

*The figures in the right margin indicate the marks for each question*

Use separate script for each section

**Section: A**

Answer any 3 (Three) questions

- ✓ 1 a) Define unit vector. Calculate the modulus and the unit vector along the sum of the vectors  $2\hat{i} + \hat{j} + 4\hat{k}$ ,  $3\hat{i} - 2\hat{j} + 7\hat{k}$  and  $5\hat{i} + 2\hat{j} - 3\hat{k}$ . 5
- b) Choose  $y$  in order that the vectors  $\vec{a} = 7\hat{i} + y\hat{j} + \hat{k}$ ,  $\vec{b} = 3\hat{i} + 2\hat{j} + \hat{k}$ ,  $\vec{c} = 5\hat{i} + 3\hat{j} + \hat{k}$  are linearly dependent. 5
- c) Find the scalar  $m$  so that the vector  $2\vec{i} + \vec{j} - m\vec{k}$  is perpendicular to the sum of the vectors  $\vec{i} - \vec{j} + 2\vec{k}$  and  $3\vec{i} + 2\vec{j} + \vec{k}$ . 5
- ✓ 2 a) Define normal and directional derivative of a vector field. 5
- b) Find the directional derivative of  $f(x, y, z) = x^2y^2z^2$  at the point  $(1, 1, -1)$  in the direction of the tangent to the curve  $x = e^t$ ,  $y = 2 \sin t + 1$ ,  $z = t - \cos t$ , at  $t = 0$ . 5
- (c) A rigid body is spinning with an angular velocity of 27 radians per second about an axis parallel to  $2\vec{i} + \vec{j} - 2\vec{k}$  passing through the point  $\vec{i} + 3\vec{j} - \vec{k}$ . Find the velocity of the point whose position vector is  $4\vec{i} + 8\vec{j} + \vec{k}$ . 5
- ✓ 3 a) Explain line integral of the vector field. 4
- b) Determine whether the line integral  $\int_C 2xyz^2 dx + (x^2z^2 + z \cos yz) dy + (2x^2yz + y \cos yz) dz$  is independent of the path of integration? If so, then evaluate it from  $(1, 0, 1)$  to  $\left(0, \frac{\pi}{2}, 1\right)$ . 5
- c) A vector field  $\vec{F}$  is given by  $\vec{F} = \sin y\vec{i} + x(1 + \cos y)\vec{j}$ . 6
- Evaluate the line integral  $\int_C \vec{F} d\vec{r}$  where  $C$  is the circular path given by  $x^2 + y^2 = a^2$
- ✓ 4 a) State and prove Stoke's theorem. 5
- b) Evaluate  $\int_C [(2x - y)dx - yz^2dy - y^2zdz]$ , where  $C$  is the circle  $x^2 + y^2 = 1$ , corresponding to the surface of sphere of unit radius. 5
- c) Verify Stoke's theorem for  $A = (y - z + 2)\vec{i} + (yz + 4)\vec{j} - xz\vec{k}$  where  $S$  is the surface of the cube  $x = 0, y = 0, z = 0, x = 2, y = 2, z = 2$  above the  $xy$  plane. 5

## Section: B

Answer any 3 (Three) questions

1. a) Define Laplace transform. Find the Laplace transform of  $f(t)$  defined as

$$f(t) = \begin{cases} \frac{t}{k} & \text{when } 0 < t < k \\ 1 & \text{when } t > k \end{cases}$$

- b) Obtain the Laplace transform of the function  $f(x) = \begin{cases} \cos(t - \frac{2\pi}{3}) & , t > \frac{2\pi}{3} \\ 0 & , t < \frac{2\pi}{3} \end{cases}$

- c) If  $L[f(t)] = F(s)$ , then show that  $L[t^n f(t)] = (-1)^n \frac{d^n}{ds^n} [F(s)]$ .

2. a) Define periodic function. Find the Laplace transform of the function

$$f(x) = \begin{cases} \sin \omega t & \text{for } 0 < t < \frac{\pi}{\omega} \\ 0 & \text{for } \frac{\pi}{\omega} < t < \frac{2\pi}{\omega} \end{cases}$$

- b) Show that the Laplace transform of  $\frac{1-\cos t}{t^2} = \cot^{-1} s + \frac{s}{2} \log \frac{s^2}{s^2+1}$

- c) Find the Laplace transform of the periodic function (saw tooth wave)

$$f(t) = \frac{kt}{T} \quad \text{for } 0 < t < T, \quad f(t+T) = f(t).$$

- (3.) a) Applying convolution, solve the following initial value problem  
 $y'' + y = \sin 3t, \quad y(0) = 0, y'(0) = 0$ .

- b) Using Laplace transform, find the solution of the initial value problem  
 $y'' + 9y = 9u(t-3), \quad y(0) = 0, y'(0) = 0$ .

Where  $u(t-3)$  is the unit step function.

- c) Solve:  $\frac{dx}{dt} - y = e^t$

$$\frac{dy}{dt} + x = \sin t$$

$$\text{given; } x(0) = 1, y(0) = 0.$$

4. a) Explain analytic function. If  $f(z) = u + iv$  is an analytic function at all points in a region  $R$ , then show that  $u_x = v_y$  and  $u_y = -v_x$ .

- b) Show that the real and imaginary parts of the function  $w = \log z$  satisfy the Cauchy-Riemann equations when  $z$  is not zero.

- c) Let  $f(z) = u(x, y) + iv(x, y)$  be an analytic function. If  $u = 3x - 2xy$ , then find  $v$  and express  $f(z)$  in terms of  $z$ .

Hajee Mohammad Danesh Science and Technology University, Dinajpur  
 Department of Computer Science and Engineering  
 B.Sc.(Engineering) in CSE  
 Semester Final Examination 2021 (Jan-Jun)  
 Level 2 Semester I, Course Code: CSE 205, Credit: 2.0  
 Course Title: Numerical Methods (Theoretical)

Time: 2 Hours

Total Marks: 60

[N.B. The figure in the right margin indicates the marks allocated for respective question.  
Split answer of any question is not allowed.]

**Section-A**

(Answer any 03(three) from the following questions)

- Find a root of an equation  $f(x)=3x^2+5x-11$  using Regula Falsi method correct upto 4 decimal places. 10
- Find the value of  $f(1.12)$  and  $f(1.13)$  using Stirling's formula from the following table: 10

$x:$	1.00	1.05	1.10	1.15	1.20	1.25	1.30
$f(x):$	1.00000	1.02470	1.04881	1.07238	1.09544	1.11803	1.14017

- Evaluate  $\int_{-3}^3 x^4 dx$  with  $n = 6$  by using i) Simpson's  $1/3$  rule and ii) Simpson's  $3/8$  rule. 10

- Find  $y(0.1)$  accurate upto 4 decimal places using modified Euler's method by solving 10

$$\frac{dy}{dx} = y - \frac{xy}{y}, y(0) = 1 \text{ with step length } 0.1.$$

$$y_0 + P \cdot \frac{\Delta y_1 + \Delta y_0}{2} + \frac{P^2}{2} \Delta^2 y_1 + \frac{P(P^2-1)}{3!} \frac{\Delta^3 y_1 + \Delta^3 y_2}{2} + \frac{P^2(P^2-1)}{4!} \frac{\Delta^4 y_2}{2}$$

**Section-B**

(Answer any 03(three) from the following questions)

- Derive Newton's forward difference interpolation formula. 10
- Find the values of  $f''(3.3)$  and  $f''(5)$  from the following table, using numerical differentiation: 10

$x:$	0	1	2	3	4	5
$f(x):$	4930	5026	5122	5217	5312	5407

- Solve the following system of equations, correct to three decimal places, by Gauss-Jacobi method. 10

$$83x + 11y - 4z = 95$$

$$7x + 52y + 13z = 104$$

$$3x + 8y + 29z = 71$$

- Solve the equation  $\frac{dy}{dx} = \frac{1}{x+y}$ ,  $y(0)=1$  for  $y(0.1)$  and  $y(0.2)$ , using Runge-Kutta method of fourth order. 10

$$y_{m+1} = y_m + h f \left( x_m + \frac{1}{2}h, y_m + \frac{1}{2}h f(x_m, y_m) \right)$$

$$x = 1.145 - 0.133y + 0.048z$$

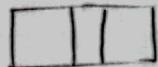
$$y = 2 - 0.135x - 0.25z$$

$$z = 2.449 - 0.103x - 0.276y$$

Time: 03 hrs

Full Marks: 90

- N. B.** i) Answer ANY THREE questions from each section in separate scripts.  
 ii) Figures in the right margin indicate full marks.  
 iii) Split answers of a question are not allowed.  
 iv) Assume a realistic value for any missing data.



### SECTION-A

1. a) What is semiconductor? Why is silicon preferred to germanium in the manufacture of semiconductor devices? 1+6  
 b) Discuss the behaviour of a p-n junction under forward and reverse biasing. 6  
 c) Why the temperature coefficient of resistance of a semiconductor is negative? 4
2. a) What is rectifier? Explain the working of bridge rectifier with a neat sketch. 1+5  
 b) Define Clipper and Clamper. Determine the output waveform for the square input of Figure A2(b). 3+3

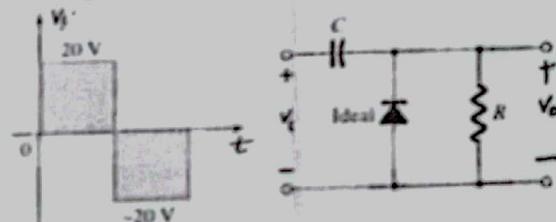


Figure A2(b)

3. a) What is filter? Explain the operation of  $\pi$ -filter. 1+2  
 b) The Zener diode circuit shown in the Figure A3(b) has a working range of current for proper regulation is  $5mA \leq I_Z \leq 50mA$  and a zener voltage,  $V_Z = 50V$ . If the input voltage,  $V_S$  varies from 150 to 250V and  $R_L = 2.2k\Omega$  determine the range of values for the resistor, R, to maintain regulation. 10

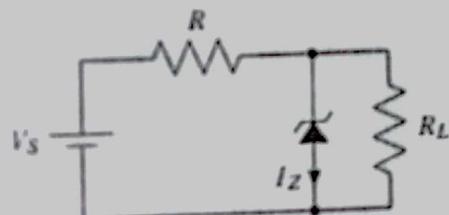


Figure A3(b)

4. a) What is transistor? Define  $\alpha$  and  $\beta$  of a transistor and drive the relationship between them. 9  
 b) Design the transistor inverter of Figure A4(b) to operate with a saturation current of 8 mA using a transistor with a beta of 100. Use a level of  $I_B$  equal to 120% of  $I_{B\max}$ .

$\beta = 100$   
 $I_B = 1.2 I_{B\max}$

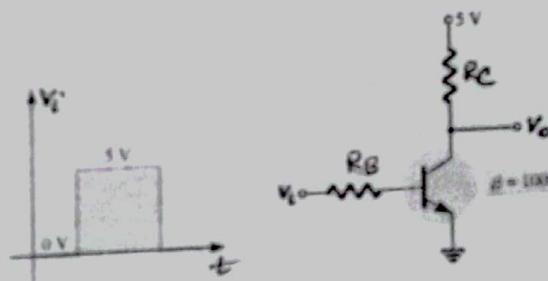


Figure A4(b)

## SECTION-B

1. a) How transistor amplifies the input signal? Explain. 5  
 b) Design a voltage-divider bias network using a supply of 24 V, a transistor with a beta of 110, and an operating point of  $I_{CQ} = 4 \text{ mA}$  and  $V_{CEQ} = 8 \text{ V}$ . Choose  $V_E = \frac{1}{8}V_{CC}$  and  $I = 10I_B$ . 10

2. a) Distinguish between FET and BJT. 4  
 b) Describe in your own words why  $I_G$  is effectively 0A for a JFET transistor. 4  
 c) For the voltage-divider bias configuration of Figure B2(c), if  $V_D = 12 \text{ V}$  and  $V_{GSQ} = -2 \text{ V}$ , determine the value of  $R_S$ . 7

$\approx 3.356$

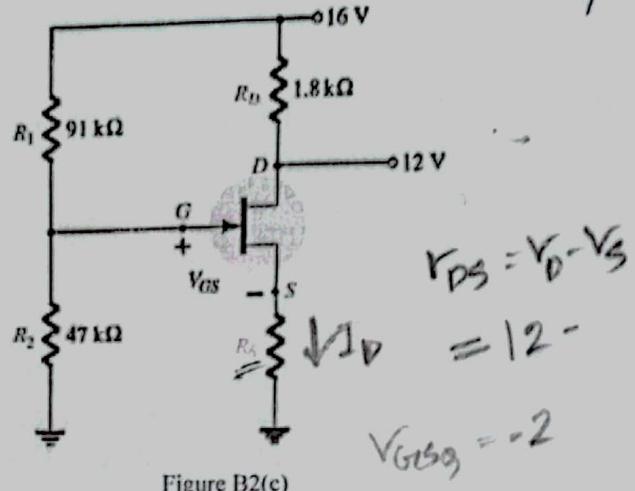


Figure B2(c)

3. a) Explain the operation and characteristics of N-channel MOSFET in enhancement mode. 7  
 b) Determine  $V_G$ ,  $I_{DQ}$ ,  $V_{GSQ}$ ,  $V_{DS}$ ,  $V_D$  and  $V_S$  for the network of Figure B3(b). 8

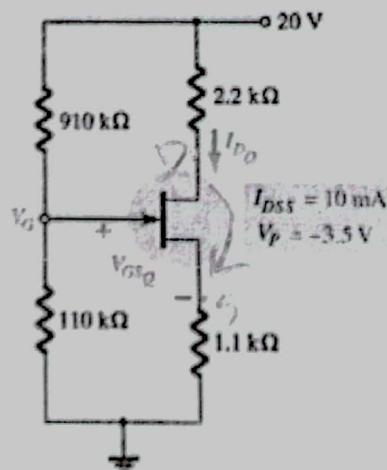


Figure B3(b)

4. a) Discuss the operation of a differential amplifier with a neat sketch. 5  
 b) What is meant by (i) CMRR (ii) output offset voltage (iii) input offset current (iv) slew rate 4  
 c) Derive an expression for the voltage gain of a noninverting amplifier. 6



Hajee Mohammad Danesh Science and Technology University, Dinajpur  
 Department of Computer Science & Information Technology  
 B.Sc in CSE  
 Semester Final Examination 2015(Jan-June)  
 Level 2 Semester I, Course Code: CIT 201, Credit: 3.0  
 Course Title: Data Structures (Theoretical)

Time: 3 Hours

Total Marks: 90

*[N.B. The figure in the right margin indicates the marks for respective question]*

**Section-A**  
Answer any THREE

1. a) Define data structure. Write the name of basic operations performed in data structure. 4
  - b) What factors effect the complexity of an algorithm? 2
  - c) Explain why the statement: "The running time of algorithm A is at least  $O(n^2)$ " is meaningless. 3
  - d) Differentiate between best, average and worst case complexities. 3
  - e) Find
    - (i) INSERT ('AAAAAA', 3, 'BBB')
    - (ii) DELETE ('JOHN PAUL JONES', 6, 5)
    - (iii) REPLACE ('AAABBB', 'AB', 'CC').
- 
2. a) What is an array? How linear arrays are represented in memory? Explain. 4
  - b) Using the bubble sort algorithm, find the number of comparisons which alphabetize the n=6 letters in PEOPLE. 4
  - c) Write an algorithm for Binary Search technique. Apply the algorithm on an ordered array A with the following elements {11, 22, 30, 33, 40, 44, 55, 60, 66, 77, 80, 88, 99}. Determine the number of key comparisons made while searching for keys 40 and 85. 7
- 
3. a) Define linked list with schematic diagram. 2
  - b) How can we handle overflow and underflow in linked list? 3
  - c) What do you understand by garbage collection? 2
  - d) Consider the following arithmetic infix expression Q.  

$$Q = A + (B * C - (D / E - F) * G) * H$$
 Convert infix expression Q into equivalent post expression using stack. 4



Time: 3 Hours

Total Marks: 90

*[N.B. The figure in the right margin indicates the marks for respective question]*

**Section-A**  
 Answer any THREE

1. a) Define data structure. Write the name of basic operations performed in data structure. 4
- b) What factors effect the complexity of an algorithm? 2
- c) Explain why the statement: "The running time of algorithm A is at least  $O(n^2)$ " is meaningless. 3
- d) Differentiate between best, average and worst case complexities. 3
- e) Find (i) INSERT ('AAAAAA', 3, 'BBB')  
 (ii) DELETE ('JOHN PAUL JONES', 6, 5)  
 (iii) REPLACE ('AAABBB', 'AB', 'CC'). 3
2. a) What is an array? How linear arrays are represented in memory? Explain. 4
- b) Using the bubble sort algorithm, find the number of comparisons which alphabetize the  $n=6$  letters in PEOPLE. 4
- c) Write an algorithm for Binary Search technique. Apply the algorithm on an ordered array A with the following elements {11, 22, 30, 33, 40, 44, 55, 60, 66, 77, 80, 88, 99}. Determine the number of key comparisons made while searching for keys 40 and 85. 7
3. a) Define linked list with schematic diagram. 2
- b) How can we handle overflow and underflow in linked list? 3
- c) What do you understand by garbage collection? 2
- d) Consider the following arithmetic infix expression Q.  

$$Q = A + (B * C - (D / E - F) * G) * H$$
  
 Convert infix expression Q into equivalent post expression using stack. 4

- /
- e) Consider the linear arrays AAA (5:50) and BBB (-5:10). 4
- Find the number of elements in each array.
  - Suppose Base (AAA) = 300 and w=4 words per memory cell for AAA.  
Find the address of AAA [15] and AAA [55].
4. a) Define Queue. Why queue is called first in first out system? 2
- b) Write an algorithm to insert an element to a queue. 4
- c) Consider the following queue of characters, where QUEUE is a circular array which is allocated six memory cells: 3
- FRONT=2, REAR=4                   QUEUE: \_, A, C, D, \_, \_
- Describe the queue as the following operations take place:
- F is added to the queue.
  - Two letters are deleted.
  - K, L and M are added to the queue.
- d) Write an algorithm for finding solution to Tower's of Hanoi problem. Explain the working of the algorithm for 3 disks. 6
-



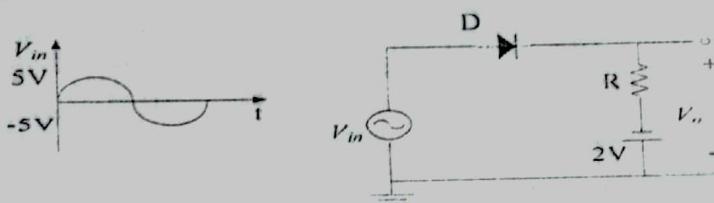
Time: 3 Hours

N.B:

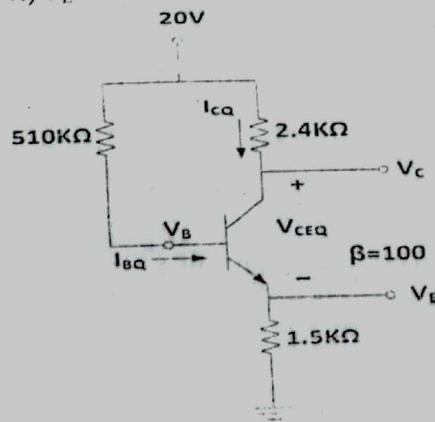
- i) Answer any six questions taking any three from each section.
- ii) Figures in the right margin indicate full marks.
- iii) Use separate answer script for each section.
- iv) Assume a realistic value for any missing data.

### Section- A

1. a) Define intrinsic and extrinsic semiconductors with its examples. By using bond diagram as well as energy band diagram, illustrate how majority and minority charge carriers are created in p-type material. 07
- b) Define reverse saturation current. Explain the effects of forward and reverse bias upon depletion region width, barrier potential, majority and minority charge carriers of pn-junction using necessary diagrams. 08
- c) Draw and explain the I-V characteristics curve of an ideal and practical diode. 05
2. a) Mention some application of diode. 03
- b) What is rectifier? Draw the circuit diagrams of full wave rectifier with input and output waveforms. Briefly describe its circuit operations. 05
- c) Sketch the output waveforms of the following circuits and shortly describe the circuit operations. 06



- d) What is clamping circuit? Describe a negative clamping circuit and calculate the peak to peak output voltage. Sketch the input and output waveforms. 06
3. a) What do you mean by operating point of a transistor? Discuss about the different modes of transistor operations. 07
- b) How can you use transistor as a switch? 05
- (c) Determine the following for the emitter-stabilized bias circuit of figure below: 08
  - i)  $I_{BQ}$  ii)  $I_{CQ}$  iii)  $V_{CEQ}$  iv)  $V_C$  v)  $V_B$  vi)  $V_E$

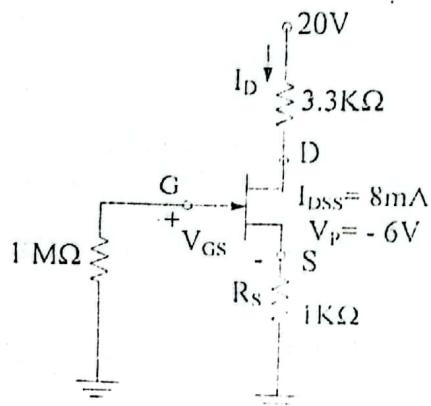


4. a) Define  $h_{ie}$ ,  $h_{oe}$ ,  $h_{re}$ ,  $h_{fe}$ . Sketch a circuit that could be used for measuring each of these components. 06
- b) Describe the differences between the  $r_e$  and hybrid equivalent models for a BJT transistor. For each model, list the conditions under which it should be applied. 06
- c) Draw the h-parameter equivalent circuit for a common emitter amplifier with an unbypassed emitter resistor. Derive the equation of i) input impedance ii) output impedance iii) voltage gain iv) current gain v) power gain of the circuit. 08

Section-B

Ques 1

- a) Discuss the construction and operation of n-channel JFET. 07  
 b) Distinguish between JFET and Bipolar Junction Transistor. 05  
 c) For the following self-bias network determine 08  
 i)  $V_{GSQ}$  ii)  $I_{DQ}$  iii)  $V_{DS}$  iv)  $V_S$  v)  $V_G$



2. a) What is MOSFET? What are the advantages of MOSFET over JFET? 06  
 b) Discuss the construction and operation of an n-channel enhancement type MOSFET. 08  
 c) Explain JFET as an amplifier. 06
3. a) Mention the electrical characteristics and applications of operational amplifier. 05  
 b) Sketch operational amplifier integrator circuit. Derive an equation for the output voltage in terms of input. 05  
 c) Why open loop op-amp is not used in linear ac application? 04  
 d) Design and construct a non-inverting amplifier circuit using operational amplifier to obtain output voltage five times greater than input voltage. 06
4. a) Define the following terms: i) CMRR ii) Slew rate iii) Input offset voltage. 03  
 b) Design a first order low pass filter at a cutoff frequency of 1 kHz with a pass band gain 2. 07  
 c) Draw a common emitter amplifier circuit with coupling capacitor and bypass capacitor. Also show the input and output waveforms. What are the functions of coupling capacitor and bypass capacitor. Briefly explain the operation of the amplifier circuit. 10

Hajee Mohammad Danesh Science & Technology University, Dinajpur.

B. Sc in CSE

Semester Final Examination 2014 (Jan-June)

Level 2 Semester I

Course Code: CIT 201 Credits: 03

Course Title: Data Structures (Theoretical)

Time: 03 hours

Full Marks: 90

Section-A

Answer Any Three

1. a) What is data structure? List out the areas in which data structures are applied extensively. 3  
b) What is the difference between linear and nonlinear data structures? 3  
c) What is the difference between ARRAY and STACK? 3  
d) Arrays are called dense list and static data structure. Why? 3  
e) Which one is faster? A binary search of an ordered set of elements in an array or a sequential search of the elements. 3
2. a) Which of the following statements will correctly store the concatenation of strings s1 and s2 in string s3? 5
  - i) `s3=strcat(s1,s2);`
  - ii) `strcat(s3,s2,s1);`
  - iii) `strcpy(s3, strcat(s1, s2));`
  - iv) `strcmp(s3, strcat(s1, s2));`
  - v) `strcpy(strcat(s1,s2), s3);`  
b) What is Recursion? Explain with an example. 4  
c) Write a program which reads words WORD1 and WORD2 and then replaces each occurrence of WORD1 in TEXT by WORD2. Test the program using WORD1='HENCE' and WORD2='THUS'. 6
3. a) Derive the best, average, worst case time complexity of a linear search. 3  
b) Develop an algorithm for binary search. Validate the algorithm with a suitable data set. 9  
c) What is Top down approach? Explain. 3
4. a) Convert the expression  $((A+B)*C-(D-E)^{(F+G)})$  to equivalent Prefix and Postfix notations. 10  
b) Write a searching algorithm that finds an item from list. 5

**Section-B**  
**Answer Any Three**

1. a) Define the following terms with proper example.

10

- i. Binary tree
- ii. Complete binary tree
- iii. Extended binary tree
- iv. Binary search tree
- v. Depth of a tree

b) What are the advantages & disadvantages of a doubly linked list over a singly linked list? 5

2. a) Consider the following queue of characters, where queue is a circular array which is allocated six memory cells: 7.5

front=3, rear=5 queue: \_, \_, c, d, e, \_

Describe the queue as the following operations take place:

- i. f is added to the queue.
- ii. two letters are deleted.
- iii. k, l and m are added to the queue.
- iv. two letters are deleted
- v. r is added to the queue.

b) Write an algorithm to perform queue insert operation. 4.5

c) Define priority queue. Write the two rules for priority queues. 3

3. a) Define path length. Show the relationship between internal and external path length of an extended binary tree. 5

b) Write an algorithm that inserts an item to the heap. 5

c) Briefly describe about Huffman's Algorithm. 5

4. a) Define graph and multigraph. 2

b) Write in detail about the Breadth first search of a graph. 8

c) Suppose a graph G is stored in memory as follows: 5

	NODE	NEXT	ADJ
START 6	1 A	4	6
	2	0	
AVAILN 5	3 C	8	1
	4 E	0	10
	5	7	
	6 D	3	2
	7	2	
	8 B	1	9

DEST	8	8		1	4	3	3		6	3	AVAILE 3
LINK	5	7	8	0	0	0	0	0	4	0	
	1	2	3	4	5	6	7	8	9	10	

Draw the graph G.



Hajee Mohammad Danesh Science & Technology University, Dinajpur  
 Department of Computer Science and Engineering  
B.Sc.(Hons) in Physics  
 Semester Final Examination 2017 (Jan-Jun)  
 Level 2, Semester I, Course Code: CSE 233, Credit: 3.0  
 Course Title: Computer Programming Language I

Time: 3 Hours

Full Marks: 90

[N.B. The figure in the right margin indicates the marks for respective question and split answer of any question is unacceptable]

Section-A

Answer any 3 (three) questions

1. (a) What is programming language? Why is it necessary to learn programming language? 1+3  
 (b) Draw the flowchart for compiling and running of a C program. 4  
 (c) Differentiate between compiler and interpreter. 3  
 (d) Why and when do you need to use the #include and #define directives? 4
  
- (2) (a) Define keyword. Write six keyword names used in C. 1+3  
 (b) Describe fundamental data types in C. 4  
 (c) Briefly describe the syntax for declaring a variable with example. 2  
 (d) Which of the following are invalid variable names and why? 5  
 i. Minimum                    ii. First.name                    iii. doubles  
 iv. 3rd\_row                    v. break
  
3. (a) Write about C increment and decrement operators with examples. 4  
 (b) Distinguish between printf( ) and scanf( ) functions. 3  
 (c) Write some computational problems for which you need to take necessary precautions in C. 3  
 (d) Write a program that reads a floating-point number and then displays the two right-most digit of the integral part of the number. 5
  
4. (a) Discuss about putchar() function with example. 3  
 (b) Discuss about %[characters] and %[^characters] conversion specifications in scanf() with examples. 4  
 (c) In response to the input statement scanf("%2d%5d%d", &num1, &num2, &num3); the following data is keyed in:  
 19886 37  
 What values does the computer assign to the variables num1, num2 and num3? 2  
 (d) Write a program to read the name ABU HENA YUSUF in three parts using the scanf statement and display the name in the following format using printf statement. 5  
 (i) ABU H YUSUF      (ii) A H YUSUF

## Section-B

Answer any 3 (three) questions

1. (a) What is control statement in C? What are the necessities of these statements in C? 1+2  
(b) Discuss about *if-else* statement with its flow chart and example. 4  
(c) Consider the following code segment of a program: 2+2
- ```
x = 1;
y = 1;
if (n > 0)
    x = x + 1;
    y = y - 1;
printf("%d %d", x, y);
```
- What will be the values of *x* and *y* if *n* assumes a value of (i) 1 and (ii) 0.
- (d) Write a program to read three integer numbers from keyboard and print the largest number. 4
2. (a) Discuss *exit-controlled* and *entry-controlled* loops with respective flow chart in C. 3+3  
Give example(s).
- (b) Find error, if any, in the following looping segments and correct it. Assume that 2+2  
all the variables have been declared and assigned values correctly.
- (i) while (count != 10)
 {
 count = 1;
 sum = sum + x;
 count = count + 1;
 }
- (ii) name = 0;
 do { name = name + 1;
 printf(" My name is Nil\n");
 } while (name != 1)
- (c) Write a program to print the following output using **while** loop. 5
- 1  
2 2  
3 3 3  
4 4 4 4
3. (a) What is size/index of an array? Why array is called derived data type in C? 2+2  
(b) Define **break** statement. Discuss how to declare and initialize one-dimensional array with example. 1+5  
(c) Write a program to compute and print a multiplication table for numbers 1 to 5 using two-dimensional array. 5
4. (a) What is a character string? Why should a null character be inserted at the end of a string? Explain. 1+2  
(b) Write various ways to read the character strings from terminal. 3  
(c) Discuss string handling functions **strcmp()** and **strcpy()** with an example. 3+3  
(d) Write a program that will take two words from keyboard and print that whether the words are same or not. 3

Hajee Mohammad Danesh Science and Technology University, Dinajpur  
 Department of Computer Science and Engineering  
 B. Sc. (Engineering) in Computer Science and Engineering  
 Semester Final Examination – 2021 (Jan-Jun)  
 Level 2, Semester I, Credit: 3.0  
 Course Code: CSE 201, Course Title: Object-Oriented Programming

Time 3.0 Hours

Total Marks: 90

*[N.B. The figure in the right margin indicates the marks allocated for the respective question.  
The split answer to any question is not allowed.]*

Part A

*(Answer any 03(three) from the following questions)*

1. (a) Define object-oriented programming and explain the intrinsic features of object-oriented programming. 5  
 (b) What is a copy constructor? Explain it with an example program. 5  
 (c) What are the different ways to define member functions of a class? What is the role of the scope resolution operator in the definition of member function? 5

2. (a) How does a c++ structure differ from a c++ class? 3  
 (b) Broadly discuss the main purposes of using the *friend function* in a single class and more than two classes. 5  
 (c) Create a class called *Complex* for performing arithmetic with complex numbers. Write a driver program to test your class. Complex numbers have the form: *realPart + imaginaryPart \* i* 7

- i. Use double variables to represent the private data of the class.
- ii. Provide a constructor function that enables an object of this Class to be initialized when it is declared.
- iii. The constructor should contain default values in case no initializers are provided.
- iv. Provide Public member functions for each of the following:
  - Addition of two Complex numbers: The real parts are added together and the imaginary parts are added together.
  - Subtraction of two Complex numbers (The real part of the right operand is subtracted from the real part of the left operand and the imaginary part of the right operand is subtracted from the imaginary part of the left operand.)
  - Printing Complex numbers in the form (a, b) where a is the real part and b is the imaginary part.

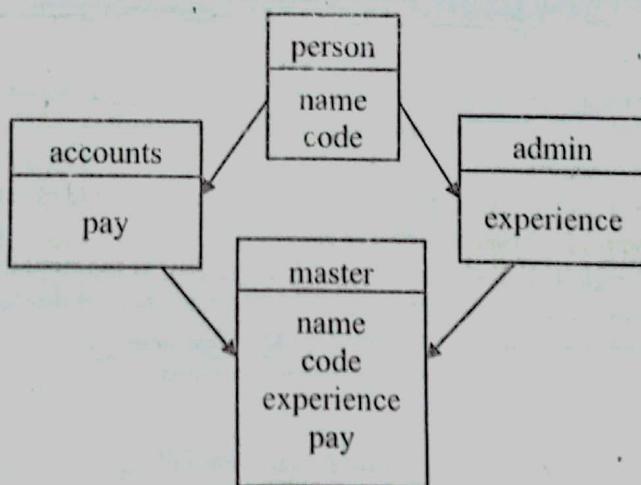
3. (a) When do we need to use default arguments in a function? Explain. 3  
 (b) What is *this* pointer? Write a code segment in C++ to illustrate the benefit(s) of using *this* pointer. 5  
 (c) Mention four ways to prove that a class can be used as a built-in data type. 7

4. (a) How is dynamic initialization of objects achieved? Distinguish between the following two statements:  
`time T2(T1);`  
`time T2=T1;` 4  
 (b) Can we use the same function name for a member function of a class and an outside function in the same program? If yes, how are they distinguished? If no, give reasons. 5  
 (c) Implement a C++/Java program that illustrates the following concept:  
 Declare a class named *integerNumber* that has several integer data members and member functions for I/O. Also, include a *unary operator-overloading* function that overloads *minus* operator for the data members of the class. Show sample input-output case(s) for your written program. 6

### Part B

(Answer any 03(three) from the following questions)

1. (a) Explain why a friend function can not be used to overload the assignment operator (=). 3  
(b) Describe the syntax of multiple inheritances. When do we use such an inheritance? 5  
(c) Prove that class can be used as a built-in data type in terms of *assignment* (=) and *plus* (+) operator among objects. 7
2. (a) Design three classes **Students**, **Tests**, and **Results**, where **Results** is inherited from **Tests**, and **Tests** is inherited from the **Students**. Write possible functions to initialize values and a main function for execution by creating objects. 5  
(b) Discuss the role of access specifiers in inheritance and show their visibility when they are inherited as public, private, and protected. 5  
(c) Write a C++ program involving the type conversion from one class type to another class. 5
3. (a) How is polymorphism achieved at (a) compile time and, (b) run time? 3  
(b) When do we make a virtual function "pure"? What is the implication of making a function a pure virtual function? 5  
(c) Consider a class network of the following figure. The class **master** derives information from both **accounts** and **admin** classes which in turn derive information from the class **person**. Define all the four classes and write a program to create, update and display the information contained in **master** objects. 7



4. (a) Describe the various approaches by which we can detect the *end-of-file* condition successfully. 5  
(b) What are the file streams? Explain the role of `seekg()`, `seekp()`, `tellg()`, and `tellp()` functions in the process of random access in a file. 5  
(c) Define exception handling. When do we need multiple catch blocks for a single try block? Give an example. 5

The figures in the right margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTIONS

Answer any three questions from each section

### SECTION-A

1. a. Define statistics. Write the applications in computer science. 4  
b. What is frequency distribution? How will you construct a frequency distribution from raw data? 5  
c. An electronics company manufactures power supplies for personal computers. They produce several hundred power supplies in each shift and each unit is subjected to a 24-hours burn-in test. The number of units failing during this 24-hours test in each shift is shown below:  
5, 8, 7, 12, 1, 18, 10, 9, 16, 3, 6, 19, 17, 11, 9, 6, 14, 0, 8, 15, 2, 12, 5, 18, 11, 2, 17, 12 28  
Construct the frequency distribution table from the above data with a suitable class interval. 6
2. a. Illustrate central tendency. Write down the properties of a good measure of central tendency. 4  
b. Briefly describe median and mode. 5  
c. The shelf life of high-speed photographic film shows the following results.

|                |       |       |       |       |       |       |       |
|----------------|-------|-------|-------|-------|-------|-------|-------|
| Life (in days) | 30-35 | 35-40 | 40-45 | 45-50 | 50-55 | 55-60 | 60-65 |
| No. of films   | 4     | 10    | 9     | 12    | 6     | 7     | 2     |

Calculate the average shelf life of high-speed photographic film.

16

3. a. What is the dispersion of a dataset? Explain the importance of dispersion. 4  
b. Define standard deviation and coefficient of variation with merits and demerits. 207 5  
c. The distribution of failure time of processors of 50 computers from different brands are shown below

|                         |     |     |     |     |     |     |
|-------------------------|-----|-----|-----|-----|-----|-----|
| Failure time (in years) | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 |
| No of processors        | 5   | 16  | 8   | 10  | 6   | 5   |

Calculate the standard deviation and comment about the result.

6

4. a. What is correlation analysis? Define positive and negative correlations with example. 4  
b. Briefly discuss regression analysis. Write down the properties of regression coefficient and uses of regression analysis. 3.8.4 5  
c. The table below presents data concerning the gasoline mileage performance and the engine displacement (in cubic centimeters) for 8 automobiles.

|              |      |      |      |      |      |      |      |      |
|--------------|------|------|------|------|------|------|------|------|
| Displacement | 3200 | 3000 | 2500 | 2800 | 3500 | 4000 | 2200 | 4200 |
| Miles/Gallon | 18   | 17   | 20   | 19   | 20   | 14   | 22   | 12   |

Calculate the correlation coefficient and comment on the relationship between mileage and engine displacement.

6

## SECTION-B

1. a. What is probability? Write down the properties of probability. 4  
b. Briefly discuss different rules used in probability. 5  
c. In a computer shop it is seen that 40% customers purchased CPU, 30% of them purchased Monitors and 20% purchased both CPU and monitor. If a computer buyer is chosen at random who bought a CPU, what is the probability that he will also buy a Monitor? Again, if a computer buyer is chosen at random who bought a Monitor, what is the probability that he will also buy a CPU? 0.5 0.67 6
2. a. Discuss Binomial distribution. Write down the conditions for Binomial distribution. 4  
b. Illustrate Poisson distribution with its properties and some examples. 5  
c. Suppose, according to latest police report 80% of cybercrimes are solved. In a day at Dinajpur district 4 such cybercrimes are reported. Now find the probability that a) all of them, b) at least 3 of them and c) within 1 to 4 of them will be solved. 6
3. a. What is continuous uniform distribution? Mention some properties. 4  
b. Define normal distribution and standard normal distribution. Write down some important properties of normal distribution. 5  
c. Gate lock buses of Rangpur passes by HSTU gate in every twenty minutes. What is the probability that a student standing at HSTU gate has to wait for the bus i) less than 8 minutes, ii) at least 14 minutes, iii) between 7 to 15 minutes. 6
4. a. Illustrate Chebyshev's inequality and Markov's inequality. 4  
b. Define weak law of large numbers (WLLN) and strong law of large numbers (SLLN). Distinguish between them. 5  
c. Explain the central limit theorem (CLT). Distinguish between CLT and law of large numbers. 6

Time: 3 hours

Total Marks: 90

*NB: Figures in the right margin indicate full marks. Parts of the same question should be answered together and in the same sequence.*

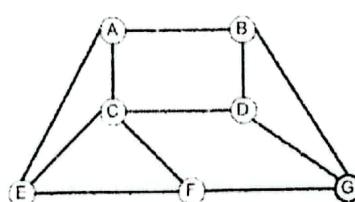
**Section-A**  
Answer any Three

- |                                                                                                                                                                                                                                                      | Marks |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1. (a) What is a data structure? Why do we need data structures?                                                                                                                                                                                     | 1+2   |
| (b) Suppose a 10-element array A contains the values a <sub>1</sub> , a <sub>2</sub> , ..., a <sub>10</sub> . Find the values in A after each loop.                                                                                                  | 3     |
| (i) Repeat for K = 1 to 9:<br>Set A[K + 1] := A[K].<br>[End of loop.]                                                                                                                                                                                |       |
| (ii) Repeat for K = 9 to 1 by -1:<br>Set A[K + 1] := A[9].<br>[End of loop.]                                                                                                                                                                         |       |
| (c) Briefly describe the notions of (i) the complexity of an algorithm and (ii) the space-time tradeoff of algorithms.                                                                                                                               | 3     |
| (d) Find the table and corresponding graph for the second pattern matching algorithm (Finite Automata based) where the pattern is P = ababab.                                                                                                        | 6     |
| 2. (a) Give some advantages and disadvantages of using linked storage for storing strings.                                                                                                                                                           | 2     |
| (b) Consider an array A containing eight elements as shown below:<br>69, 22, 46, 5, 83, 17, 49, 35, 12<br>(i) How many passes of the bubble sort algorithm will be required to sort the elements of array A in descending order? <del>Ans</del> 4(4) | 1+6   |
| (ii) Show the state of the array after each pass                                                                                                                                                                                                     |       |
| (c) Discuss the time complexity of binary search, heap sort, and radix sort algorithm.                                                                                                                                                               | 6     |
| 3. (a) What is priority queue? How is the priority queue implemented using linked list and array ?                                                                                                                                                   | 1+4   |
| (b) Let a and b denote positive integers. Suppose a function Q is defined recursively as follows:                                                                                                                                                    | 2+2   |
| (i) Find the value of Q(2,3) and Q(14,3)<br>(ii) What does this function do? Find Q(5861,7)                                                                                                                                                          |       |
| (c) (i) What is stack? What are the basic operations associated with stack?<br>(ii) Convert following arithmetic infix expression into postfix by using stack:<br>((A + B) * D) ↑ (E - F)                                                            | 2+4   |
| 4. (a) What is a threaded binary tree? Write the advantages of threaded binary tree.                                                                                                                                                                 | 1+2   |
| (b) Write the properties of recursive procedure. Write a recursive solution of a program that will print 20 18 16 14 12 10 8 6 4 2.                                                                                                                  | 1+4   |
| (c) With the help of an example, explain how a binary tree can be represented using an array.                                                                                                                                                        | 2     |
| (d) Create a binary search tree for the following numbers starting from an empty binary search tree. Delete keys 10, 60 and 45 one after the other and show the trees at each stage. [45,26,10,60,70,30,40].                                         | 5     |

**Section B**  
**Answer any Three**

**Marks**

- |    |                                                                                                                                                                                                                                                                             |        |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 1. | (a) Define singly linked list. Write and explain an algorithm to insert a node at the beginning and the end of the list.                                                                                                                                                    | 1+6    |
|    | (b) Suppose the following sequences list the nodes of a binary tree T in preorder and inorder, respectively:<br>Preorder: G, B, Q, A, C, K, F, P, D, E, R, H.<br>Inorder: Q, B, K, C, F, A, G, P, E, D, H, R.<br>Draw the diagram of the tree.                              | 4      |
|    | (c) Consider the initial and final states of a STACK as shown below:<br>INITIAL: 10, 9, 27, 4, 29, __, __, __<br>FINAL: 10, 7, 8, 4, 36, __, __, __<br>Write the series of PUSH and POP operations that will transform the STACK from its initial state to its final state. | 4      |
| 2. | (a) What are the merits of binary search tree over linked list? Is there any drawback of binary search tree? Explain.                                                                                                                                                       | 1+2    |
|    | (b) Suppose the 7 data items A, B, ..., G are assigned the following weights: (A, 13), (B, 2), (C, 19), (D, 23), (E, 29), (F, 5), (G, 9). find a 2-tree with a minimum weighted path length P. What is the Huffman coding for the 7 letters using this tree?                | 6      |
|    | (c) What is the intuition behind selection sort? Show different passes required to perform selection sort on the following list of numbers in ascending order: 76, 32, 43, 10, 87, 21, 65, 54.                                                                              | 1+5    |
| 3. | (a) What is a doubly linked list? State the advantage of such a list.                                                                                                                                                                                                       | 1+1    |
|    | (b) What is max-heap? Construct max-heap from the following list of numbers: 44, 30, 50, 22, 60, 55, 77, 55. After the construction of heap, delete the root element and maintain the max-heap properties.                                                                  | 1+6    |
|    | (c) Write short note on:<br>i) Transitive closure<br>ii) 2-Trees<br>iii) Complete Binary Trees<br>iv) Indexing<br>v) Deques<br>vi) Garbage collection                                                                                                                       | 6      |
| 4. | (a) Define Graph. What are the different ways of representing a graph?                                                                                                                                                                                                      | 1+2    |
|    | (b) What is the difference between DFS and BFS algorithm? Use BFS algorithm to traverse the following graph. Consider that E is a starting vertex. Find the shortest distance from E to G.                                                                                  | 1+6 +1 |
|    | (c) What is linear probing? The following keys 10, 16, 11, 1, 3, 4, 23 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function $h(k) = k \bmod 10$ and linear probing. What is the resultant hash table?               | 1+3    |





[N.B. The figure in the right margin indicates the marks allocated for respective question. Split answer of a question will not be accepted.]

### SECTION-A

(Answer three from the following questions including question number 1.)

1. (a) Compare and contrast between structured programming and object-oriented programming (OOP) paradigms. Do you think that object-oriented programming paradigm is superior to structured programming? Justify your answer. 2+2
- (b) A private dental practice wishes to computerize its patients' records system. A patient must register with the practice and the system needs to store their name, address and mobile telephone number. Each patient is given a unique seven digit patient number. The system will keep a count of how many patients the practice currently has. Patients can book an appointment with a particular dentist; the system needs to store the date of the appointment and if the patient attended. A text message will be automatically sent out two working days before the appointment. After the appointment the dentist update the system with the cost of the treatment undertaken. The practice employs two types of staff: Receptionists and Dentists. The system needs to record their details; which for all staff includes a four digit employee number, their name, address, gender, contact telephone number and next of kin. Dentists must be qualified; the system will store their highest dental qualification, date awarded and their General Dental Council registration number. A list of appointment statistics is required at the end of each week. This will be a summary of how many patients turned up and how many were no-shows. If a patient repeatedly misses an appointment they will be charged a fixed amount of money. All receptionists must go on a first aid course every year. The system must record the date of when they last attended the course and the name of the course provider. Now,
  - i. Extract the required classes (with abstraction) and associations
  - ii. Draw a class diagram or object oriented (OO) model for this system2+4
2. (a) How a C++ program can be structured using the concept of OOP? 2
- (b) Explain information hiding in OOP. Is it needed in OOP? How can it be achieved? 2
- (c) Explain how can you create a two dimensional array of objects in C++. Create a class called **Complex** for complex numbers. Write the header file for this class, and write a testing program to illustrate how to use this class. Following requirements should be satisfied:
  - i. Use double variables for the private data.
  - ii. Provide a constructor with default values.
  - iii. Provide functions support arithmetic calculation of adding and subtracting with more than two **Complex** number objects.
  - iv. Provide function printing **Complex** numbers in the form "(a, b)".
  - v. Make a method explicitly *inline*2+4
3. (a) Clearly mention the rules for getting the properties by the derived class when a class is inherited using the *visibility mode* as *private*, *public* and *protected*. 2
- (b) Explain the primary mechanism for code re-use in object-oriented programming. 2
- (c) Explain what is meant by the term *abstract data type* (ADT) and how ADTs are implemented using an object oriented programming language. 2+4
4. (a) What is *this* pointer? Write a code segment in C++ to illustrate the benefit(s) of using *this* pointer. 2
- (b) Define *ambiguity resolution* in inheritance. How can it be performed in C++? 2
- (c) How can you prove that inheritance has been happened in your written C++ program? Using an object oriented programming language with which you are familiar write a class which contains a method called *getNumberOfInstances*. This method should return the number of instances of the class. 2+4

### SECTION - B

(Answer any three from the following questions.)

1. a) Why is Java known as a *platform-independent* programming language? Explain with proper reason(s). 2

- b) Compare between *classes* and *structures*. 2

- c) Differentiate between method overloading and overriding. Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur wishes to keep information on its students electronically. The proposed *Student* class has the following instance variables: 2+4

*studentNo*: String

*studentName*: String

*dateOfBirth*: Date/String

*tariffPoints*: Integer

- *tariffPoints* represents the entry qualification achieved by a student, which is a number between 32 and 150.
- A class variable is also required, called *noOfStudents*, which will be incremented each time a *Student* instance is created.

Using an object oriented programming language that you are familiar with, write the code to perform the following, where appropriately include suitable integrity checks:

- Show the declaration of the *Student* class, including any setter and getter methods.
- Declare two constructors as follows; both constructors should increment the class variable appropriately:

- The first is a default constructor that has no parameters and sets the instance variables to either "not known" for the strings, 20 for the integer and 1<sup>st</sup> January 1995 for the date (assume there is a Date constructor that accepts dates in a string format).
- The second takes 4 parameters, one for each of the instance variables.
- Show how both constructors could be used to instantiate an object.

2. a) What is *Java byte-code*? What are the basic steps for compiling and running a simple Java program in command mode? 2

- (b) Why is inheritance called "IS A" or "IS A KIND OF" relationship? Explain with examples. 2

- (c) What are the ways to prove that class can be used as built-in data type? Prove that class can be used as built-in data type in terms of use of *assignment* (=) and *plus* (+) operator among objects. 2+4

3. a) How *run-time function overloading* can be achieved in C++? virtual function 2

- (b) Define exceptions in C++. Discuss the general exception handling mechanism in C++. 2

- (c) Write a C++ program to implement a *vector* container from the C++ standard template library (STL) showing the use of various kinds of member functions supported by the container as well as some available algorithms. Also, show the implementation of *sort ()* and *merge ()*. 4+2

4. a) Explain *ios* class functions and *manipulator*. Write a Java program to implement the concepts of classes and objects. 2

- b) How memory is allocated for the *states* and *behaviors* of the objects of a class? Write an example. 2

- (c) What are the major differences between *early* and *dynamic* binding? Which rules should be followed for using usual *member* function and *friend* function for overloading either a unary or a binary operator in C++? Illustrate with a simple example that when should you declare a class as *virtual*. 6