specific heat for monoatomic, diatomic and triatomic gas. (10)
- b) We know that, Maxwell velocity distribution function is $f(c) = 4\pi \left(\frac{m}{2\pi k}\right)^{3/2} c^2 e^{-mc^2/2kT}$; (15)
where the symbols have their usual meanings. Using this function find,
 - i) Average velocity,
 - ii) Root mean square velocity,
 - iii) Most probable velocity.
- c) Calculate the mean free path of a gas molecule, given that the molecular diameter is 2×10^{-8} cm and the number of the molecule per cc is 3×10^{19} . (10)
2. a) Explain how first law thermodynamics leads to the concept of internal energy. (10)
- b) Draw a schematic diagram of Carnot's cycle. Show that the work done in a Carnot's cycle operation is $W = R(T_1 - T_2) \ln \frac{V_2}{V_1}$, where the symbols have their usual meanings. (15)
- c) A Carnot engine whose low temperature reservoir is at 7°C has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees should the temperature of the high temperature reservoir be increased? (10)
3. a) Discuss simple harmonic motion with its characteristics. Show that for a particle executing S.H.M. the instantaneous velocity is $w\sqrt{a^2 - y^2}$. (10)
- b) 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)
- c) Design an RLC circuit with $L = 2\text{mH}$, $C = 5\mu\text{F}$ and $R = 0.2\text{ ohm}$ and deduce the frequency and quality factor of this circuit. (10)
4. a) What is LASER? Distinguish between spontaneous and stimulated emission. Explain population inversion. (12)
- b) Explain lasing action. Discuss the working principle of Ruby LASER with suitable diagram. (13)
- c) A laser beam has a power of 0.2 watt and an aperture of 1 mm. It emits light of wavelength 6000\AA . When focused by a lens of focal length 80 cm, calculate the area and intensity of the image. (10)

SECTION B

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

5. a) What is meant by the de-Broglie concepts of matter wave? (08)
- b) What is Compton effect? Show that $\lambda' - \lambda = \frac{h}{m_0c} (1 - \cos \phi)$, where the symbols have their usual meanings. (17)
- c) A beam of x-rays is scattered by a target. At 45° from the beam direction of the scattered x-rays have a wavelength of 2.2 pm. What is the wavelength of the x-rays in the direct beam? (10)
6. a) Discuss the origin of quantum mechanics. (10)
- b) Derive an expression for three-dimensional time dependent Schrödinger equation. (15)
- c) Calculate and draw the permitted energy levels of an electron in a box of 10^{-10}m wide. (10)
7. a) An electron is not the part of a nucleus. Is it true? Give logic in favour of your statement. Write down the failures of relativistic atom model. (10)
- b) Write the down the quantum numbers associated with the vector atom model. Explain L-S coupling and j-j coupling. What are the possible values of L for a system of two electrons whose orbital quantum numbers are $l_1 = 1$ and $l_2 = 3$? Give vector diagram. (15)
- c) Find the S, L, and J values that correspond to each of the following states: $^1\text{S}_0$, $^3\text{P}_2$, $^2\text{D}_{3/2}$, $^5\text{F}_5$, $^6\text{H}_{5/2}$. (10)

8. a) Define astigmatism, coma, curvature and distortion. (12)
- b) Demonstrate the formation of Newton's rings and show how you would use them to determine the wavelength of light. (13)
- c) A bi-prism 5 cm from a slit illuminated by a Na light ($\lambda = 589 \text{ nm}$). The width of the fringe obtained on a screen 750 mm from the biprism is 0.094 cm. What is the distance between two coherent sources? (10)