

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2024
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) Explain why is C classified as structured programming language? Describe the control structures of C programming language. (10) [CO1]
b) How does a computer store and handle overflow of a 32-bit float type data? List different types of tokens from the following code. (12) [CO1]

```
#include <stdio.h>
#define f(a,b) a##b
int main(){
    int x1=10, x2=20;
    printf("%d\n", f(x1,1)+f(x2,2));
    return 0;
}
```

- c) Write a function that takes variable number of arguments, where each 3 consecutive parameters represent roll, name, and marks (float) of a student. The function prints (roll-grade) tuple of each student according to the following condition:
marks ≥ 80: A, 70 to 79: B, 60 to 69: C, marks < 60: F. (13) [CO3]
2. a) Write down the following algebraic expression in C language. (05) [CO1]

$$z = p \times r \bmod q + \frac{w}{x} - y$$

- b) Define 'stack overflow problem'. Write a recursive function to compute the cosine series up to n^{th} term, where x is in radian: $\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \dots$ (10) [CO4]
c) When switch-case block is beneficial than else-if ladder block? Explain the output of the following program with iteration table: (10) [CO1]

```
#include <stdio.h>
int main(){
    unsigned int sum = 0;
    unsigned char i, j;
    for(i = 0, j = -247; 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;
}
```

- d) Write a program to find out the largest one among three numbers using conditional operator only. (10) [CO3]
3. a) Explain the character and use of the following storage classes with proper example. (12) [CO1]
(i) Static variable, (ii) External variable, (iii) automatic variable.
b) What is dangling else problem? Explain using example(s). (08) [CO1]
c) Write a program that can be run on command line as follows: (15) [CO3]
./student_info student.dat Status.txt 101 "Name" 85.50
Here, (i) *student.dat* is a binary file that will be written with the given information (roll, name, marks) as parameters, (ii) *Status.txt* will contain file open status redirected from console by checking the file pointers used in the program.
4. a) Differentiate between Enum and Structure. Also distinguish between '#' and '##' operators with proper example. (15) [CO2]

- b) A program generates the following 'summary.txt' file from 'course.txt' file. You have (20) [CO4] to design the program where- (i) all mathematical operations are in the file 'statistics.c', (ii) all file operations are in the file 'file.c', (iii) main function is written in 'main.c' that only includes 'main.h' as header file. You must handle multiple inclusions of header files.

course.txt						summary.txt			
course	Marks					course	min	max	average
CSE 1101	98	80	75	60	26	CSE 1101	26	98	67.8
CSE 1102	75	66	77	54	40	CSE 1102	40	77	62.4
CSE 1107	92	80	21	34	80	CSE 1107	21	92	61.4

SECTION B

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

5. a) Explain the conceptual models underlying arrays and strings in structured programming (10) [CO1] with example(s).
- b) Write a program in C using only arrays and strings to detect inappropriate keywords in (15) [CO2] user-generated posts. Given an array of banned keywords and a post represented as a string, describe how you would: (i) Tokenize the post into words, (ii) Compare each word against the banned keywords while handling punctuation and case sensitivity.
- c) Pollution levels across a city are represented using a 2D grid. The city is divided into (10) [CO3] an $N \times M$ grid, where each cell (i, j) represents the pollution level in that area. A "highly polluted region" is defined as a 3×3 subgrid where the average pollution level exceeds a given threshold T . Output the coordinates of the top-left cell (i, j) of each detected 3×3 highly polluted subgrid using a self-defined function. Assume $N \geq 3$ and $M \geq 3$.
6. a) Explain the following declaration involving pointers in C: (05) [CO3]
`int *(*k[5])(char(*a)[])`
- b) Develop a program that reads an array of integers using pointer & prints its elements in (08) [CO4] reverse order.
- c) Given a dynamically allocated 2D array, explain how pointer arithmetic can be used to (07) [CO1] access its elements efficiently.
- d) You are given a $N \times N$ matrix M containing integer values. Replace each element (15) [CO2] $M[i][j]$ with the sum of its adjacent elements (top, bottom, left, right). If an adjacent element does not exist (i.e., at edge/corners), consider it as 0. Write the program in C using only pointers and instead of array indexing use pointer arithmetic.
7. a) "In an array of structures, although all structures are stored in non-contiguous memory (08) [CO1] locations, the elements of individual structures are stored in contiguous locations." –justify the statement.
- b) Write a program in C that will take the roll number and marks of 3 subjects (Math, (15) [CO2] Physics, Chemistry) of N students as input. Calculate the average mark of each student and print the roll number and average mark of the student whose average mark is the second highest. If more than one student gets the second highest average, print the roll number and average mark of the student who got the highest mark in Math among them. It is ensured that no two students get the same mark in Math.
- c) Design a compact data structure in C to efficiently store and manipulate a 32-bit word (12) [CO4] representing sensor data. The 32-bit word should be divided as follows: 3 bits: Sensor type identifier, 5-bits: Error code, 1-bit: Status flag, 23 bits: Measurement value. Write functions in C to encode individual sensor components into the 32-bit word and decode the 32-bit word back into its respective components.
 N.B.: `uint8_t` is 8 bits wide and `uint32_t` is 32-bit wide.
8. a) What is error handling in C? Write a program for handling the divide by zero errors. (08) [CO1]
- b) Suppose, you have 4 files (`main.c`, `add.c`, `sub.c`, `calculate.h`). Write an efficient (12) [CO3] Makefile for these files using dependencies, variables and proper comments. Now, consider the situation where you have run the Makefile once and after that you have made some changes in the `add.c` file. Which commands will be executed if you re-run the Makefile?
- c) Differentiate between `malloc` and `calloc`. Dynamically allocate memory for an array to (15) [CO2] store integer data. Input the elements of the array from the user and print the elements. After that, during run time, double the size of the array, take more inputs from the user and print all the elements of the array. Write a program in C for this.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2024
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 the course outcomes.

SECTION A

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

1. a) Prove that $(A \cup B) = (A - B) \cup (B - A) \cup (A \cap B)$ by showing that each is a subset of other. (08) [CO1]
b) In a class there is a set of 5 students $S = \{\text{Alice, Bob, Charli, David, Emily}\}$. There is a relation on set S which is define "is academically more successful than" relation between the students. The relation is represented by R and pair (A, B) represents that "A is academically more successful than B". Now, R is explained as following:
 - Alice is academically more successful than Bob, Charli, and Emily.
 - Bob is academically more successful than Emily.
 - Charli is academically more successful than no one in this case.
 - David is academically more successful than Alice, Bob, Charli, and Emily.
 - Everybody is academically more successful than himself.Now, represent the relation using graph and determine it is a POSet relation or not.
c) Consider the set $A = \{2, 7, 14, 28, 56, 84\}$ and the relation $a \leq b$ if and only if a divides b . Give the Hasse diagram for the POSet (A, \leq) . (10) [CO2]
d) If composite function $g \circ f$ is onto, does it follow g is also onto? (07) [CO1]
2. a) Show that the sequence $\{a_n\}$ is a solution of the recurrence relation $a_n = 2a_{n-1} - a_{n-2} + 2$ if $a_n = n^2 - 3$. (10) [CO2]
b) In a group of athletic teams in a certain institute, 21 are in the basketball team, 26 in the hockey team, 29 in the football team. If 14 play hockey and basketball, 12 play football and basketball, 15 play hockey and football, 8 play all the three games:
 - i) How many players are there in all?
 - ii) How many play only football?
c) Suppose that a person deposits \$10,000 in a savings account at a bank yielding 11% per year with interest compounded annually. Define recursively the compound amount in the account at the end of n years. Also, find the closed form of this recurrence problem. (15) [CO4]
3. a) Solve the following linear non homogeneous recurrence relation: $a_n = 5a_{n-1} - 4a_{n-2} + n^2$ with initial condition $a_0 = 1, a_1 = 2$. (10) [CO3]
b) Consider the set Q of rational numbers, and let "*" is the operation on Q defined by $a * b = a + b - ab$.
 - i) Is $(Q, *)$ a semigroup? Is it commutative?
 - ii) Find the identity element for "*".
c) What is the importance of finding growth of a function? Consider the function $f(x) = 5x^4 + 3x^3 + 2x^2 + 1$ and $g(x) = x^4$. Find the best witness of function value such that $f(x)$ is $O(g(x))$. (15) [CO3]
4. a) Determine how many integer solutions there are to solve $x_1 + x_2 + x_3 + x_4 = 19$ if
 - i) $0 \leq x_i$ for all $1 \leq i \leq 4$
 - ii) $0 \leq x_i < 8$ for all $1 \leq i \leq 4$
 - iii) $x_1 > 6, x_2 < 3, x_4 \geq 8$.
b) Find the generating function of the sequence $1, a, a^2, a^3, \dots$. (10) [CO1]
c) What is algebraic system? What are the condition needed for an algebraic system to be a group? Give example. (07) [CO2]
d) How many ways are there to put four different employees into three indistinguishable offices, when each office can contain any number of employees? (08) [CO4]

SECTION B

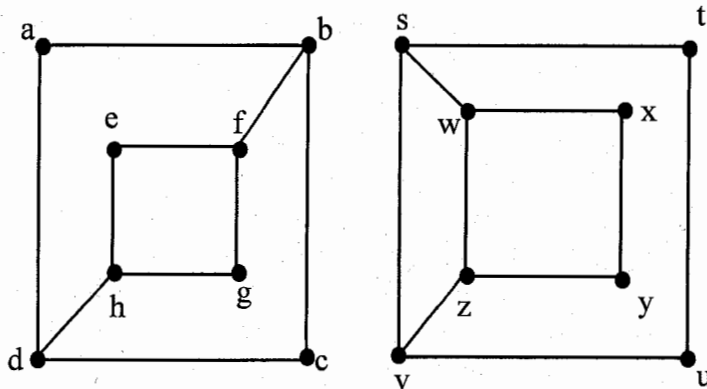
(Answer ANY THREE questions from this section in Script B)

5. a) Define “Contrapositive”, “Inverse” and “Converse” propositions using example(s). (12) [CO1]
 b) Are $\neg(P \vee Q)$ and $\neg P \wedge \neg Q$ logically equivalent? Prove your answer using a truth table. (08) [CO2]
 c) Four friends have been identified as suspect for an unauthorized access into a computer system. They have made statement to the investigating authorities. Alice said “Carlos did it”, John said “I did not do it”, Carlos said “Diana did it”, Diana said “Carlos lied when he said that I did it”.
 i) If the authorities also know that exactly one of the four suspects is telling the truth, who did it? Explain your reasoning.
 ii) If the authorities also know that exactly one is lying, who did it? Explain your reasoning.

6. a) What is a graph? Let $G = (V, E)$ be a graph with directed edges. Then prove that (12) [CO2]

$$\sum_{v \in V} \text{deg}^-(v) = \sum_{v \in V} \text{deg}^+(v) = |E|.$$

 b) What are the necessary and sufficient conditions for two graphs to be isomorphic? Are the following two graphs isomorphic? Explain. (13) [CO3]



- c) State and prove the Chinese Remainder Theorem. (10) [CO1]
7. a) What is induction method? Explain the idea of it using an example. (12) [CO2]
 b) Provide the recursive definition of the sequence $\{a_n\}$, $n = 1, 2, 3, \dots$, if (12) [CO3]
 i) $a_n = 3n + 2$;
 ii) $a_n = 3^{n+1}$.
 c) Name the different methods to represent graphs. Draw the graphs for the following matrices: (11) [CO3]
 i) $A_G = \begin{bmatrix} 0 & 1 & 1 & 2 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 3 \\ 2 & 1 & 3 & 0 \end{bmatrix}$, ii) $A_G = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix}$
8. a) What is linear congruential method? Use this method to find pseudo random numbers between the limit 2 to 20. (10) [CO3]
 b) Produce a secret message from the message “BEST OF LUCK FOR THE EXAM” using Caesar cipher method. Also decipher it. (15) [CO4]
 c) Give a direct proof of the theorem, “If $3n + 2$ is odd, then n is odd”. (10) [CO2]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2024
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 the course outcomes.

SECTION A

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

1. a) Make sentences on the following structures using the verb given in brackets. (14) [CO1]
i) Subj. + Intransitive verb + adverbial of manner. (dance as verb)
ii) Subj. + Linking verb + adjective complement. (act as verb)
iii) Subj. + Linking verb + noun complement. (prove as verb)
iv) Subj. + Transitive verb + gerund as object. (start as verb)
v) Subj. + Transitive verb + obj. + adj. complement. (judge as verb)
vi) Subj. + Transitive verb + obj. + noun complement. (call as verb)
vii) Subj. + Transitive verb + obj. + obj. (explain as verb)
- b) Change the following words as directed and make sentences with the changed words. (12) [CO3]
Father (into adjective); Glass (into verb); Court (into adjective); Moral (into noun);
Large (into verb); Large (into adverb).
- c) Make a new word with each of the following prefixes and suffixes, and use them in (09) [CO1]
sentences.
For ..., Out ..., With ..., ive, let, way.
2. a) Transform the following sentences as directed. (14) [CO2]
i) Rahim always minds his lesson. (Negative)
ii) It matters little if I go. (Interrogative)
iii) Had I possessed the mine of Solomon! (Assertive)
iv) I called but you did not respond. (Simple)
v) I saw him playing. (Complex)
vi) They were hungrier than I thought. (Positive)
vii) We are going to publish a book. (Passive)
- b) Make sentences using the following word as directed. (12) [CO3]
phone (as verb), time (as noun adjective), disturb (as noun), morning (as adverb), report
(as verb), easy (as noun adjective).
- c) Write two antonyms for each of the following words and make sentences with them. (09) [CO2]
steady, passive, visible.
3. a) Frame wh questions from the underlined parts of the following answers. (14) [CO2]
i) I heard the girl singing.
ii) On account of his illness he could not go there.
iii) I got admitted into KUET in 2022.
iv) I got admitted into KUET in 2022.
v) Time waits for none.
vi) I have a Samsung TV set.
vii) He delivered a good speech.
- b) Complete the sentences with subordinate clauses as directed. (12) [CO2]
i) This is a grammar book (Adjective clause)
ii) Mr. Karim's car has broken down. (Adjective clause)
iii) He explained..... (Noun clause)
iv) I know nothing except..... (Noun clause)
v) I will let you know..... (Adverb clause of time)
vi), your parents will be happy. (Adverb clause of condition)
- c) Make sentences using the following phrases and idioms. (09) [CO1]
As good as gold, in the common interest, to need for variety, call off, sign out, put back.
4. a) Correct the following sentences. (14) [CO1]
i) I agree to you in their matter.
ii) He left the place somewhat five years ago.

- iii) The girl prefers dance than sing.
 - iv) He neither helped me nor my brother.
 - v) The group is comprised of thirty members.
 - vi) He tried hardly.
 - vii) You should not pride on your health.
- b) Make sentences using the following modals as directed. (12) [CO3]
- i) May (To express guess about the present)
 - ii) Must (To express internal obligation)
 - iii) Need (To express unnecessary action in the past)
 - iv) Could (To express inference)
 - v) Had better (To express preference)
 - vi) Be to (To express command)
- c) Make sentences expressing the following notions/emotions. (09) [CO3]
- i) Annoyance
 - ii) Disapproval
 - iii) Imprecation
 - iv) Farewell
 - v) Suggestion
 - vi) Threat

SECTION B

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

5. a) Read the passage and answer the questions that follow. (20) [CO2]
- Self-reliance is the pilgrim's best staff, the worker's best tool. It is the master-key that unlocks all the difficulties of life. 'Help yourself and Heaven will help you' is a maxim which receives daily confirmation. Help from within always strengthens, but help from without invariably weakens the recipient. The habit of depending on others tends to weaken the intellectual faculties and paralyse the judgement. The struggle against adverse circumstances has, on the contrary, a strengthening effect, like that of the pure mountain air on an enfeebled frame. This is a lesson which is not taught in the schools nowadays. The vice of the modern system of education is that it lays down too many royal roads to knowledge. The difficulties which formerly compelled the student to think and labour for himself are now most carefully removed. The race of thorough and complete scholars is dying out. Our young men are equipped to such an extent with manuals that explain everything and guides that go everywhere, that they find no occasion for thought. Why take any trouble at all when so many are willing to relieve you of it?
- Questions:
- i) Why should we be self-reliant?
 - ii) What are the evil effects of dependance on others?
 - iii) What is the vice of modern system of education?
 - iv) Why is the race of thorough scholars dying out?
- b) Make a precis of the passage (Question 5. a) with a suitable title. (15) [CO2]
6. a) Amplify the idea contained in the following statement. (20) [CO4]
Prosperity brings friends; adversity tries them.
- b) Write a listing paragraph on "Advantages of social media". (15) [CO2]
7. a) Write a report to the editor of a newspaper on the fresher's reception programme of your University. (20) [CO2]
- b) Prepare a CV with an application. (15) [CO2]
8. a) Write a free composition on anyone of the following. (35) [CO4]
- i) Political instability in Bangladesh.
 - ii) The blessings of modern science.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2024
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 course outcomes.

SECTION A

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

1. a) What do you mean by continuity of function at a particular point and at an interval? (10) [CO1]
Also, define the differentiability of a function at that cases. Write the statement of Euler's theorem on homogenous function.
- b) Given, $f(x) = 1$ for $x < 0$ (12) [CO2]

$$= 1 + \sin x \text{ for } 0 \leq x < \frac{\pi}{2}$$

$$= 2 + \left(x - \frac{\pi}{2}\right)^2 \text{ for } \frac{\pi}{2} \leq x$$

Test the differentiability of the function at $x = 0$ and $x = \frac{\pi}{2}$.
- c) Evaluate $\lim_{x \rightarrow 0} \frac{(1+x)^{1/x} - e}{x}$. (13) [CO2]
2. a) Write the statement of Leibnitz's theorem. (02) [CO1]
- b) If $\frac{x^2}{a^2+u} + \frac{y^2}{b^2+u} + \frac{z^2}{c^2+u} = 1$, then show that $u_x^2 + u_y^2 + u_z^2 = 2(xu_x + yu_y + zu_z)$. (12) [CO2]
- c) Determine the maximum and minimum values of u where, $u = \frac{4}{x} + \frac{36}{y}$ and (12) [CO3]
 $x + y = 2$.
- d) If $y = (\sin^{-1} x)^2$, then construct the relations between y_{n+2} , y_{n+1} and y_n . (09) [CO2]
3. a) Discuss the maximum and minimum of the function $\sin x(1 + \cos x)$. If possible, find (12) [CO3]
the point of inflexion.
- b) Expand $\log(1 + x)$ in ascending powers of x . (12) [CO2]
- c) Evaluate $\sin 33^\circ$ by using Taylor's series. (11) [CO2]
4. a) If $lx + my = 1$ touch the curve $(ax)^n + (by)^n = 1$, (13) [CO3]
then show that $\left(\frac{l}{a}\right)^{\frac{n}{n-1}} + \left(\frac{m}{b}\right)^{\frac{n}{n-1}} = 1$.
- b) Determine the asymptotes of $x^3 + x^2y - xy^2 - y^3 + 2xy + 2y^2 - 3x + y = 0$. (12) [CO3]
- c) Evaluate the radius of curvature at origin for the curve (10) [CO3]
 $3x^4 - 2y^4 + 5x^2y + 2xy - 2y^2 + 4x = 0$.

SECTION B

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

5. Integrate the followings:
 - a) $\int \frac{2 \cos x + \sin x - 3}{4 \sin x - \cos x + 5} dx$ (12) [CO2]
 - b) $\int \frac{x^2 + 1}{x^4 + x^2 + 1} dx$ (11) [CO2]
 - c) $\int \sin^{-1} \sqrt{\frac{x}{a+x}} dx$ (12) [CO2]
6. a) Obtain the reduction formula for $\int \cot^m x \cdot \operatorname{cosec}^n x dx$ and hence evaluate (13) [CO2]
 $\int \cot^5 x \cdot \operatorname{cosec}^2 x dx$.
- b) Evaluate $\int_0^1 \frac{\ln(1+x)}{1+x^2} dx$. (10) [CO2]

c) Use integration to approximate the value of (12) [CO2]

$$\lim_{n \rightarrow \infty} \left[\left(1 + \frac{1}{n^2}\right)^{2/n^2} \cdot \left(1 + \frac{2^2}{n^2}\right)^{4/n^2} \cdot \left(1 + \frac{3^2}{n^2}\right)^{6/n^2} \cdot \dots \cdot \left(1 + \frac{n^2}{n^2}\right)^{2n/n^2} \right]$$

7. a) Define Beta and Gamma functions. Write down the relationship between them. (04) [CO1]

b) Determine the value of $\int_0^1 x^5(1-x^2)^{3/2} dx$ by using Beta and Gamma functions. (09) [CO3]

c) Find the value of the improper integral $\int_{-\infty}^{\infty} \frac{x}{x^4+1} dx$. (10) [CO2]

d) Evaluate $\int_0^{\pi} \log(1 + \cos x) dx$ by using differentiation under the sign of integration. (12) [CO2]

8. a) Determine the area bounded by the curve $y = \frac{(a-x)^3}{a+x}$ and its asymptote. (10) [CO3]

b) Evaluate the entire length of the curve $x^{2/3} + y^{2/3} = a^{2/3}$. (10) [CO3]

c) Evaluate $\iint (x^2 + y^2) dx dy$ over the positive quadrant to the circle $x^2 + y^2 = a^2$. (12) [CO3]

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

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2024
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) Why the potential energy of a gas molecule is negligible? Why do we consider mean velocity and mean free path instead of normal velocity and free path? (10) [CO1]
b) Derive an expression for the pressure exerted by gas on the basis of kinetic theory. (15) [CO2]
Show that the energy associated with each degree of freedom is $\frac{1}{2}KT$.
c) Calculate the total random kinetic energy of one gram-molecule of oxygen at 300 K. (10) [CO1]
2. a) State 2nd and 3rd law of thermodynamics. Show that entropy remains constant for an adiabatic reversible process but increases for an irreversible process. (10) [CO1]
b) Describe a Carnot cycle. Obtain expressions for the work done in each operation of the cycle and the net work done in the cycle. (15) [CO3]
c) A Carnot's refrigerator takes heat from water at 0° C and discards it to a room at 27° C. 1 kg of water at 0° C is to be changed into ice at 0° C. How many calories of heat are discarded to the room? What is the work done by the refrigerator in this process? What is the coefficient of performance of the machine? (10) [CO1]
3. a) What do you mean by free, damped and forced vibrations? (10) [CO1]
b) Obtain an expression for the displacement in the case of a damped oscillatory motion. Discuss the effect of damping on the natural frequency. (15) [CO3]
c) Find whether the discharge of a condenser for the following inductive circuit is oscillatory, $C = 0.1 \mu\text{F}$, $L = 10 \text{ mH}$, $R = 200 \text{ ohms}$. If the circuit is oscillatory, calculate its frequency. (10) [CO4]
4. a) Write short notes on absorption, spontaneous emission, stimulated emission and population inversion. Distinguish between temporal coherence and spatial coherence. (10) [CO1]
b) Explain three level and four level lasers. Describe the working principle of Ruby laser with suitable diagram. (15) [CO4]
c) The coherence length for sodium light is $2.84 \times 10^{-2} \text{ m}$, the wavelength of sodium is 5890 Å. Calculate (i) the number of oscillations corresponding to the coherence length and (ii) the coherence time. (10) [CO4]

SECTION B

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

5. a) Write down the limitations of classical physics to explain photoelectric effect. Show that Einstein's equation gives adequate explanation of all the facts about the photoelectric effect. (10) [CO3]
b) Give the explanation of Compton effect with the help of quantum theory and find an expression for the Compton shift $\Delta\lambda$. (15) [CO3]
c) Compute the number of photons of yellow light of wavelength 6000 Å required to make an erg of energy. (10) [CO4]
6. a) Sommerfeld assigned different denominations for the orbits, what are they? (12) [CO3]
b) Prove that the deBroglie wavegroup associated with a moving body travels with the same velocity as the body. Write down the drawbacks of relativistic atom model. (13) [CO5]
c) Monochromatic X-rays of wavelength 0.124 Å are scattered by a carbon block. Find the wavelength of X-rays scattered through 180°. (10) [CO4]

7. a) What do you understand by the terms eigen value and eigen function? Discuss the significance of the wave function. (10) [CO3]
- b) Deduce the time-dependent Schrödinger wave equation in 3 dimensions. (15) [CO3]
- c) Applying uncertainty principle, show that the presence of protons in a nucleus is entirely plausible. (10) [CO5]
8. a) Discuss the condition of achromatism for two thin lenses in contact. (12) [CO3]
- b) Two independent sources of light cannot produce interference fringes. Is it true? Give logic in favour of your statement. Show that the distance between any two consecutive bright or dark fringes is equal to the width of a fringe. (13) [CO4]
- c) Two convex lenses of focal length 12 cm and 4 cm and of the same material are placed at a certain distance apart so as to satisfy the condition for minimum spherical aberration. Is the combination achromatic? Prove it. (10) [CO4]