BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Computer Science and Engineering
Student Group : 36<Earned Credit Hour<=72, Final Examination (Fall):Nov 2019

Subject: CSE- 217, Theory of Computation

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question - 1** in **Section A** and **Question - 5** in **Section B** are compulsory.
c. Answer any **OTHER TWO** questions from **EACH** section.
d. Figures in the margin indicate **full marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. What are the differences between a deterministic finite automation (DFA) and an nondeterministic finite automation (NFA). **06**

b. Design an NFA which recognizes the following language: **12**
$L = \{\{0,1\}^* \mid$ number of symbol is divisible by 2 or 3$\}$

c. Convert the following regular expression to an NFA with ϵ transition: **12**
$11\ (0+1)^*\ 0(0+1)^*$

Question – 2

a. What do you mean by power of an alphabet? What are Σ^* and Σ^+ ? **06**

b. Convert the following NFA to an equivalent DFA: **14**

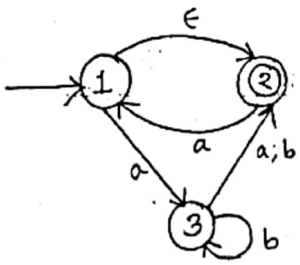

Fig: 2(b)

c. The formal description of a DFA M is $(\{q_1, q_2, q_3, q_4, q_5\}, \{u, d\}, \delta, q_3, \{q_4\})$, where δ is given by the following table. **10**

	u	d
q_1	q_1	q_2
q_2	q_1	q_3
q_3	q_2	q_4
q_4	q_3	q_5
q_5	q_4	q_5

Give the state diagram for this machine. Describe the language of this DFA.

Question – 3

a. Prove that- "The class of regular language is closed under the star operation". 18

b. For the alphabet $\Sigma = \{0, 1\}$, write the regular expression for the following languages. 06+06 =12

(i) $L_1 = \{w \mid w$ starts and ends with some symbol$\}$

(ii) $L_2 = \{w \mid w$ does not contain two consecutive 0's$\}$

Question – 4

a. "Nondeterministic is an inessential feature of finite automata" – explain. 06

b. Prove that $L = \{0^n 1^{2n} \mid n \geq 0\}$ is not regular. 12

c. Find a regular expression for the following automation. 12

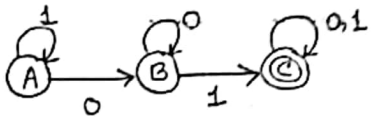

Fig: 4(c)

SECTION-B

Question – 5

a. Consider the following context free grammar. 10

$E \rightarrow +EE \mid *EE \mid -EE \mid x \mid y$

Find leftmost and rightmost derivations and a parse tree for the string +*-xyxy

b. Design context free diagram for each of the following languages. 15

i) $L_1 = \{w \mid w$ is a string of balanced parenthesis$\}$

ii) $L_2 = \{w \mid$ the number of a's and the number of b's in w are equal$\}$

iii) $L_3 = \{ 0^n 1^n \mid n \geq 0\} \cup \{1^n 0^n \mid n \geq 0\}$

c. Define ambiguous grammar and inherently ambiguous language. 05

Question –6

a. Explain when a context free grammar can be said to be in Chomsky Normal Form. 05

b. Covert the following context free grammar into an equivalent CFG 15

in Chomsky Normal Form.

$S \rightarrow ASA \mid aB$
$A \rightarrow B \mid S$
$B \rightarrow b \mid \epsilon$

c. Design an appropriate context free grammar for the following deterministic finite automaton (DFA). **10**

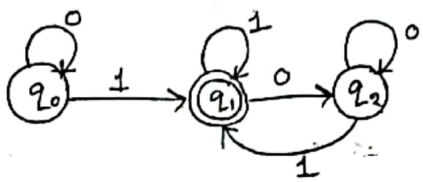

Fig: 6(c)

Question –7

a. Write down formal definition of pushdown automaton in terms of tuples. **05**

b. Design a pushdown automaton for the language $L = \{0^n 1^{2n} \mid n \geq 0\}$ and describe its tuples. **15**
Also show the computations for the input string 001111 by the designed PDA.

c. State pumping lemma for context free grammar and using pumping lemma prove that the language $D = \{ww \mid w \in \{0, 1\}^*\}$ is not a context free language.

Question–8

a. Define the Turing Machine and describe power of Turing Machine. **05**

b. Design a Turing Machine for the fo0llowing language and give an implementation level description. **15**
$L(M_1) = \{w\#w \mid w \in \{0, 1\}^*\}$

c. For the Turing machine M_1 as designed in question 8(b), show the steps of configuration for the input string 101#101 **10**

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Student Group: 36<Earned Credit Hour<=72, Final Examination (Fall): Nov 2019

Subject: CSE-217, Theory of Computation

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question - 1** in **Section A** and **Question - 5** in **Section B** are compulsory.
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d. Figures in the margin indicate **full marks**.
e. Assume reasonable data if necessary.
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SECTION-A

Question – 1

a. What is automata theory? What is the relation between complexity and computability? **6**

b. Give the difference between deterministic finite automata (DFA) and nondeterministic finite automata (NFA) with examples. **6**

c. DFA, D_1 has a rather strange alphabet $\sum_1 = \{a,b,1\}$, containing both letters and digit. D_1 accepts all and only the strings which has number of a's divisible by 3 and has an even sum of digits. As such strings like ε, aabb1a1, aab1bba11b1, baaba, 11b11 will be accepted. And strings like aab11, aba, 111 will be rejected. Draw the state diagram of D_1. **12**

d. Language L_1 consists of all strings over alphabet {a,b,c} containing at least one a and at least one b. Write down regular expression for L_1. **6**

Question – 2

a. Design DFA for the following language, $L_2 = \{w \mid w$ is any string that does not contain exactly two a's$\}$ over $\sum = \{a,b\}$ **6**

b. Design an NFA which accepts all and only the set of string over alphabet {0, 1, 2, 3} such that the final digit has appeared before. **6**

c. Consider the following NFA, N_1. **8**

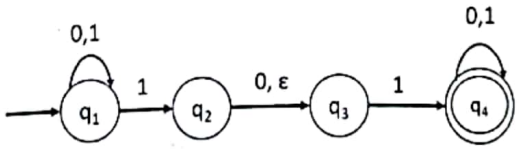

Fig: The nondeterministic finite automation N_1

Verify whether the string 010110 will be accepted or not. Draw the computation of N_1 on this input.

d. Consider the following ε-NFA: **10**

	ε	a	b	c
p	{q,r}	ø	{q}	{r}
q	ø	{p}	{r}	{p,q}
r	ø	ø	ø	ø

Convert the automaton to a DFA.

Question – 3 6+6

a. Write down regular expressions for the following:
   (i) The set of strings that consist of alternating 0's and 1's.
   (ii) The set of strings over alphabet {a,b,c} containing at least one occurrence of each symbol.

b. Convert the following DFA into Regular expression. 10

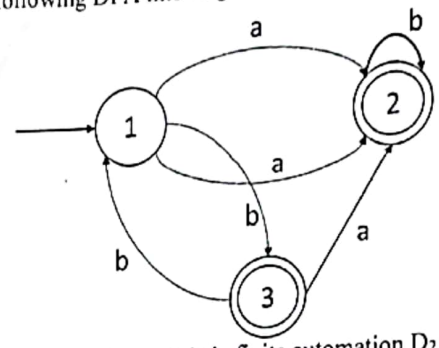

Fig: The deterministic finite automation D_2

c. Give the state diagram of NFA with three states for the language $1^*(001^+)^*$ over the alphabet {0,1} 8

Question – 4

a. "Nondeterminism is an inessential feature of finite automata" – explain. 6

b. Prove that a set is regular if and only if it can be described by a regular expression. 12

c. Prove that $D_4 = \{ 1^{n!} \mid n \geq 1 \}$ is not a regular language. 12

SECTION-B

Question – 5

a. Write down implementation-level description of a Turing Machine for the following language. 10

$A = \{ w \mid w \in \{0,1\}^* \text{ and } w \text{ contains an equal number of 0s and 1s} \}$

b. Design a Pushdown Automaton (only the state diagram) for the following language over the alphabet {0,a}. 10
$B = \{ 0^{3n} a^{2n} \mid n \geq 0 \}$

c. Define the following terminologies with example where necessary. 10
   i) Turing recognizable and Turing decidable.
   ii) Ambiguous and inherently ambiguous language.

Question – 6

a. Design context free grammar for each of the following languages: 15
   i) $L1 = \{ 0^{n+1} 1^n \mid n \geq 0 \} \cup \{ 1^n 0^{n+1} \mid n \geq 0 \}$
   ii) $L2 = \{a^n b^m c^k \mid n,m,k \geq 0 \text{ and } n = 2m+3k \}$

b. Convert the following CFG into an equivalent CFG in Chomsky normal form. 15
$R \rightarrow XRX \mid S$
$S \rightarrow aTb \mid bTa$
$T \rightarrow XTX \mid X \mid \varepsilon$
$X \rightarrow a \mid b$

Question – 7

a. Write formal definition of Pushdown Automata. Design Pushdown Automata for each of the following languages: **15**

i) $L(P1) = \{x^i y^j z^k \mid i,j,k \geq 0 \text{ and } (i=j \text{ or } i=k)\}$

ii) $L(P2) = \{w\#w^R \mid w \in \{0,1\}^*\}$ where w^R means w written in reverse order.

b. Sate pumping lemma for Context Free languages. Using pumping lemma prove whether the language $C = \{a^n b^n c^n \mid n \geq 0\}$ is context free or not. **10**

c. Convert the following context free grammar into an equivalent Pushdown Automaton where the set of terminals is {0,#}. **5**

$S \rightarrow TT \mid U$

$T \rightarrow 0T \mid T0 \mid \#$

$U \rightarrow 0U00 \mid \#$

Question – 8

a. Design Turing Machine that decide each of the following languages: (only state diagram) **20**

i) $D = \{1^{n^2} \mid n \geq 0\}$

ii) $E = \{w \mid w \in \{0,1\}^* \text{ and } w \text{ is palindrome}\}$

b. Show the configurations for the Turing Machine designed in question 8(a)-(ii) for the input 01011010. **5**

c. Explain different variants of Turing Machine model. **5**

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Student Group : 0<Earned Credit Hour<=36, Final Examination (Fall) : Nov 2019

Subject: MATH-143, Mathematics II (ODE, PDE and Coordinate Geometry)

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question - 1** in **Section A** and **Question - 5** in **Section B** are compulsory.
c. Answer any **OTHER TWO** questions from **EACH** section.
d. Figures in the margin indicate **full marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. Define linear and non-linear differential equations. Derive a differential equation which satisfies the family of circles $x^2 + y^2 + 2ax + 2by + c = 0$, where a, b, c are arbitrary constants and $a^2 + b^2 > c$. **12**

b. Define exact equation. Solve the following differential equation by reducing to exact form: $(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0$ **10**

c. What do you mean by the Bernoulli's differential equation? Solve the following differential equation: **8**

$$\frac{dy}{dx} + \frac{y}{x} lny = \frac{y}{x^2} (lny)^2.$$

Question – 2

a. Solve the differential equation: **10**

$$(D^4 + 2D^3 - 3D^2)y = x^2 + 3e^{2x} + 4sinx$$

b. Solve the differential equation: **12**

$$(D - 2)^2 y = 8x^2 e^{2x} cos^2 x$$

c. Solve the differential equation: **8**

$$(x^3D^3 + 3x^2D^2 + xD + 1)y = x + lnx$$

Question – 3

a. Define linear partial differential equation of order one. Find the general solution of the following partial differential equation of Lagrange's form: **12**

$$(x-y)p + (x+y)q = z(y-x)$$

b. Define complete integral. Apply Charpit's method to find a complete integral of the following partial differential equation : **18**

$$2z + p^2 + qy + 2y^2 = 0$$

Question – 4

a. Solve : $r + s - 2t = (2x + y)^{\frac{1}{2}}$. **7**

b. Solve: $(D^2 + DD' - 6D'^2)z = ysinx$. **8**

c. Solve: $(D^2 - DD' + D' - 1)z = \cos(x + 2y) + e^y$.

d. *Solve*: $(D^2 - D' - 1)z = x^{2y}$.

SECTION-B

Question – 5

a. Find the transformation equation of $14x^2 - 4xy + 11y^2 - 36x + 48y + 41 = 0$ to rectangular axes through the point (1, -2) inclined at an angle $tan^{-1}\frac{-1}{2}$ to the original axes.

b. Find the bisectors of the angles between the lines represented by $ax^2 + 2hxy + by^2 = 0$

c. One of the lines $ax^2 + 2hxy + by^2 = 0$ be perpendicular to one of the lines $a'x^2 + 2h'xy + b'y^2 = 0$, show that $(aa' - bb')^2 + 4(a'h + bh')(ah' + b'h) = 0$

Question – 6

a. Define conic. Identify the nature of the conics given by the following equations:
(1) $2x^2 - 3y^2 + 8x + 30y - 27 = 0$.
(2) $34x^2 + 24xy + 41y^2 + 48x + 14y - 108 = 0$.

b. Reduce the equation $x^2 - 5xy + y^2 + 8x - 20y + 15 = 0$.

c. Calculate the latus rectum of the conic $25x^2 + 120xy + 144y^2 - 82x - 163y + 32 = 0$.

Question – 7

a. Define diameter chord of circles. Find the equation of the circles through the points of intersection of the circles $x^2 + y^2 = 2ax$ and $x^2 + y^2 = 2bx$ and having its centre on the line $\frac{x}{a} - \frac{y}{b} = 2$.

b. Define angle of intersection of two circles. Find the limiting points of the co-axial system determined by the circles $x^2 + y^2 + 2x - 6y = 0$ and $2x^2 + 2y^2 - 10y + 5 = 0$.

c. Write an equation of a vertical parabola with a vertex of (2, 6) and passing through the point (-1, 4). Apply this concept to find an equation of a bridge which is designed with an arch in the shape of a parabola. The road over the bridge is 120 feet long and the maximum height of the arch is 50 feet.

Question – 8

a. Define conjugate diameters of an ellipse. Show that the straight line $lx + my + n = 0$ is normal to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ if $\frac{a^2}{l^2} + \frac{b^2}{m^2} = \frac{(a^2 - b^2)^2}{n^2}$.

b. If CP and CD be a pair of conjugate semi-diameters of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, show that the area of the triangle CPD is constant.

c. Define hyperbola. Derive an equation of a hyperbola.

SECTION-B

6/07

Question – 5

a. State the convolution theorem and hence solve $\mathcal{L}^{-1}\{\frac{1}{(s+1)(s^2+1)}\}$ 1(

b. Show that , $\int_0^t \int_0^v F(u)\,dudv = \int_0^t (t-u)\,F(u)\,du.$ 8

c. State Heaviside's Expansion formula and solve $\mathcal{L}^{-1}\{\frac{s-1}{(s+3)(s^2+2s+2)}\}$ 1

Question –6

a. Prove that if $\mathcal{L}\{F(t)\} = f(s)$, then 1(
$\mathcal{L}\{F''(t)\} = s^2 f(s) - sF(0) - F'(0)$ and
hence prove that $\mathcal{L}\{\sinh at\} = \frac{a}{s^2-a^2}$

b. Show that $\mathcal{L}\{t^n F(t)\} = (-1)^n \frac{d^n}{ds^n}[f(s)] = (-1)^n f^n(s)$; 1
where $\mathcal{L}\{F(t)\} = f(s)$

c. Find $\mathcal{L}\{F(t)\}$ *if* $F(t) = \begin{cases} Cos\left(t-\frac{2\pi}{3}\right), & t > \frac{2\pi}{3} \\ 0 \quad , & t < \frac{2\pi}{3} \end{cases}$ 5

Question –7

a. Evaluate $(i)\ \mathcal{L}\{t^2 Cos\, at\}$ $(ii)\ \mathcal{L}\{\int_0^t \frac{\sin u}{u}\,du\}$ 10

b. Show that $\int_0^\infty \frac{e^{-t} Sin\, t}{t}\,dt = \frac{\pi}{4}$ 10

c. State final value theorem. Verify the theorem for the function $F(t) = 3\,e^{-2t}$ 10

Question–8

a. Solve $X' + 2Y'' = e^{-t}$
$X' + 2X - Y = 1$
subject to $X(0) = Y(0) = Y'(0) = 0$ using Laplace transformation. 15

b. A particle P of mass 2 grams moves on the X axis and is attracted toward origin O with force numerically equal to $8X$. If it is initially at rest at X=10 , find it's position at any subsequent time assuming a dumping force numerically equal to 8 times the instantaneous velocity acts. Also illustrate the nature of the solution. 15

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Short Term Final Examination :Jan2020

Subject: EECE- 269, Electrical Drive and Instrumentation

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question - 1** in **Section A** and **Question - 5** in **Section B** are compulsory.
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SECTION-A

Question – 1

a. Derive the expression for the r.m.s value of induced EMF of a transformer. Also show that, emf/turn is the same in both the primary and secondary windings. **12**

b. Draw the equivalent circuit of the transformer. **05**

c. Explain various losses of a transformer. **05**

d. The maximum flux density in the core of a 250/3000 volts, 50 Hz single phase transformer is 1.2 Wb/m^2. If the emf per turn is 08 volts, calculate **08**
   (i) Primary and xsecondary turns
   (ii) Area of the core.

Question – 2

a. Show that the frequency of an alternator can be expressed as **05**

$$f = \frac{PN}{120} Hz.$$

b. Show that, for an alternator the induced voltage per phase is given by the expression **15**

$$E_{eff} = 4.44\, K_f K_c K_d f \phi T \text{ Volts.}$$

c. The stator of a 3- phase, 16 pole alternator has 144 slots and there are 4 conductors per slot connected in two layers and the conductor of each phase are connected in series. If the speed of the alternator is 375 r.p.m calculate the emf induced per phase. Resultant flux in the air gap is 5×10^{-2} webers per pole sinusoidally distributed. Assume the coil span as 150° electrical. **10**

Question – 3

a. Draw a comparison between motor and generator action. **05**

b. Show that the torque developed by the armature of a dc motor can be expressed by the equation, **15**

$$T_a = 0.159 \phi Z I_a \times (P/A) \text{ N-m}$$

c. A short- shunt compound generator delivers a load current of 30A at 220 V and has armature, series- field and shunt –field resistances of 0.05 Ω, 0.30 Ω and 200 Ω respectively. Calculate the induced emf and the armature current. Allow 1.0 V per brunch for current drop. **10**

Question – 4

a. Show that, in case of induction motor, starting torque is maximum when rotor resistance equals the rotor reactance. **05**

b. Show that for a 3- phase induction motor, when a 3-phase stator winding is fed by a 3- phase supply: **15**

(i) Resultant flux is 1.5 times the maximum value of the flux due to any phase.

(ii) The resultant flux rotates around the stator at synchronous speed given by

$$N_s = 120\ f/p\ .$$

c. A 150 kW, 3000V, 50 Hz, 6 pole star connected induction motor has a star connected slip- ring rotor with a transformation ratio of 3.6 (stator/ rotor) . The rotor resistance is 0.1 Ω/ phase and its per phase leakage reactance is 3.61 mH. The stator impedance may be neglected. Calculate the starting current and starting torque on rated voltage with short- circuited slip rings. **10**

SECTION-B

Question – 5

a. Sketch the block diagram and sketch all the elements of modern digital data acquisition system. **10**

b. Discuss the advantages of instrumentation amplifier. Consider the following instrumentation amplifier and find the output voltage V_{out} from figure 5(b). **12**

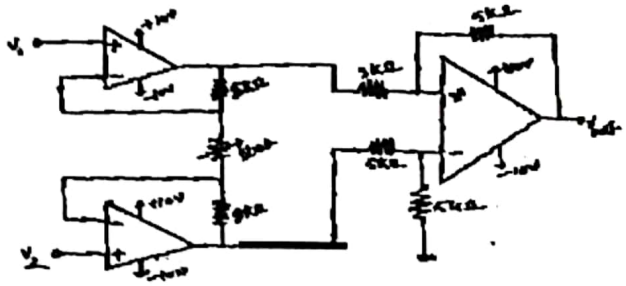

Fig 5(b)

c. For a piezo electric transducer, develop the equation of the output voltage. **08**

Question –6

a. Sketch the block diagram of basic X-Y recorder and discuss it's operation. **12**

b. For a logarithmic amplifier show that, **10**

$$V_o = -V_t \ln (V_{in}/R_1 I_s)\ .$$

c. A barium titanate pickup has the dimensions of 5mm×5mm×1.25mm, and the force acting on it is 5N. The charge sensitivity of barium titanate is150 pc/N and it's permittivity is 12.5×10^{-9} F/m. If the modulas of elasticity of barium titanate is 125×10^{6} N/m^2 , calculate the strain. Also, calculate the charge and the capacitance. **08**

Question –7

a. Explain interference capacitance coupling with neat diagram and discuss how the problem can be solved at higher frequencies. **10**

b. For a strain gauge made of a circular wire, derive the following equation, **10**

$$G_F = 1 + 2\nu + \frac{\Delta P}{\epsilon P}.$$

c. A thermistor has a resistance of 3980Ω at the ice point and 794Ω at 50°C. If the resistance- temperature relationship is given by $RT = aR_o e^{bT}$, calculate the range of resistance to be measured if the temperature varies from 40°C to 100°C. **10**

Question–8

a. Prove that a decode counter acts as a decode frequency divider. **10**

b. Define spectrum analyzer. Explain the operating principle of basic swept receiver spectrum analyzer. **12**

c. Explain noise figure and prove that, **08**
maximum thermal noise power, $P_n = KTB$,
where,

K= Boltzman's constant,
T= Absolute temperature of the resistor in Kelvin,
B= Noise Bandwidth in Hz.

BANGLADESH UNIVERSITY OF PROFESSIONALS
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B.Sc. In Computer Science and Engineering
Short Term Final Examination: Jan 2020

Subject: CSE 203, Data Structure

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
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SECTION-A

Question – 1

a. What is data structure? Write down the advantages of data structure. **6**

b. Prove that $15n^3 + 3n = O(n^4)$, but $15n^3 + 3n \neq O(n^2)$ **12**

c. Given a singly linked-list and two integers m and k. Write a function that finds the node with item value m and then delete next k nodes from the linked-list. **12**

Question – 2

a. Write the advantages and disadvantages of static array list over linked list. **6**

b. Suppose that you are given the following implementation of a doubly linked list. **12**

```
struct listNode{
    int item;  // will store data
    struct listNode *next; // will keep address of next node
    struct listNode *prev; // will keep address of next node
};
struct listNode *head; //pointer to the first node of the list
struct listNode *tail; // pointer to the last node of the list
```

Implement the function "void delete (int N)" that delete N^{th} node of the list.

c. Compare the worst case time complexities of Array List and Doubly Linked List (with head and tail pointers) for the following operations. **18**

(i) Insert an item at the N^{th} position of the list (need to preserve order of items).
(ii) Remove the first item of the list (need to preserve order of items).
(iii) Remove the N^{th} item of the list (need to preserve order of items).
(iv) Get (without removing) the N^{th} item of the list.

Question – 3

a. Suppose we create a BST by inserting the following values in the given order: 60, 10, 15, 45, 50, 85, 5, 30, 65, 40. **6+4+4+6**
Answer the following questions.

(i) Draw the BST.
(ii) Show the output values if we visit the tree using pre-order traversal technique.

(iii) Show the output values if we visit the tree using post-order traversal technique.

(iv) Show the resulting tree after deleting item 40, 85, and 50.

b. Suppose that we double the memory of an array list every time we see that the memory is full during inserting a new item. Show that the average time required per insertion to copy the existing items from old memory to new memory is constant.

Question – 4

a. Describe two reasons why we should use restrictive data structures (e.g., stack and queue) instead of general purpose data structures (e.g., list)

b. Give a brief description of

(i) Full binary tree

(ii) Perfect binary tree

(iii) Complete binary tree

c. Suppose you are given the following definition of a singly linked list.

```
struct listNode{
    int item;  // will store the value
    struct listNode *next;//will keep pointer to the next node
};
struct listNode *head; //pointer to the first node of the list
struct listNode *tail; // pointer to the last node of the list
```

Implement a queue data structure using the above linked list definition. You need to implement only the following functions: enqueue, dequeue, and isEmpty.

SECTION-B

Question – 5

a. Write an algorithm for the Depth-First search of a given disconnected graph. Analyze the time complexity of algorithm if the graph is represented by-

i) Adjacency list

ii) Adjacency matrix

b. Consider a weighted mixed graph G as shown in the following figure.

i) Draw adjacency list of G

ii) Draw adjacency matrix of G

iii) Draw DFS forest of G assuming 'a' as starting vertex.

iv) Write the sequence of vertices if you want to explore the graph G starting from vertex 'a' in BFS.

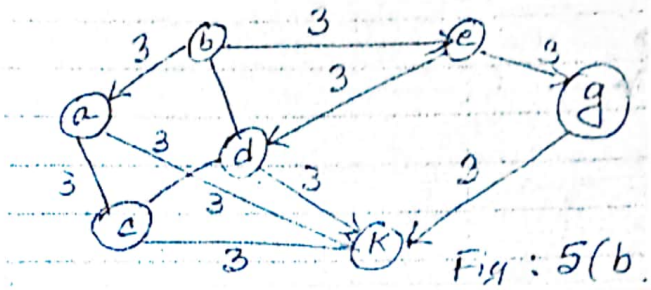

Fig : 5(b.

Question – 6

a. Write the quick sort algorithm. Analyze the best case and worst case time complexity of the algorithm. **15**

b. Write down every steps of sorting this given list by the bubble sort algorithm. **15**

5, 1, 6, 2, 4, 3

and prove that the worst case complexity of the bubble sort algorithm is $O(n^2)$

Question – 7

a. What is a priority key? How could you implement the Increase-Key, Decrease-Key, Extract-max and Insert operations of a priority queue. **15**

b. What is an AVL tree? Draw the AVL tree that results after successfully inserting the keys 31, 14, 15, 27, 36, 57, 53, 41 into an initially empty AVL tree. **15**

Question – 8

a. Suppose you have 17 buckets. Insert following 12 keys using linear probing. **15**

6, 12, 34, 29, 28, 11, 23, 7, 0, 33, 30, 45.

Use hash function.

b. Compare adjacency lists and adjacency matrix representation of a graph. **10**

c. What is stability in sorting algorithms and why is it important? **5**

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Short Term Final Examination: Jan 2020

Subject: CSE 215, Algorithms

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question - 1** in **Section A** and **Question - 5** in **Section B** are compulsory.
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d. Figures in the margin indicate **full marks**.
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f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. Discuss how greedy approach is different form dynamic programming approach. **10**

b. Prove that $an^2 + bn + c$ is $\Theta(n^2)$ and $\Theta(n^3)$, but not $\Theta(n)$. **10**

c. Write down the insertion sort algorithm and analyze its complexity. Write down the condition for which it will be: best case, worst case and average case. **10**

Question – 2

a. Write down the properties of a problem for which it can be solved using dynamic programming approach. Analyze the Fibonacci number generation problem and draw recursion tree for $n = 5$. **10**

b. Develop a recursive solution for longest common subsequence problem. **10**

c. Find all the longest common subsequence of $X = (GCTGAT)$ and $Y = (CAGTA)$ using dynamic programming method. **10**

Question – 3

a. Show a comparison between breadth first search and depth first search. **10**

b. Prove that a directed graph is acyclic if and only if a DFS of a graph yields no back edge. **10**

c. Write the pseudocode of breadth first search and analyze the time complexity. Modify the pseudocode to find the number of disconnected graph in a forest. **10**

Question – 4

a. What is spanning tree of a graph?
Write Kruskal's algorithm for finding a minimum spanning tree of an edge weighted graph. What will be the running time of this algorithm? **10**

b. Write the correctness proof of Kruskal's algorithm. **10**

c. Let G be a weighted connected graph and let V_1 and V_2 be a partition of the vertices of G into two disjoint non-empty sets. Let - e be an edge in G with minimum weight among those edges with on endpoint in V_1 and other in V_2. Then show that there is a minimum spanning tree T of G containing e. **10**

SECTION-B

Question – 5

a. Discuss the optimal substructure property of matrix chain multiplication (MCM) problem.

b. Explain how memorization can improve the performance of MCM.

c. Using dynamic programming, compute the minimum number of scaler multiplication for the matrix chain multiplication of A_1, A_2, A_3, A_4, A_5 with dimensions 15X50, 50X20, 20X10, 10X35, 35X25, respectively.

Question – 6

a. Solve the following instance of 0/1 Knapsack problem using the branch and bound approach with a state space tree. Assume that the Knapsack capacity is 10

Item	Weight	Value
1	4	60
2	6	52
3	3	80
4	7	84

b. Show a comparison between backtracking branch and bound and brute force approach of solving a problem.

Question – 7

a. Define the following six classes of problems-
P, Co-P, NP, Co-NP, NP-complete, NP-hard
   i. Write four known and four unknown (open) relations among these classes of problems.
   ii. By diagram, show that the relationship among these classes of problems that most researches regards as most likely.

b. Write a polynomial time 2-approximation algorithm for the vertex cover problem, and prove the approximation ratio of the algorithm. If $N \neq NP$, then prove that for any constant $\rho>1$. There is no polynomial time approximation algorithm with ratio ρ(rho) for the general traveling salesman problem.

Question – 8

a. Explain Maximum Bipartite matching Problem and show how it can be solved using Ford-Fullerson algorithm.

b. Show a comparison among the following approaches of attacking a NP-hard problem:
   I. Brute Force Approach
   II. Heuristics
   III. Approximation algorithm

BANGLADESH UNIVERSITY OF PROFESSIONALS
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B.Sc. in Computer Science and Engineering
Short Term Final Examination: Jan 2020

Subject:CSE 217, Theory of Computation

Time: 3.00 hours **Full Marks:180**

INSTRUCTIONS:

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SECTION-A

Question – 1

a. Design a deterministic finite automaton for the language L1 = { ω | ω begins with 1 and ends with 0} over the alphabet Σ = {0, 1}. Explain the mathematical representation of the designed DFA. **12**

b. Compare between deterministic finite automaton and nondeterministic finite automaton. **4**

c. Depict computation of the automaton shown in **fig-1(c)** on input 010110. **4**

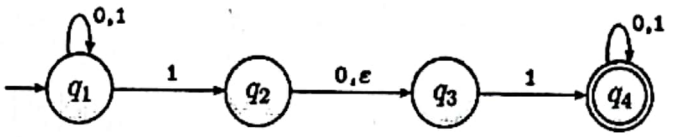

Fig-1(c)

d. Prove that, "If a language is described by regular expression, then it is regular." **10**

Question – 2

a. Design DFA (only state diagram) for each of the following languages: **15**
   i. L(D1) = { ω | ω contains at least one 1 and an even number of 0's follow the last 1}, where Σ = { 0, 1}.
   ii. L(D2) = { ω | ω has an even number of a's and each 'a' is followed by at least one 'b'}, where Σ = { a, b}.

b. Prove that, "The class of regular language is closed under union operation." **10**

c. Describe how DFA computes for a particular input string. Use example if necessary. **05**

Question – 3

a. Design Nondeterministic finite automaton (only state diagram) for each of the following languages over the alphabet {0, 1} **15**
   i. L(N1) = { ω | ω ends with 00}
   ii. L(N2) = { ω | the length of ω is at most 5}

b. Convert the following NFA shown in fig-3(b) to an equivalent DFA showing all the necessary diagrams and transition tables.

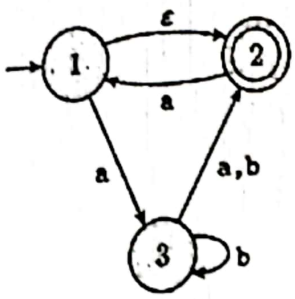

Fig-3(b)

Question – 4

a. For an alphabet Σ = {0, 1}, write down the regular expression for each of the following languages:
   i. L(R1) = { ω | ω has at least one 1}
   ii. L(R2) = { ω | the length of ω is a multiple of 4}
   iii. L(R3) = { ω | ω starts and ends with the same symbol}
   iv. L(R4) = { ω | ω contains the substring 1010}

b. Convert the regular expression
$$(a \cup ab^*)\, a^+b^+)$$
to an equivalent NFA.

SECTION-B

Question – 5

a. Write down formal definition of Context-Free Grammar. Use example if necessary.

b. Design a Pushdown Automaton (PDA) for the L = $\{\omega\omega^R | \ \omega$ belongs to $\{0, 1\}^* \}$ where ω^R means reverse string of ω. Present both the diagrammatic and mathematical representation.

c. Explain Turing-recognizable and Turing-decidable.

Question –6

a. Design Context-Free Grammar for each of the following languages:
   i. L(G1) = $\{a^i b^j c^k \mid i = j + k\}$
   ii. L(G2) = $\{a^n b^n \mid n \geq 0\}$
   iii. L(G3) = $\{0^n 1^n \mid n \geq 0\} \cup \{1^n 0^n \mid n \geq 0\}$

b. Convert the following CFG to an equivalent CFG in Chomsky Normal Form:
$$S \rightarrow ASA \mid aB$$
$$C \rightarrow B \mid S$$
$$E \rightarrow b \mid \varepsilon$$

c. Explain inherently ambiguous languages along with examples.

Question –7

a. Design Pushdown Automaton (only state diagram) for each of the following languages:
   i. L(P1) = $\{a^n b^n \mid n \geq 0\}$

ii. $L(P2) = \{ \omega 1 \# \omega 2 \mid n_a(\omega 1) = n_a(\omega 2) \}$
where $n_a(\omega 1)$ means number of a's in $\omega 1$,
$n_a(\omega 2)$ means number of b's $\omega 2$,
where $\Sigma = \{ a, b \}$.

b. i. State Pumping lemma for non-context free languages. Using pumping lemma prove whether the language $\{a^n b^n c^n \mid n \geq 0\}$ is context free or not. **10**

Question–8

a. Write down an implementation-level description for the language $L(T) = \{0^{2^n} \mid n \geq 0\}$ and draw the state diagram for the Turing Machine T. **20**

b. Show the configuration for the Turing Machine designed in question 8(a) for the input string 0000. **10**

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SECTION-B

Question – 5

a. Define Laplace transform. Find $\mathcal{L}\{\sin at\}$.

b. Find the Laplace transform of
(i) $t \sin 2t$
(ii) $(\sin t - \cos t)^2$.

c. If $\mathcal{L}\{F(t)\} = f(s)$ then prove that $\mathcal{L}\{e^{at}F(t)\} = f(s-a)$. Apply it to find the Laplace transform of $e^{-3t}t^3$.

Question – 6

a. Define inverse Laplace transform. Find
(i) $\mathcal{L}^{-1}\left\{\frac{4}{s-2}\right\}$
(ii) $\mathcal{L}^{-1}\left\{\frac{1}{s^2(s^2+4)}\right\}$
(iii) $\mathcal{L}^{-1}\left\{\frac{(s^2+2s+3)}{(s^2+2s+2)(s^2+2s+5)}\right\}$

b. State Heaviside's expansion formula. Apply it to find $\mathcal{L}^{-1}\left\{\frac{s+5}{(s+1)(s^2+1)}\right\}$

Question – 7 Apply Laplace transform to solve the following differential equations

a. $Y''(t) + Y(t) = t; Y(0) = 1,\ Y'(0) = -2.$

b. $Y''(t) + tY(t) - Y(t) = 0;\ Y(0) = 1, Y'(0) = 1.$

Question – 8

a. Solve the following differential equations:
$X' = 2X - 3Y$
$Y' = Y - 2X$
subject to $X(0) = 8, Y(0) = 3.$

b. Apply Laplace transformation to solve the following system of differential equations
$tY + z + tZ' = (t-1)e^{-t}$
$Y' - Z = e^{-t}$
given that $Y(0) = 1,\ Z(0) = 1.$

BANGLADESH UNIVERSITY OF PROFESSIONALS
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B.Sc. In Computer Science and Engineering
Short Term Final Examination: Jan 2020

Subject: Math 143, Mathematics II (ODE, PDE & Coordinate Geometry)

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question - 1** in **Section A** and **Question - 5** in **Section B** are compulsory.
c. Answer any **OTHER TWO** questions from **EACH** section.
d. Figures in the margin indicate **full marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. Show that the differential equation of $r = c(1 - cos\theta)$ is $\frac{dr}{d\theta} = \frac{rsin\theta}{1-cos\theta}$. **10**

b. Solve: **10**

(i) $\frac{dy}{dx} + 1 = e^{x-y}$

(ii) $y(1 + xy)dx + x(1 - xy)dy = 0$

c. State the Bernoulli equation. Find the solution of **10**
$(1 - x^2)\frac{dy}{dx} + xy = xy^2\ (x < 1)$.

Question – 2

a. Find the general and singular solution of the equations **10**
$xp^2 - 2yp + 4x = 0$.

b. Solve: $(D^3 - 5D^2 + 7D - 3)y = 0$. **10**

c. Using the method of variation of parameters solve: **10**
$(D^2 - 2D)y = e^x sinx$.

Question – 3

a. Distinguish between linear and nonlinear partial differential equations with examples. **06**

b. Solve the following problems using Lagrange's method: **24**

(i) $(y - z)p + (z - x)q = x - y$.

(ii) $xyp + y^2q = zxy - 2x^2$.

Question – 4

a. Write down the working rule for solving nonlinear partial differential equation by Charpits method. Hence find a complete integrals of $2xz - px^2 - 2qxy + pq = 0$ by using this method. **14**

b. Solve: **16**

(i) $(D^2 - 2DD' + D'^2)z = e^{2x+5y}$.

(ii) $(D - 3D')^2 z = 12(x^2 + 3xy)$.

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Computer Science and Engineering
Short Term Final Examination: Jan 2020

Subject: CSE 203, Data Structure & Algorithm I

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question - 1** in **Section A** and **Question - 5** in **Section B** are compulsory.
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SECTION-A

Question – 1

a. What is data structure? Write down the advantages of data structure. 6

b. Prove that $15n^3 + 3n = O(n^4)$, but $15n^3 + 3n \neq O(n^2)$ 12

c. Given a singly linked-list and two integers m and k. Write a function that finds the node with item value m and then delete next k nodes from the linked-list. 12

Question – 2

a. Write the advantages and disadvantages of static array list over linked list. 6

b. Suppose that you are given the following implementation of a doubly linked list. 12

```
struct listNode{
    int item;  // will store data
    struct listNode *next; // will keep address of next node
    struct listNode *prev; // will keep address of next node
};
struct listNode *head; //pointer to the first node of the list
struct listNode *tail; // pointer to the last node of the list
```

Implement the function "void delete (int N)" that delete N^{th} node of the list.

c. Compare the worst case time complexities of Array List and Doubly Linked List (with head and tail pointers) for the following operations. 18

(i) Insert an item at the N^{th} position of the list (need to preserve order of items).
(ii) Remove the first item of the list (need to preserve order of items).
(iii) Remove the N^{th} item of the list (need to preserve order of items).
(iv) Get (without removing) the N^{th} item of the list.

Question – 3

a. Suppose we create a BST by inserting the following values in the given order: 60, 10, 15, 45, 50, 85, 5, 30, 65, 40. 6+4+4+6
Answer the following questions.
(i) Draw the BST.

(ii) Show the output values if we visit the tree using pre-order traversal technique.

(iii) Show the output values if we visit the tree using post-order traversal technique.

(iv) Show the resulting tree after deleting item 40, 85, and 50.

b. Suppose that we double the memory of an array list every time we see that the memory is full during inserting a new item. Show that the average time required per insertion to copy the existing items from old memory to new memory is constant. 10

Question – 4

a. Describe two reasons why we should use restrictive data structures (e.g., stack and queue) instead of general purpose data structures (e.g., list) 6

b. Give a brief description of 6

(i) Full binary tree

(ii) Perfect binary tree

(iii) Complete binary tree

c. Suppose you are given the following definition of a singly linked list. 18

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struct listNode{
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struct listNode *head; //pointer to the first node of the list
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```

Implement a queue data structure using the above linked list definition. You need to implement only the following functions: enqueue, dequeue, and isEmpty.

SECTION-B

Question – 5

a. Write an algorithm for the Depth-First search of a given disconnected graph. Analyze the time complexity of algorithm if the graph is represented by- 15

i) Adjacency list

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b. Consider a weighted mixed graph G as shown in the following figure. 3+4+4+4 =15

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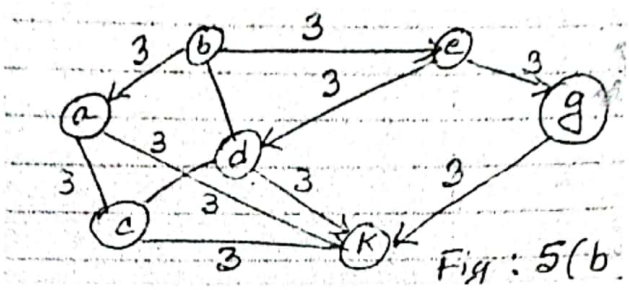

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b. Write down the algorithm for computing Fibonacci Numbers by Recursion. "Computing Fibonacci Numbers can be done by dynamic programming with linear time complexity." – Justify the statement with proper examples. **15**

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BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Short Term Final Examination (Improvement): Jan 2020

Subject: CSE 203, Data Structure & Algorithm I

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

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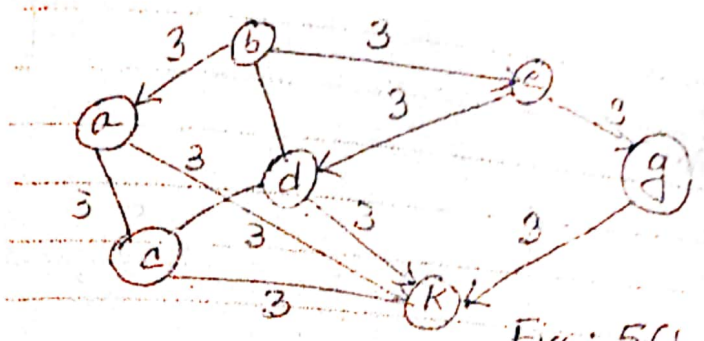

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BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Short Term Final Examination (Improvement): Jan 2020

Subject: Math 143, Mathematics II (ODE, PDE & Coordinate Geometry)

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

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SECTION-A

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BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Student Group : 0 < Earned Credit Hour <= 36, Final Examination (Spring) :Feb 2021

Subject: CSE-203, Data Structures

Total: 2.00 hours
Section A : 1.00 hour

Full Marks:180
Section A : 90

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 1 and Question – 4 (Viva Voce)** in **Section A** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 2 & Q - 3)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1 (Compulsory)

a. Write down the two versions of binary search algorithm. **10**

b. Discuss presumed optimal solution for Multipeg tower of Hanoi with properties. **10**

c. Write down the quicksort algorithm. Use partition algorithm for finding the smallest 5 values of the array 6,1,7,2,8,3,9,4,10,5,11,17,4,5 showing every step. **10**

Question – 2

a. Simulate binary search algorithm on the array 2,3,5,6,8,10,12,15,20,21,23 in finding 1,6,23,24 by drawing tables containing values low, high and mid. **15**

b. Given a directed graph G, both BFS and DFS from a particular starting vertex 'S' will traverse the same set of vertices. Do you agree with this statement? Justify your answer. **15**

Question – 3

a. Write down the mergesort algorithm. Simulate it using the data of Q-(1c). **15**

b. Construct a maxheap with data from Q-2(b) by insertion and adjustment. Show changes in values in the right side of the node. Carry out the complexity analysis for both the algorithms. **15**

30

Question – 4 (Compulsory)
Marks allotted for Viva 30

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Student Group : 0 < Earned Credit Hour <= 36, Final Examination (Spring) :Feb 2021

Subject: CSE 203, Data Structures

Total: 2.00 hours
Section B : 1.00 hour

Full Marks:180
Section B : 90

INSTRUCTIONS:

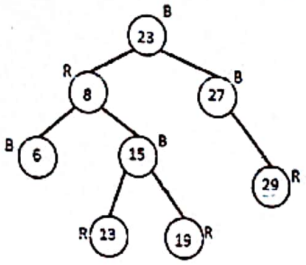
a. Use **SEPARATE** answer scripts for each section.
b. **Question – 5 and Question – 8 (Viva Voce)** in **Section B** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 6 & Q - 7)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-B

Question – 5 **(Compulsory)**

a. Prove that a tree with n nodes and the property that the heights of the two children of any node differ by at most 1 has O(logn) height. **15**

b. Insert 11 into the Red Black tree shown below. You have to show each operation. The red and black nodes are indicated by 'R' & 'B'. **15**



Question – 6

a. Mention the running times of the following operations for both Binomial heap and Fibonacci heap. **15**

(i) Input key
(ii) Find min
(iii) Extract min
(iv) Union of two heaps
(v) Decrease key

b. One of your friends claim to have designed a mergeable heap let which takes O(1) time for each of the operation mentioned at Q-6(a). Would you believe it? Justify your answer. **15**

Question – 7

a. What is the main objective of splay trees? Do splay trees explicitly try to balance the height? **10**

b. What is meant by "maximally damaged tree" in the concept of Fibonacci heaps? **10**

c. Draw the maximally damaged tree of order 5 (that means the degree of the root is 5. **10**

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Computer Science and Engineering
Student Group : 36 < Earned Credit Hour <= 72, Final Examination (Spring): Feb 2021

Subject: CSE-203, Data Structures and Algorithms - I

Total: 2.00 hours
Section A: 1.00 hour

Full Marks: 180
Section A : 90

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 1 and Question – 4 (Viva Voce)** in **Section A** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 2 & Q - 3)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1 (Compulsory)

a. Find the time complexity of the below mentioned codes. Justify your answers by tracing the code.

(i)
```
void function (int n)
{
    int count = 0;
    for (int i = n/2; i <= n ; i++)
        for (int j = 1; j <= n; j = 2*j)
            for (int k = 1; k <= n; k = k*2)
                count++;
}
```
08

(ii)
```
void function (int n)
{
    int count = 0;
    for (int i = 0; i < n ; i++)
        for (int j = i; j < i*i; j = j++)
        {
            if (j%i == 0)
            {
                for (int k = 0; k <= j; k++)
                    printf("*");
            }
        }
}
```
07

b. Given a string containing opening and closing braces, check if it represents a balance equation. Use suitable data structure and give a pseudo code to solve the problem. Also provide the time complexity of the pseudo code you have used. 15

For example: [{( ) ( )}] is a balanced expression and [ ] { () is not a balanced expression.

Question – 2 15

a. Give the pseudo code and time complexity of enqueue and dequeue operation in circular queue.

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering

Student Group: 36 < Earned Credit Hour <= 72, Final Examination (Spring): Feb 2021

Subject: CSE-203, Data Structures and Algorithms - I

Total: 2.00 hours
Section B: 1.00 hour

Full Marks: 180
Section B : 90

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 5 and Question – 8 (Viva Voce)** in **Section B** are compulsory.
c. Answer any **OTHER ONE** question from this section**(From Q - 6 & Q - 7)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-B

Question – 5 **(Compulsory)**

a. Given a directed graph G, both BFS and DFS from a particular starting vertex 'S' will transfer the same set of vertices. Do you agree with this statement? Justify your answer. **15**

b. Simulate binary search algorithm on the array 2, 3, 5, 6, 8, 10, 12, 15, 20, 21, 23 in finding 1, 6, 23, 24 by drawing tables containing values low, high and mid. **15**

Question – 6

a. Write down the mergesort algorithm. Simulate it using data of Q-5(b). Show the recursion tree formed and label the nodes serially as per order of creation. **15**

b. Prove how the time complexity of Quicksort algorithm can be achieved better in worst case. Show with simulation. **15**

Question – 7

a. Give pseudocode of BFS and DFS algorithms. **20**

b. Compare with the help of a matrix between bubble, insertion, selection, merge and quick sort. It should mention the time complexity and applications. **10**

30

Question – 8 **(Compulsory)**
Marks allotted for Viva 30

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Computer Science and Engineering
Student Group : 36 < Earned Credit Hour <= 72, FinalExamination (Spring) :Feb 2021

Subject: CSE-205, Object Oriented Programming

Total: 2.00 hours
Section A: 1.00 hour

Full Marks:180
Section A : 90

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 1 and Question – 4 (Viva Voce)** in **Section A** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 2 & Q - 3)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1 (Compulsory)

a. Briefly explain the main features of Object Oriented Programming. **07**

b. Identify and state the errors in the code snippet given in Figure 1(b). Modify and rewrite the program to make it error free. (Do not change the main function and keep the member variables of the class as private. Modify the other parts of the code to make it correct for the two statements in main function.) **08**

```
#include<iostream>
using namespace std;
class Student{

  int ID;
  string name;
  double cgpa;

  void Student(int i, string n, double c){
    ID = i;
    name = n;
cgpa = c;
  }
};

void Show(Student ob){
cout<<"Student Details"<<endl;
cout<<ob.ID<<endl;
cout<<ob.name<<endl;
cout<<ob.cgpa<<endl;
}

int main(){
  Student ob1(28,"Tariquel", 4.00),ob2;
  show(ob1);
}
```

Code Snippet: 1b

Figure: 1(b)

c. Build a class called **BOX** whose constructor function is passed with **three double** values, each of which represents the length of on side of the box. Write a program to compute the volume of the box using **10**

the constructor and store the result in a variable.

Include a member function called **displayVol( )** that displays the volume of each box object created in the main function. Create multiple objects in the main function to demonstrate the output of your program.

d. Explain why static member functions do not have **"this"** pointer with an example. 05

Question – 2

a. Why is it necessary to define a destructor in a program? Explain with proper example. 08

b. "Default argument sometimes provide a simple alternative to function overloading" – Justify the statement with appropriate example. 10

c. Assignment operator (=) by default performs a bitwise copy of one operand to the other. Write a program where such copying creates unexpected results. 12

Extend your code to show how this problem can be solved.

Question – 3

a. What is an exception? Briefly explain how try, catch and throw work together to provide exception handling in C++ with an example. 2+8=10

b. What are the advantages of new and delete over **malloc( )** and **free( )** ? 05

c. Create a generic class that implements a Stack. Memory required for the stack must be allocated dynamically according to the size that will be passed as an argument to the constructor. Implement suitable operations to **push** and **pop** elements into the stack. 15

Add error checking inside the functions of your **'Stack'** class in an appropriate place using C++ exception handling.

Question – 4 **(Compulsory)** 30

Marks allotted for Viva 30

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Computer Science and Engineering
Student Group :36 < Earned Credit Hour <= 72, Final Examination (Spring) :Feb 2021

Subject: CSE-205, Object Oriented Programming

Total: 2.00 hours **Full Marks: 180**
Section B: 1.00 hour **Section B : 90**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 5 and Question – 8 (Viva Voce)** in **Section B** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 6 & Q - 7)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-B

Question – 5 (Compulsory)

a. Briefly explain the importance of inheritance in object oriented programming. **08**

b. How is inheritance in Structure different from inheritance in class? **07**

c. A simple fraction consists of two integers. The one above the line is called numerator and the one below the line is called denominator. Design a class named 'Fraction' that will hold these two integers. Now perform the following operations given below: **15**
(i) Overload the binary (+) operator. It will allow two fraction objects to be summed up into a new fraction.

(ii) Overload the postfix increment (++) operator. It will add 1 to the operand fraction and also return the resultant fraction.

(iii) Overload the tilde (~) operator. It will invert the fraction, i.e, numerator and denominator will be swapped.

Question – 6

a. Write short notes on the following: **3*5=15**
(i) Object Slicing

(ii) Delegate function

(iii) Virtual destructor

(iv) Interface

(v) Run time type Identification

b. How is function overriding different from function overloading? Demonstrate how the visibility of a variable can be changed from public to private in derived class using public inheritance using C++ code. **15**

Question – 7

a. Consider the following scenario. Parallelogram is a Quadrilateral, Rhombus is a parallelogram, Rectangle is also a parallelogram, Square is both Rhombus and Parallelogram. In this scenario there **15**

are five classes mentioned.

(i) Draw the class hierarchy.

(ii) Explain how the diamond problem can be solved. Write the correctness declaration for each class in C++ code.

(iii) Write the constructor and destructor call sequence.

b. Demonstrate the usage of virtual destructor in C++. Give a code example.

c. Consider a base class where three virtual functions f1( ), f2( ) and f3( ) are defined.

Derived1 class derived from base class where f1( ) and f2( ) are overridden. Derived2 class is also derived from base class where f1( ) and f3( ) are overridden.

Demonstrate the above scenario using C++ code.

Question – 8 (Compulsory)

Marks allotted for Viva 30

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Computer Science Engineering
Student Group : 36<Earned Credit Hour<=72, Final Examination (Spring) : Feb 2021

Subject: EECE 269, Electrical Drives and Instrumentation

Total: 2.00 hours **Full Marks: 180**
Section A : 1.00 hour **Section A : 90**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 1 and Question – 4 (Viva Voce)** in **Section A** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 2 & Q - 3)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1 (Compulsory)

a. Derive the expression for the r.m.s values of E.M.F of a transformer. Also, show that ratio of primary current to the secondary current of a transformer at full load condition is constant and is expressed by the equation **12**

$$\frac{I_2}{I_1} = \frac{N_1}{N_2} = \frac{V_1}{V_2} = constant$$

b. Briefly explain the efficiency of a transformer and hence derive the condition for maximum efficiency. **08**

c. A single phase transformer has (400+A) primary and (1000+B) secondary turns, where A and B are last digit and last but one digit of your exam roll number. The net-cross section area of the core is 60 cm^2. If the primary winding is connected to a 50 Hz supply at 520 V, calculate: **10**
   (i) The voltage induced in the secondary winding.
   (ii) The peak value of the flux density in the core.

Question – 2

a. For proper synchronization of alternators few conditions must be satisfied. List those conditions. **06**

b. Show that the alternator induced voltage per phase is 4.44 $K_c K_d$ f Φ T where symbols have their usual meaning. **14**

c. A 4-pole, 3-phase, 50-Hz star-connected alternator has 60 slots, with 4 conductors per slot. Coils are short-pitched by 3 slots. If the phase spread is 60^0, find the line voltage induced for a flux per pole of 0.943 Wb distributed sinusoidally in space. All the turns per phase are in series. **10**

Question – 3

a. Show that the torque developed by the armature of a DC, motor can be expressed by the equation

$$T_a = 0.159\,\Phi\, Z\, I_a \times \frac{P}{A}\ N-m$$

where, the symbols have their usual meaning

b. Explain the significance of back E.M.F in case of a DC motor. Also, show that speed of a DC motor is directly proportional to the back E.M.F. and inversely proportional to the flux.

c. A DC motor takes an armature current of 110 A at 480 V. The armature circuit resistance is 0.2 Ω. The machine has 6-pole and the armature is lap-connected with 864 conductors. The flux per pole is 0.05 Wb. Calculate-

(i) the speed and

(ii) the gross torque developed by the armature.

Question – 4 (Compulsory)

Marks allotted for Viva 30

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science Engineering
Student Group : 36<Earned Credit Hour<=72, Final Examination (Spring) : Feb 2021

Subject: EECE 269, Electrical Drives and Instrumentation

Total: 2.00 hours **Full Marks: 180**
Section B : 1.00 hour **Section B : 90**

INSTRUCTIONS:

a. **Use SEPARATE** answer scripts for each section.
b. **Question – 5 and Question – 8 (Viva Voce)** in **Section B** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 6 & Q - 7)**.
d. Figures in the margin indicate full marks.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.
g. **Assume: X = Last digit of your exam roll number.**
Y = Second last digit of your exam roll number.

SECTION-B

Question – 5 (Compulsory)

a. Define SNR. Explain Johnson, Shot and Pink noise. **05**

b. Differentiate accuracy and precision in the electrical measurement system. **05**

c. Derive the following noise voltage equation for a noise generator where k is known as Boltzmann constant. **10**

$$E_n = 2\sqrt{R_n \cdot k \cdot T \cdot \Delta f}$$

d. Strain Gauges are used to measure pressure. In a common configuration, one strain gauge is active and other is dummy. These strain gauges form the opposite arms of a Wheat-stone Bridge. The other two arms are formed by equal resistance of 120 Ω each at 300 k. The frequency bandwidth is 100 kHz. The output of the bridge is voltage signal. Analyze the following cases: **10**

(i) When the pressure of 70XY kN/m^2 is applied, the output voltage is 0.1X mV. Determine the ratio of the output voltage to the noise voltage generated by the resistors.

(ii) Calculate the ratio of output voltage to noise voltage if the applied pressure is 7 kN/m^2.

(iii) Compare above two results and comment. The Boltzmann constant is 1.38×10^{-23} J/K.

Question – 6

a. Illustrate the digital data acquisition system. **05**

b. Discuss the applications of thermistor in electrical measurement system. **05**

c. Explain piezo-resistive effect of a transducer. Derive the equation of Gauge factor G_f of strain gauge

$$G_f = 1 + 2\nu$$

Where, ν is the Poisson's ratio

d. A resistance wire strain gauge with a gauge factor of 2 is bonded to a steel structural member subjected to a stress of $1XY\ MN/m^2$. The modulus of elasticity of steel is 200 GN/m^2.

(i) Calculate the poisson's ratio.
(ii) Determine the percentage change in the value of the gauge resistance due to applied stress.

Question – 7

a. Describe the elements of signal conditioning system. 0

b. Write short notes on LCD and LED display. 0

c. Explain the operating principle of an instrumentation amplifier and derive the equation of differential gain G_d using necessary circuit diagram. 1

d. A balanced output source provides a signal of 3X mV for a differential amplifier. The noise signal is common to both terminals is 6XY mV. The differential gain of the amplifier is 150, while the common mode gain is 0.04. Determine the ratio of signal to noise at the output. 1

Question – 8 (Compulsory) 3

Marks allotted for Viva 30

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Computer Science and Engineering
Student Group : 0< Earned Credit Hour <= 36, Final Examination (Fall) :Dec 2020

Subject: MATH-143 : Mathematics-II(ODE, PDE & Coordinate Geometry)

Total: 2.00 hours
Section A : 1.00 hour

Full Marks:100
Section A : 90

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 1 and Question – 4 (Viva Voce)** in **Section A** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 2 & Q - 3)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1 (Compulsory)

a. Define differential equation. Form the differential equation whose solution is $y = A\cos\beta x + B\sin\beta x$ where A and B are arbitrary constants and β is fixed constant. Also find the degree and order of the obtained equation. **2+8+4**

b. Solve: (Any one) **10**
   (i) $\ln\left(\frac{dx}{dy}\right) = ax + by.$
   (ii) $(2\cos x + 3\sin x)dy = (3\cos x + 2\sin x)dx.$
   (iii) $(4x - y + 7)dx = (2x + y - 1)dy.$

c. Define exact differential equation. Show that **2+10**
$(x^2 - ay)dx + (y^2 - ax)dy = 0$ is an exact differential equation. Hence solve it.

Question – 2

a. Solve: $\frac{dy}{dx} + x\sin 2y = x\cos^2 y.$ **12**

b. Determine the general solution of the following equations: (Any two) **12 × 2**
   (i) $(D^2 - 4D + 6)y = 0.$
   (ii) $(D^2 - 4D + 4)y = e^{3x} + x^2.$
   (iii) $(D^2 - 2D + 5)y = e^{2x}\sin x.$

Question – 3

a. Discuss about Lagrange's auxiliary equation. Using this demonstrate $p + 5q = 7z + \tan(y - 5z)$. **12**

b. Find complete and singular integral of $(p^2 + q^2)y = qz$ using Charpit's method. **12**

c. Solve: (Any one) **12**
   (i) $r = \sin xy + c.$
   (ii) $3xys = 3.$

Question – 4 Viva Voce(Compulsory) **18**

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science Engineering
Student Group : 36 < Earned Credit Hour <= 72, Final Examination (Fall) ;Dec 2020

Subject: CSE-217, Theory of Computation

Total: 2.00 hours
Section A: 1.00 hour

Full Marks: 180
Section A: 90

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 1 and Question – 4 (Viva Voce)** in **Section A** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 2 & Q - 3)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1 (Compulsory)

a. Design a DFA with alphabet $\sum = \{0, 1, 2, R\}$ which recognize the language A, the set of all strings where the sum of symbols is multiple of 3, except that the sum is reset to 0 whenever the symbol R appears. Write down the formal description of the DFA you designed. **10**

b. Make an alphabet set containing all the digits in your student ID. Now draw the state diagram of NFAs to accept the following languages. **8+8**

(i) The set of all strings such as the final symbol in the string has appeared before.
(ii) The set of all strings such as the final symbol in the string has not appeared before.

c. Consider the NFAZ given in figure 1(c). **10**

	a	b	c	ε
→ p	{p}	{q}	{r}	φ
q	{q}	{r}	φ	{p}
* r	{r}	φ	{p}	{q}

Figure: 1(c)

Convert the automaton to an equivalent DFA. Give the state diagram of this DFA with only the reachable states from the start state.

Question – 2

a. Construct an NFA over the alphabet $\sum = \{0, 1\}$ that accepts the set of string which contains an even number of occurrences of substring '01'. Now convert the NFA to an equivalent DFA. Show only the portion of the DFA in state diagram which is reachable from the start state. **8+10**

b. Write down the regular expression for the followings. **6+6+6**

(i) Set of strings consisting of alternating 0's and 1's.
(ii) Binary strings consisting of either an odd number of 0's (and any number of 1's) or an odd number of 1's (and any number of 0's).

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Computer Science Engineering
Student Group : 36 < Earned Credit Hour <= 72, Final Examination (Fall) :Dec 2020

Subject: CSE-217, Theory of Computation

Total: 2.00 hours **Full Marks: 180**
Section B: 1.00 hour **Section B : 90**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 5 and Question – 8 (Viva Voce)** in **Section B** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 6 & Q - 7)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-B

Question – 5 (Compulsory)

a. Design a Turing Machine (TM) M1 for the language $A = \{0^{3^n} | n \geq 0\}$ which means the language consisting of all strings of 0's whose length is a power of 3. **16**

b. Write down all the sequence of configurations that M1 enters when started on the input string "000000000" (9 zeros) to reach accept configuration. **10**

c. Consider the pushdown automaton shown in figure – 5(c). Now design an equivalent context-free grammar (CFG) for that. You must have to show for which case, you are adding a rule in the equivalent CFG. **10**

Question – 6

a. Design context-free grammar (CFG) for each of the following languages and justify your answer. **3x9=27**

i. $B = \{w | w \text{ contains at least } p \text{ number of } 1's\}$, $\sum = \{0,1\}$ where $p = \left\lfloor \frac{\text{last digit of your exam roll}}{3} \right\rfloor + 2$

ii. C = {w | w starts and ends with the different symbol over the alphabet {0,1}}

iii. $D = \{w \in \{a,b\}^* | \text{ where } n_a(w) = 2 \times n_b(w)\}$ where, $n_a(w)$ means number of a's and $n_b(w)$ means number of b's in the string w.

b. Write a short note on the variants of Turing Machine (TM). **09**

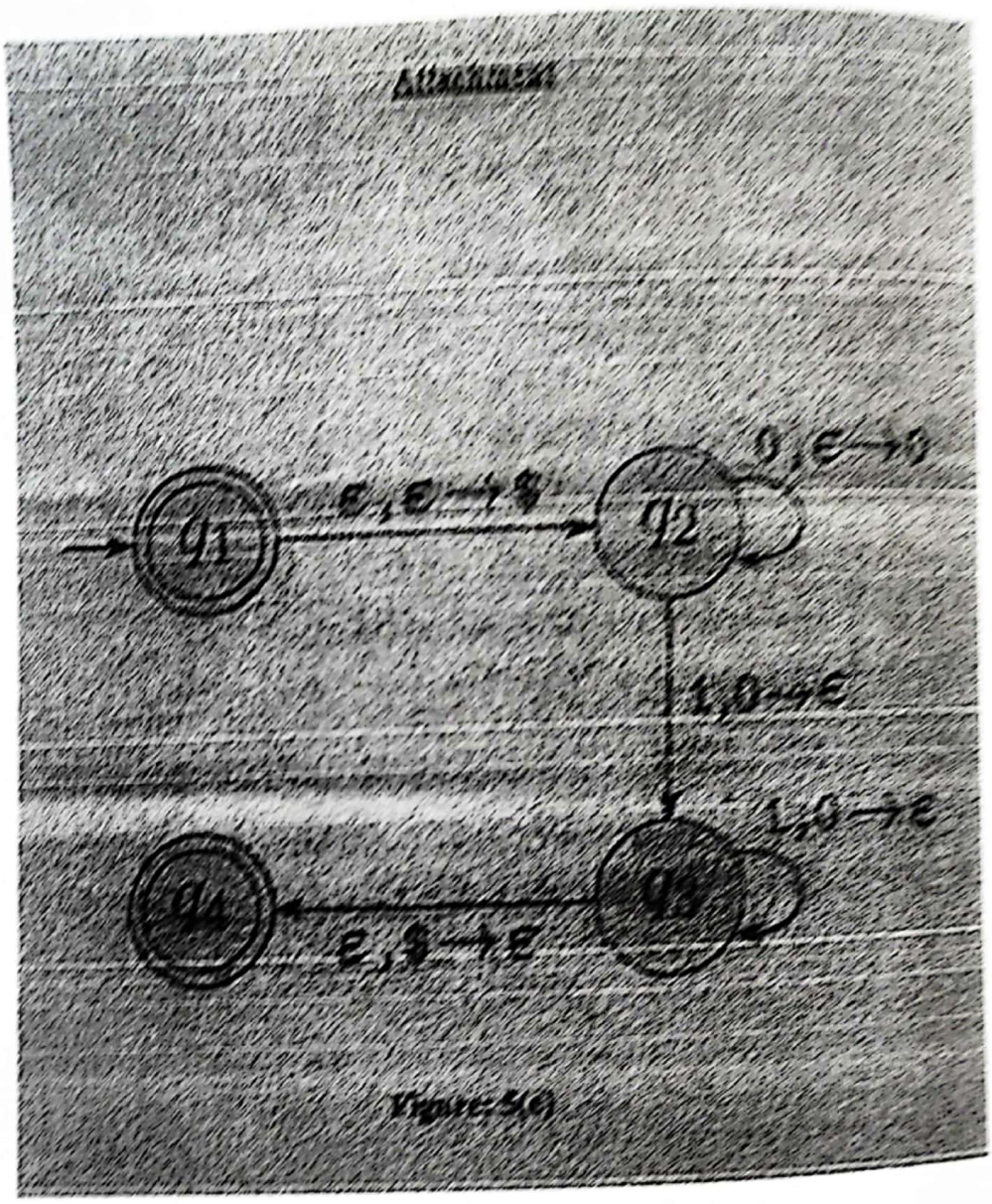
Question – 7

a. Design a Pushdown Automaton (only the state diagram) for the language $E = \{0^{2n}1^{5n} | n \geq 0\}$ over the alphabet {0,1}. **16**

b. Write down a high-level description of a Turing Machine for the language $F = \{w | w \in \{0,1\} \text{and } w \text{ is palindrome}\}$. **10**

c. Using pumping lemma for non-context-free language, proof whether the language, $H = \{0^i\#j1^k | 0 \leq i \leq j \leq k\}$, is context free or not. **10**

Question – 8 Viva Voce(Compulsory) **18**


Attachment
q_1
q_2
q_3
q_4
$\varepsilon, \varepsilon \to \$$
$0, \varepsilon \to 0$
$1, 0 \to \varepsilon$
$1, 0 \to \varepsilon$
$\varepsilon, \$ \to \varepsilon$
Figure 5.9

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science Engineering
Student Group : 36 < Earned Credit Hour <= 72, Final Examination (Fall) : Dec 2020

Subject: MATH-247, Complex Variable and Laplace Transform

Total: 2.00 hours
Section B : 1.00 hour

Full Marks: 180
Section B : 90

INSTRUCTIONS:

a. Use SEPARATE answer scripts for each section.
b. Question – 5 and Question – 8 (Viva Voce) in Section B are compulsory.
c. Answer any OTHER ONE question from this section (From Q - 6 & Q - 7).
d. Figures in the margin indicate full marks.
e. Assume reasonable data if necessary.
f. Symbols used have their usual meanings.

SECTION-B

Question – 5 (Compulsory)

a. Define Laplace Transform. If $\mathcal{L}\{F(t)\} = f(s)$ and 08

$$G(t) = \begin{cases} 0 & , t < a \\ F(t-a) & , t > a \end{cases}$$

Then show that , $\mathcal{L}\{G(t)\} = e^{-as} f(s)$.

b. Evaluate 10X2=20

(i) $\int_0^\infty e^{-t} erf(\sqrt{t})\, dt$

(ii) $\mathcal{L}\left\{\frac{\cos\sqrt{t}}{\sqrt{t}}\right\}$

c. If $\mathcal{L}\{F(t)\} = f(s)$ then show that $\mathcal{L}\left\{\int_0^t \frac{1-e^{-u}}{u} du\right\} = \frac{1}{s}\ln\left(1+\frac{1}{s}\right)$ using 08
Laplace Transform of integrals.

Question – 6

a. State the first translation or shifting property for inverse Laplace Transform. Use this property show that 10

$$\mathcal{L}^{-1}\left\{\frac{3s+7}{s^2-2s-3}\right\} = 4e^{3t} - e^{-t}.$$

b. Evaluate 8X2=16

(i) $\mathcal{L}^{-1}\left\{\frac{1}{s^3(s^2+1)}\right\}$

(ii) $\mathcal{L}^{-1}\left\{\frac{1}{s}\ln\left(1+\frac{1}{s^2}\right)\right\}$

c. State Convolution theorem . Use this theorem to find 10

$$\mathcal{L}^{-1}\left\{\frac{s}{(s^2+a^2)^2}\right\}.$$

Question – 7

a. Solve $Y''+9Y=\cos 2t$ if $Y(0)=1$, $Y\left(\frac{\pi}{2}\right)=-1$ using Laplace Transform.

8X2=

b. Show that

(i) $\mathcal{L}\left\{\frac{\partial^2 U}{\partial t^2}\right\}=s^2U(x,s)-sU(x,0)-U_t(x,0)$

(ii) $\mathcal{L}\left\{\frac{\partial^2 U}{\partial x^2}\right\}=\frac{\partial^2 u}{\partial x^2}$.

Question – 8 Viva Voce (Compulsory)

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Student Group : 36 < Earned Credit Hour <= 72, Final Examination (Fall) : Dec 2020

Subject: CSE-215, Algorithms

Total: 2.00 hours
Section A : 1.00 hour

Full Marks: 180
Section A : 90

INSTRUCTIONS:

a. Use SEPARATE answer scripts for each section.
b. **Question – 1 and Question – 4 (Viva Voce)** in **Section A** are compulsory.
c. Answer any **ONE** question from this section **(From Q - 2 & Q - 3)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-A

Question – 1 **(Compulsory)**

Consider the following pseudocode:

```
Test(n)
{
    If(n>1)
    {
        printf(n)
        Test (n/2)
    }
}
```

a. Find the recurrence relation of the above code. 2

b. Find the time complexity of the above code by using the recurrence free method. 7

c. Find the time complexity of the above code by substitution method. 7

d. State the Master's theorem for decreasing functions. 8

e. In naïve string matching algorithm the time complexity to search a specific pattern of length 'm' in string of length 'n' is O(mn). 12

Justify how the time complexity changes to O (m+n) by using KMP algorithm.

Question – 2

a. Compare the key properties of problems that can be solved by greedy method, divide and conquer method and dynamic programming method. 10

b. Find the correctness of Kruskal's algorithm that computes a minimum spanning tree of a weighted graph. 10

c. Find an optimal solution to the 0/1 knapsack instance of n=4, w=6, $(V_1,V_2,V_3,V_4) = (50,30,12,45)$ and $(W_1,W_2,W_3,W_4) = (2,3,1,3)$ using dynamic programming method. 16

Question – 3

a. Write the Bellman Ford algorithm for finding shortest paths in a directed weighted graph. Prove the time complexity and correctness of the algorithm. 16

b. Consider a positive integer n as Your_ID%100. Insert the following values sequentially in a max-heap and show the state of the heap after each insertion: 20

0 20 10 90 n 25 -10

Now sort the heap in ascending order and show the states of the array after each deletion.

Question – 4 Viva Voce (Compulsory) 18

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Student Group : 36 < Earned Credit Hour <= 72, Final Examination (Fall) : Dec 2020

Subject: CSE-215, Algorithms

Total: 2.00 hours **Full Marks: 180**
Section B: 1.00 hour **Section B: 90**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question – 5 and Question – 8 (Viva Voce)** in **Section B** are compulsory.
c. Answer any **OTHER ONE** question from this section **(From Q - 6 & Q - 7)**.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** used have their usual meanings.

SECTION-B

Question – 5 (Compulsory)

a. Write the Dijkstra's algorithm for finding the shortest paths in a directed weighted graph. Show by an example the Dijkstra's algorithm gives wrong answer for a graph with negative weights. **16**

b. Using dynamic programming compute the minimum number of scalar multiplication for the matrix chain multiplication of $A_1 A_2 A_3 A_4 A_5$ with dimensions 15x50, 50x20, 20x10, 10x35, 35x25 respectively. **20**

Also show the ordering of the matrices for the derived minimum number of scalar multiplication.

Question – 6

a. Compute the Π- table using KMP algorithm for the following patterns: **10**

(i) a a a a b a a c d
(ii) a a a a a a a a b
(iii) a a b c a d a a b c
(iv) a b c d c a b f a b c

b. Consider **20**

X = "STONE"
Y = "LONGEST"

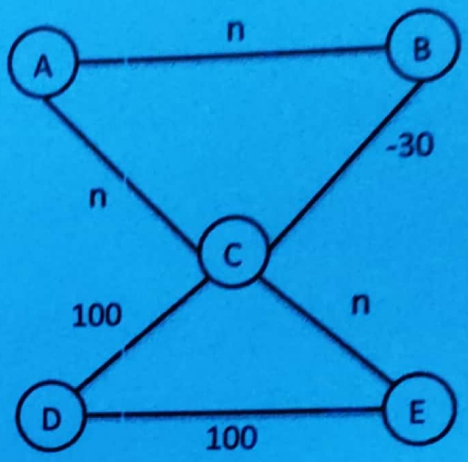
Find all the longest common subsequences of X and Y using dynamic programming method. Show necessary tables for calculation.

c. Convert the following complete binary tree from its array representation to its linked list representation. **6**

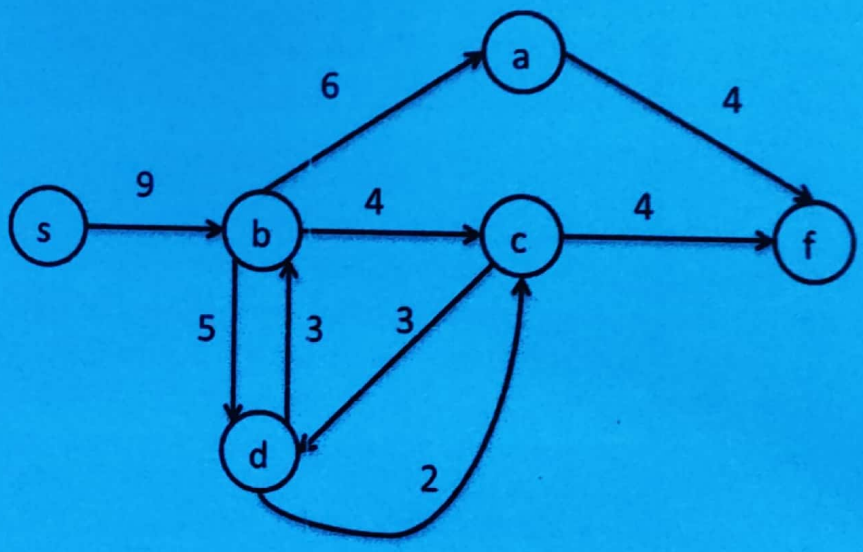
.	4	9	1	0	1	0	0	2	1
0	1	2	3	4	5	6	7	8	9

Question – 7

a. Consider a positive integer n as your_ID%100. For example, if your_ID = 201514010, then n=10. Now find out all the minimum spanning trees of the following graph. Show necessary steps and figures for calculating the minimum spanning trees. **18**



b. Find the values of the maximum flow for the following flow network using Ford-Fulkerson algorithm. You must show the residual network and identify the augmenting path at each step of the calculation.



Question – 8 Viva Voce (Compulsory)

18

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Supplementary Examination: July 2019 [Improvement]

Subject:CSE-217, Theory of Computation

Time: 3.00 hours **Full Marks: 210**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks**.
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. State and prove pumping lemma for regular language. **15**

b. Using pumping lemma prove whether Language $\{w \mid w \in \{0,1\}^*\}$ is regular or not. **10**

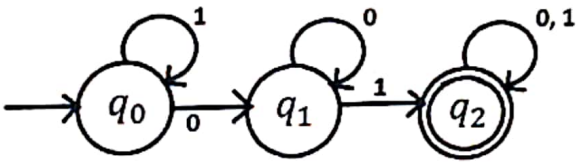
c. Prove that, $\Sigma^* = \Sigma^+ \cup \{\in\}$ **10**

Question – 2

a. Define and explain the formal definition of a Deterministic Finite Automata. **07**

b. Construct DFA for each of the following Language: **2x10=20**
   i) $L_1=\{w \mid w$ has "1001" at any place over the alphabet $\{0, 1\}\}$
   ii) $L_2=\{w \mid w$ has both an even number of 0's and an even number of 1's over the alphabet $\{0, 1\}\}$

c. Prove that the string "10100" is a valid string of the following DFA. **08**



Question – 3

a. Design an Nondeterministic Finite Automaton (NFA) for the following Language describing 5-tuples: **10**
L={w | w ends in "abb" over the alphabet {a, b}}

b. Draw transition diagram of an NFA for the following transition table. Convert the NFA to an equivalent DFA showing necessary table and diagrams. **25**

	0	1
→ p	{p, q}	{p}
q	{r}	{r}
r	{s}	Φ
*s	{s}	{s}

Question – 4

a. Write regular expression for each of the following Language over the alphabet {0, 1}.
   i) L_1= {w | w is a string of even length}.
   ii) L_2= {w | every 0 in w is followed}
   iii) L_3= {w | w starts and ends with the same symbol}
   iv) L_4= {w | w contains a single 1}

b. Prove that, "The class of regular Languages is closed under the union operation".

SECTION-B

Question – 5

a. Design CFG for each of the following languages:
   i) {w}w contains 10010 as substring}
   ii) $\{p^i q^j r^k \mid i=j \text{ or } j=k \text{ where } i, j, k \geq 0\}$

b. Determine whether the following grammar is ambiguous or not by using derivation tree for the string "a + a * a". Justify your answer.
E→E+ E| E* E| E| a

c. Find out the leftmost derivation for input string "111*000" by using following CFG:
Q→ 1Q0
Q→ R
R→ *

Question –6

a. Briefly explain the formal definition of pushdown automata. What are the differences between Turing machine and Pushdown automaton?

b. Construct pushdown automaton for each of the following languages:
   i) $\{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i=j \text{ or } i=k\}$
   ii) $\{a^m b^m c^r \mid \text{where } m, n, r \geq 0 \text{ and } r=n+m\}$

Question –7

a. What is a Turing machine? Explain with an example how a Turing machine performs its computation.

b. Design a Turing machine that recognizes the following language:
$\{w \divideontimes w \mid w \in \{0, 1\}^*\}$

c. Give formal definition of a Turing machine.

Question–8

a. Prove that "Any context-free language is generated by a context-free grammar in Chomsky normal form." **10**

b. Design a PDA that recognizes the language $\{1^{2n}0^{3n} \mid n \geq 1\}$. Depict the automation using state diagram as well as mathematical representation including transition table. **20**

c. Construct CFG for the following language: **05**
{w | w is a string of balanced parenthesis}

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Supplementary Examination:July 2019

Subject: CSE-203, Data Structure

Time: 3.00 hours

Full Marks: 210

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks.**
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. What is data structure? Write down the differences between linear and nonlinear data-structures. **10**

b. Sort the following array elements in ascending order using Bubble sort algorithm. Write all passes those are needed to sort the array elements – 7, 1, 5, 2, 4. **10+5=15**
What are the best case, average case and worst case complexity of this algorithm?

c. Analyze complexity for the following algorithm. **10**
Algorithm:

```
sum = 0
for ( i=0; i<n; i++ )
    for ( j=0; j<n; j++ )
        sum = sum + arr [ i ] [ j ]
```

Question – 2

a. Write down the merits and demerits of a linked list over an array. **10**

b. Discuss the "insert" operation of a single linked list. Give illustrative examples for: **15**
   i) Insert first
   ii) Insert anywhere
   iii) Insert last

c. Assume that both Head and Tail pointers are given for a single linked list containing n elements. Then write a function that sorts the elements in the list in ascending order. **10**

Question – 3

a. 'Is stack a linear data structure' – justify your answer. Give some real life example of stack. **5+5=10**

b. Write two functions for push and pop operations of a stack that is implemented by using an array. **10**

c. What are the differences between FIFO Queue and Priority Queue? Give proper examples. **07**

d) Write down the properties and parameters of an array. **08**

Question – 4

a. What is a proper binary tree? Write the properties of a proper binary tree with a figure.

b. Construct a binary tree whose preorder and inorder traversals are given as:
Preorder: a h i g j k l m n b c e d f p o q
Inorder: i h j k m l n g a b c f o p q d e

c. Let T be a proper binary tree with height h. Prove that-
   i) The number of external leaves in T is at least h+1 and at most 2^h.
   ii) The number of internal nodes in T is at least h and at most $2^h - 1$.

SECTION-B

Question – 5

a. Write the principal of "Divide-and-Conquer" technique. Write down the "Merge sort algorithm" 2+8

b. Analyze the best-case, average-case and worst-case **time complexity** of the "Merge Sort" algorithm.

c. Build a "Max-Heap" from the array **A** given below and show all the steps with necessary diagrams.

A = { 13, 20, 11, 5, 41, 27, 7, 4, 36, 39 }

Question –6

a. What is a "Binary Search Tree" (BST)? Write down the **properties and advantages** of a BST. 2+4

b. Explain the three cases of the **deletion** operation in a BST with illustrative examples.

c. What is "Collision" in the context of **Hashing**? Explain how collisions are resolved by **chained linked-lists** and **open addressing.**

Question –7

a. What are the basic operations of a **Max-Priority Queue**? Write an algorithm for building a **Min-heap**.

b. Sort the following array of numbers step-by-step using **"Quick Sort"** algorithm.

{ 35, 1 , 7, 20, 5, 15, 11, 22, 17 }

c. Show the expected space used by a skip list with n entries is O(n). Draw the skip list for the following table (Table 7(c)) that shows the keys and consecutive numbers of the heads found in toss while inserting the keys in the skip list.

Key	17	5	26	11	33	9	19	14	27.	2
No. of Consecutive Heads	2	0	4	3	5	1	3	4	3	2

Table 7(c)

Question–8

a. Explain whether "Heap" and "binary Search Tree" are always complete binary trees or not. 5

b. Define Complete graph and Spanning Subgraph. Prove, that, if G is a connected undirected graph with **n** vertices and **m** edges then **m ≥ n-1** 4+6 = 10

c. Consider the graph G in Figure 8(c) and answer the following questions: 4×5 = 20

i) Draw the **adjacency matrix and adjacency list.**
ii) Write the sequence of vertices if you explore the graph G starting from vertex **"A"** using **BFS.**
iii) Considering "S" as source vertex, draw the **DFS forest** for graph G.
iv) Find out the tree edge, back edge, forward edge and cross edge of the graph G.

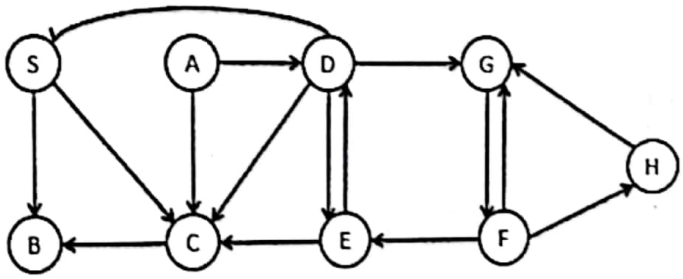


Figure 8(c)

SECTION-B

Question – 5

a. Define Laplace transform.

b. Find $\mathcal{L}\{3t^4 + 4e^{-5t} - 2Sin5t + 3cos2t\}$

c. Show that $\mathcal{L}\{t^2 Sint\} = \frac{6s^2-2}{(s^2+1)^3}$

Question –6

a. Find $\mathcal{L}^{-1}\left\{\frac{5s+4}{s^3} - \frac{2s-18}{s^2+9} + \frac{24-30\sqrt{s}}{s^4}\right\}$

b. Use partial fraction to find $\mathcal{L}^{-1}\left\{\frac{s^2-3}{(s+2)(s-3)(s^2+2s+5)}\right\}$

c. Evaluate $\mathcal{L}^{-1}\left\{\frac{1}{(s+3)(s-1)}\right\}$ using convolution theorem.

Question –7

Evaluate the followings:

a. $\int_0^\infty \frac{e^{-3t} - e^{-6t}}{t} dt$

b. $\int_0^\infty t^3 e^{-t} Sintdt$

c. $\int_0^\infty e^{-x^2} dx$

Question–8

a. Solve $y'' + y = t$ where $y(0) = 1, y'(0) = -2$ by Laplace Transform.

b. Solve $\frac{\partial U}{\partial t} = 3\frac{\partial^2 U}{\partial x^2}$ where $U_x(0,t) = 0$, $U\left(\frac{\pi}{2}, t\right) = 0$ and $U(x,0) = 20\cos(3x) - 5\cos(9x)$ by Laplace Transform.

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Supplementary Examination: July 2019 [Improvement]

Subject: CSE-205, Object Oriented Programming Language

Time: 3.00 hours

INSTRUCTIONS:

Full Marks:210

a. Use SEPARATE answer scripts for each section.
b. Answer any THREE questions from each section out of FOUR.
c. Figures in the margin indicate full marks.
d. Assume reasonable data if necessary.
e. Symbols used have their usual meanings.

SECTION-A

Question – 1

a. What is "Data Encapsulation"? How is Data Encapsulation achieved in C++? 08

b. Write down the differences between procedural programming and object oriented programming. Which style of programming between the two would you prefer? Give reasons for your answers. 10

c. What is Exception Handling? What are its advantages? Handle the exception that may arise due to memory allocation in the following code:- 10

```
int main(){
int *array1=new int[1000000];
}
```

d. Explain the difference between new and malloc. Why is new preferred over malloc? 07

Question – 2

a. Create a class called 'TIME' that has the following:- 20
- three integer data members for hours, minutes and seconds
- constructor to initialize the object to zero
- constructor to initialize the object to some constant value
- member function to add two TIME objects
- member function to display time in HH:MM:SS format

Write a main function to create two TIME objects, add them and display the result in HH:MM:SS format.
sample output:-

```
Time 1 :  10:48:30
Time 2 :  2:22:35
Time1+Time2 :  13:11:5
```

b. Create a class called 'EMPLOYEE' that has 15
- EMPCODE and EMPNAME as data members
- member function getdata() to input data
- member function display() to output data

Write a main function to create EMP, an array of EMPLOYEE objects. Accept and display the details of at least 6 employees.

Sample Output:-

NAME	CODE
Ashok	111
Fahim	112
Afzal	113
Autony	114
Rejaul	115
Fatima	116

Question – 3

a. Create a class 'COMPLEX' to hold a complex number. Write a friend function to add two complex numbers. Write a main function to add two COMPLEX objects.

b. What is function overloading? What type of errors will the following function declarations generate?

```
void multiply (int, int);
int multiply (int, int);
```

Explain the causes of the error.

c. What are friend functions and how are they useful to C++? Consider the following code

```
Class A
{
   int x;
public:
   A(int a=0){x=a;}
};
Class B
{
   int y;
public:
   B(int b){y=b;}
};
```

- Add a member function to the class B to display the values of variables x, y by suitably modifying the code.

Question – 4

a. What do you understand, by the "this" pointer? Give out the uses of this pointer and illustrate your answer by writing suitable code.

b. What do you understand by references in C++? How are references different from pointers?

c. What is copy constructor? When is copy constructor called?

d. Design a C++ class to store indefinite/ any number of integer values. The class should have only one member variable. Write a display() function to show all the stored variables in the class.

SECTION-B

Question – 5

a. Why do we need protected members in inheritance? Explain with coding example. **10**

b. Demonstrate how we can modify the behavior of functions and their visibility in derived class. **10**

c. A 2D box has height and width. Its area is height * width. A 3D box on the other hand has height, width and depth. Its area is height * width * depth. **15**

i) Draw the class hierarchy of this situation. Mention the properties of each class in the boxes.

ii) Implement the design in C++ code having the following features

(a) Parameterized constructor for each class

(b) getArea function for both classes. Make sure the function is properly overridden.

iii) Write the constructor and destructor call sequence.

Question –6

a. Explain why declaring destructor as virtual in base class is a good practice. **10**

b. Why does C++ allow RTTI (Runtime Type Information) identification in polymorphic classes only? **10**

c. Show a comparison between concrete class, abstract class and interface. **15**

Question –7

a. Demonstrate when we should declare an operator function as non-member function. Write how the compiler distinguishes ++ prefix and postfix operator. **10**

b. Show possible cases where composition and aggregation are preferred over private inheritance. Give coding examples. **10**

c. Design a vehicle class that consists of: License Number, Owners name, Issue date and Model number. Write the inserter and extractor of the class so that the class becomes stream enabled. Make sure the following code works. **10**

```
vehicle v1;
cin >> v1;
cout << v1;
```

d. How will you modify the inserter and extractor written in 7(c) so that they will work for file stream too? Write down only the modified lines. **05**

Question–8

a. Does dynamic method dispatch make a problem faster or slower? Justify your answer. **10**

b. Explain the concept of object slicing. How can it be a problem in **10**

Runtime polymorphism?

c. An Electronic Device is a device. A Printer is an Electronic Device. A Scanner is also an Electronic Device. A copier is both a Printer and a Scanner.
There are total five classes in the given scenario.

i) Draw the class hierarchy diagram based on the statements mentioned above.
ii) Write down the declaration/signature of each of the classes mentioned above in such a way that the diamond problem is resolved.
iii) Write down the constructor & destructor call sequence of the class hierarchy.

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. In Computer Science and Engineering
Supplementary Examination: July 2019

Subject : Math - 143, Ordinary & Partial Differential Equations and Co-ordinate Geometry

Time: 3.00 hours **Full Marks : 210**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks.**
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. Determine the differential equation (DE) of $y = e^{ax}(Acosbx + Bsinbx)$ where A and B are arbitrary constants. 12

b. Solve the following DEs: 12

(i) $y\sqrt{1+x^2}\,dy = x\sqrt{1+y^2}dx$

(ii) $3e^{2x}\text{Sec}^2(3y)dy + 2(e^{2x}-1)\tan(3y)\,dx = 0$ 11

Question – 2 Solve the following DEs: 10

a. $(D^3 + 2D^2 + D)^2 y = 0$ 13

b. $(D^2 + 2D + 4)\,y = x^2 + e^x \cos 2x$ 12

c. $(D^3 - 1)\,y = e^x + x$

Question – 3 Solve the following DEs: 15

a. $(x^2D^2 - xD + 4)y = xsin(lnx)$ 10

b. $2y = px - \frac{16x^2}{p^2}$ 10

c. $(x^2 + y^2 + x)dx + xy\,dy = 0$ 15

Question – 4

a. Derive Lagrange's equation for the first order linear partial differential equations. 10

b. *Solve the following partial DEs:* 10

(i) $yzp + zxq = xy$

(ii) $x(y^2 - z^2)p + y(z^2 - x^2)q = z(x^2 - y^2)$

BANGLADESH UNIVERSITY OF PROFESSIONALS

Military Institute of Science and Technology

in Computer Science and Engineering, Term Final (Spring) Examination 2021: July-Aug 2021

Student Group: 36 < Earned Credit Hours ≤ 72

Subject: CSE-203, Data Structures and Algorithms I

:2.00 hours (Online Examination for Section-A + Section-B)

: 1.00 hour (Online Examination)

Full Marks :180
Section A : 90

NSTRUCTIONS - ONLINE EXAMINATION (IF PHYSICAL EXAMINATION IS NOT HELD)

- **Question -1** and **Question – 4(Viva Voce)** in **Section A** are compulsory.
- Answer any **OTHER ONE** question from **Q-2 & Q-3** of **Section-A**.
- Figures in the margin indicate full **marks.**
- Assume reasonable data if necessary.
- **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

ıtion – 1 (Compulsory)

a. Assume that you are given a Min Priority Queue of n elements. Write three functions that implement the **15**
   i. Extract-Min(),
   ii. Find-Max(), and
   iii. Decrease-Key()
   operations of the Min Priority Queue.

b. Assume that both Head and Tail pointers are given for a single linked list containing n elements. Write two functions for the Enqueue and Dequeue operations of a FIFO queue that is implemented by the given single linked list. Both Enqueue and Dequeue operations must be done in $O(1)$ time. **15**

ıtion – 2

a. Consider a modified version of the Merge Sort algorithm as follows: if the array size is less than or equal to 2, then it sorts the array at constant time. Otherwise, it divides the array of size n into 3 sub-arrays, each with a size of n/4. This division takes $O(\log n)$ time. Then the algorithm sorts the sub-arrays recursively, and then merges their solution at time $O(n)$. Write a recurrence relation for the running time $T(n)$ of this algorithm. **06**

b. If the recurrence equation of an algorithm is **09**

$$T(n) = 3T\left(\frac{n}{3}\right) + O(n) \text{ with } T(1) = O(1),$$

then determine $T(n)$ using recursion tree method.

c. Solve the following recurrences by using Master Theorem. **09**
   i. $T(n) = 16T\left(\frac{n}{4}\right) + 7n\sqrt{n} + 8\log n$
   ii. $T(n) = 3T\left(\frac{n}{2}\right) + 5n^2 + 6n$
   iii. $T(n) = 3T\left(\frac{n}{3}\right) + 2n + 3\sqrt{n}$

d. Let the Euler tour traversal sequence of a proper binary tree be $e\,f\,a\,f\,b\,k\,b\,j\,b\,f\,e\,g\,c\,i\,c\,h\,c\,g\,d\,g\,e$. Then write the preorder, in-order and post-order traversal sequence of the tree. **06**

ion – 3

a. Write the quick sort algorithm by assuming the first element as the pivot element. Write the recurrence equations for the best-case and the worst case time-complexities of the algorithm. Then solve the recurrence equation for the worst-case time complexity of the algorithm by Iterative Expansion method. **15**

c. What will be the resultant forest after calling Union (Q, N) in Figure 4. You must use the union-by-rank and the path-compression heuristics.

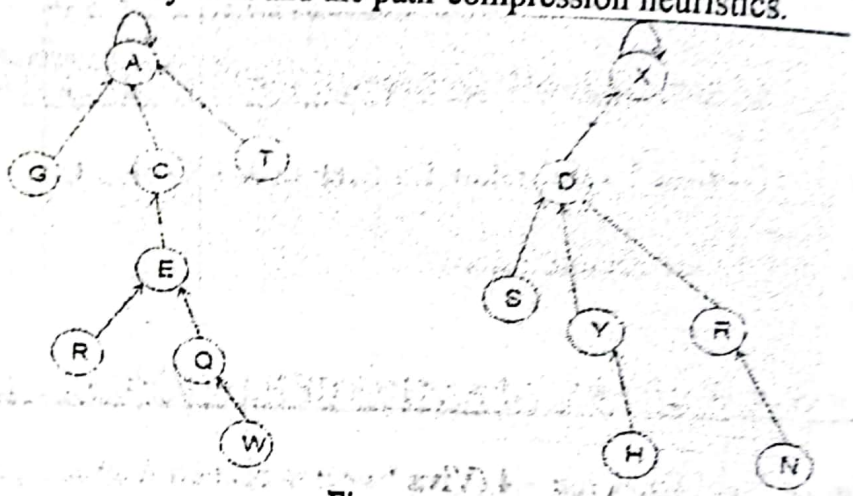


Figure 4

Question – 7

a. By showing an example explain why one can solve the fractional knapsack problem by a greedy strategy, but one cannot solve the 0-1 knapsack problem by such a strategy.

b. Propose a divide-and-conquer algorithm to find the maximum and minimum elements of an unsorted array of size n. Analyze the time complexity of the algorithm by writing the recurrence equation.

c. Prove that $8n^2 + 7n + 5 = O(n^3)$

Question – 8

VIVA VOCE (Compulsory in case of Online Examination)

BANGLADESH UNIVERSITY OF PROFESSIONALS

Military Institute of Science and Technology

c, In Computer Science and Engineering, Term Final (Spring) Examination 2021: July-Aug 2021

Student Group: 36 < Earned Credit Hours ≤ 72

Subject: CSE-205, Object Oriented Programming

: 2.00 hours (Online Examination for Section-A + Section-B)

n A : 1.00 hour (Online Examination)

Full Marks : 180
Section A : 90

INSTRUCTIONS - ONLINE EXAMINATION (IF PHYSICAL EXAMINATION IS NOT HELD)

a. **Question - 1** and **Question – 4 (Viva Voce)** in **Section A** are compulsory.
b. Answer any **OTHER ONE** question from **Q-2 & Q-3** of **Section-A**.
c. Figures in the margin indicate full **marks.**
d. Assume reasonable data if necessary.
e. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

tion – 1 (Compulsory)

a. "C++ is an object oriented programming language, but it is not purely object oriented" – justify this statement in comparison with procedural and other object oriented languages. **10**

b. "**Vehicle** is a thing used for transporting people or goods. They have distinct features like *color, wheel, registration_no* etc. As Vehicles move from one place to another, we can calculate *distance_travelled* by a Vehicle. **15**
Vehicles can be classified into 3 categories, all having the common properties of **Vehicle – Cars, Trucks** and **Ricky (Rickshaw).** These 3 categories have some unique features and functionalities of themselves as well.
It is interesting to note that there is a function for **Cars** called *fuel_economy* which calculates the fuel consumption of a car per km based on different parameters. For example: for liquid fuel vehicles *fuel_economy* can be calculated based on km run (int) per liter (float) and for CNG vehicles, it is calculated as km run (int) per cylinder (int)."

Explain the above scenario using object oriented programming concepts. Describe the features of OOP language from this example. You may use graphical representation or code snippets to support your answer.

c. What is the significance of "`using namespace std`" while **istream** and **ostream** are used? **05**

stion – 2

a. You have applied for a game developer position for EA sports. They have assigned you to design a CPP class given some specific instructions for their upcoming release of FIFA '22 game. Your recruitment depends on the perfect execution of the tasks endowed upon you. **20**

Shapes	A generic class which deals with all kinds of 2D shapes in the game.
var1	**"Quads"/ "Circles"/ "Triangle"** – could be any of the 3 classes which represents basic shapes. This variable can be inherited in future so access protection should be set available for the derived classes but not from any other part of the program.
area	Accessible only within the class and stores the area of the shape.
set_area()	Calculates the area of *var1* and sets the value of *area.* The function can receive 3 sets of arguments. i) Base & Height (double, double) – for **Triangles** ii) Radius (double) – for **Circles** iii) Length & Width (int, int) – for **Quads**

area_sum()	Generic global function which receives 2 Shapes objects of the same type and returns the sum of their area. The function requires access to the *area* variable of the **Shapes** class.

Design the generic class and the generic global method following the instructions provided above.

b. Destructors are special member functions used to de-allocate dynamically allocated memory and destroy objects when it goes out of scope. Is it possible to overload destructors as they are also member functions? If yes, then how to overload destructor? If no, why can't we overload destructor? Explain with examples. **06**

c. If the member variables of a class and the constructor arguments have the exact same name, how to remove the ambiguity? Give an example. **04**

Question – 3

Go through the code in figure – 01 (page 3).

a. What will be the output of the code? Briefly explain each line with proper reasoning. **07**

b. Write a copy constructor for the class **Employee** where all member variables are copied. **08**

c. `cout << "Copy constructor called: " << name << endl;` **05**

If the above mentioned line is added at the beginning of your copy constructor, what will be the output of the code? Briefly explain each line with proper reasoning.

d. What are the conditions of function overloading? Give examples of each condition. Show an example of function overloading using default arguments. **2+6+2 = 10**

Question – 4 (Compulsory)

VIVA VOCE **30**

```
#include <iostream>
#include <cstring>

using namespace std;

class DOB{
    int d, m, y;
public:
    DOB(){}
    DOB(int d, int m, int y):
        d(this->d), m(this->m), y(this->y){
            cout << "Constructor Called DOB." << endl;
        }
};

class Employee{
    int emp_id;
    char * name;
    DOB * ob;
public:
    Employee(){
        name = new char[10];
        ob = new DOB();
        strcpy(name, "Default");
        cout << "Default Constructor Called." << endl;
    }
    Employee(int id, int d, int m, int y, string st){
        cout << "Constructor Called Employee: " << st << endl;
        ob = new DOB(d, m, y);
        name = new char[st.size()];
        strcpy(name, st.c_str());
        emp_id = id;
    }
    ~Employee(){
        cout << "Destructor Called Employee: " << name << endl;
        delete [] name;
        delete ob;
    }
    void display();
};


void Employee::display(){
    cout << name << endl;
}

Employee func(Employee ob1, Employee &ob2){
    Employee temp;
    ob2 = temp;
    return temp;
}

int main(){
    Employee ob1(45, 14, 7, 2000, "ob1"), ob2(55, 26, 10, 1997, "ob2");
    ob1.display();
    ob2.display();
    Employee ob3 = func(ob1, ob2);
    ob1.display();
    ob2.display();
    ob3.display();
}

```

BANGLADESH UNIVERSITY OF PROFESSIONALS

Military Institute of Science and Technology

s: in Computer Science and Engineering, Term Final (Spring) Examination 2021: July-Aug 2021

Student Group: 36 < Earned Credit Hours < 72

Subject: EECE-269, Electrical Drives and Instrumentation

: 2.00 hours (Online Examination for Section-A + Section-B)

: 1.00 hour (Online Examination)

Full Marks : 180
Section A : 90

INSTRUCTIONS - ONLINE EXAMINATION

a. **Question - 1** and **Question – 4 (Viva Voce)** in **Section A** are compulsory.
b. Answer any **OTHER ONE** question from **Q-2 & Q-3** of **Section-A.**
c. Figures in the margin indicate full **marks.**
d. Assume reasonable data if necessary.
e. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question – 1 (Compulsory)

a. Deduce the equation of starting torque in case of an induction motor and hence find out the condition for maximum starting torque. **12**

b. Show for an alternator that the induced voltage per phase is given by, $E_{eff} = 4.44\ K_c K_d f\ \Phi T$ volt. **10**

c. A 3-phase induction motor having a star-connected rotor has an induced e.m.f. of 80 volts between slip rings at standstill on open circuit. The rotor has a resistance and reactance per phase of 1Ω and 4Ω respectively. Calculate current/phase and power factor when slip-rings are short-circuited. **08**

Question – 2

a. Show that the torque developed by the armature of a dc motor can be expressed by the equation, $\tau_a = 0.159\ \Phi Z\ I_a\ (\frac{P}{A})$ where, symbols have their usual meanings. **12**

b. "Gross mechanical power developed by a motor is maximum when the back EMF equals half of the applied voltage" – prove. **12**

c. A 100 kVA lighting transformer has a full-load loss of 3 kW, the losses being usually divided between iron and copper. During the day, the transformer operates on full-load for 3 hours, one half load for 4 hours, the output is negligible for remainder of the day. Calculate the all-day efficiency. **06**

Question – 3

a. Show that the generated E.M.F. equation for a simplex lap-wound dc generator can be expressed by, $E_g = \frac{\Phi ZN}{60}$ volt. **12**

b. "Whatever the load conditions, the net flux passing through the core of a transformer is approximately the same as that of no-load" – explain. **08**

c. A short-shunt compound generator delivers a load current of 30 A at 220 V, and has armature, series-field and shunt-field resistance of 0.05 Ω, 0.30 Ω and 200 Ω respectively. Calculate the induced emf and armature current. Allow 1.0 V per brash for contact drop. **10**

BANGLADESH UNIVERSITY OF PROFESSIONALS

Military Institute of Science and Technology

..c. in Computer Science and Engineering, Term Final (Spring) Examination 2021: July-Aug 2021

Student Group: 36 < Earned Credit Hours ≤ 72

Subject: EECE-269, Electrical Drives and Instrumentation

: 2.00 hours (Online Examination for Section-A + Section-B)

..n B : 1.00 hour (Online Examination)

Full Marks : 180
Section B : 90

INSTRUCTIONS - ONLINE EXAMINATION

a. **Question - 5** and **Question – 8 (Viva Voce)** in **Section B** are compulsory.
b. Answer any **OTHER ONE** question from **Q-6 & Q-7** of **Section-B**.
c. Figures in the margin indicate full **marks.**
d. Assume reasonable data if necessary.
e. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-B

..uestion – 5 (Compulsory)

a. As a computer science engineer, you have to choose some transducer for your robotics project for some specific applications. Explain the characteristics that you will look for when choosing the transducers. **08**

b. "The instrumentation amplifier is a dedicated differential amplifier with extremely high input impedance and its gain can be precisely set by a single internal or external resistor" Justify this statement mathematically with appropriate circuit diagrams. **12**

c. Suppose you have to repair a faulty temperature measurement system. While checking, you found that the measurement system employs an analog transducer having range of 0-10 V and it is able distinguish a change of 10 mV. You also found that the analog to digital converter is also damaged. For the process of repairing you need to calculate **10**
   (i) Resolution of the transducer
   (ii) The number of bits of the new A/D converter
   (iii) Quantization error of the system
   (iv) The number of decision levels of the system

..uestion – 6

a. When it is necessary to decide between digital and analog indicating instruments, the choice depends upon many factors. Illustrate these factors along with your comments. **10**

b. List the advantages and disadvantages of Linear Voltage Differential Transformer (LVDT).

c. The following table gives the variation of resistance with temperature for a Resistance Temperature Detector (RTD). Find the linear and quadratic approximation of the resistance temperature curve for temperature variations between 15°C and 33°C about a mean temperature of 24°C. **10**

Temperature °C	Resistance Ω
15	106.06
18	167.14
21	108.22
24	109.30
26.5	110.38
29.5	111.46
33	112.75

Question – 7

a. Identify the reasons for reasons for which most of the measurement and instrumentation system uses electrical transducers. **10**

b. Explain the working principle of the ramp type digital voltmeter with necessary circuit and timing diagram. **10**

c. Briefly describe the major components of a generalized digital data acquisition system. **10**

Question – 8

VIVA VOCE **30**

BANGLADESH UNIVERSITY OF PROFESSIONALS

Military Institute of Science and Technology

B.Sc. in Computer Science and Engineering, Term Final (Spring) Examination 2021; July-Aug 2021

Student Group: 16 < Earned Credit Hours ≤ 72

Subject: MATH-245, Mathematics III (Vector Analysis, Matrices and Fourier Analysis)

Total : 2.00 hours (Online Examination for Section-A + Section-B)

Section B : 1.00 hour (Online Examination)

Full Marks : 1

Section B : 9

INSTRUCTIONS - ONLINE EXAMINATION (IF PHYSICAL EXAMINATION IS NOT HEL

a. Question - 5 and Question – 8 (Viva Voce) in Section B are compulsory.
b. Answer any OTHER ONE question from Q-6 & Q-7 of Section-B.
c. Figures in the margin indicate full marks.
d. Assume reasonable data if necessary.
e. Symbols and abbreviations used have their usual meanings.

SECTION-B

Question – 5 (Compulsory)

a. Find the Fourier series of $f(x)$: 15

$$f(x)=\begin{cases}0 & ; \ -2<x<-1\\ k & ; \ -1<x<1\\ 0 & ; \ 1<x<2\end{cases}$$

b. Compute the half-range Fourier Cosine series for the function 15

$$f(x)=\begin{cases}2, & 0\le x\le \frac{\pi}{2}\\ 0, & \frac{\pi}{2}<x\le \pi\end{cases}$$

Question – 6

a. Expand $f(x)=2x^2$, $0<x<2\pi$, in a Fourier series and hence find the value of 20

$$\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+\cdots$$

b. (i) What is a Fourier series? A Fourier sine series? A half range expansion? 10

(ii) What do you mean by piecewise continuous function?

Question – 7

a. A bar of length 10 whose entire surface is insulated including its ends at $x=0$ and $x=10$ has initial temperature $f(x)=x$. Determine the subsequent temperature of the bar. 20

b. Sketch the function 10

$$f(x)=\begin{cases}\cos x, & 0\le x\le \pi\\ 0, & \pi<x\le 2\pi\end{cases} \ ; \text{Period} = 2\pi$$

Question – 8 (Compulsory)

VIVA VOCE 30

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Short Term Final Examination(Improvement): Jan 2019

Subject: MATH-247, Complex Variables and Laplace Transforms

Time: 3.00 hours **Full Marks: 210**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks.**
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question –1

a. Define complex conjugate number. Find the modulus and argument of the complex number $\frac{i+2i}{1-3i}$ and express it in the polar form. **13**

b. What region in z plane is represented by $2< |z-4-5i| \leq 3$. ? **12**

c. Prove that $|z_1 - z_2| \leq |z_1| + |z_2|$ where z_1 and z_2 are complex numbers. **10**

Question –2

a. Derive the necessary condition for f(z) to be analytic. **13**

b. Construct an analytic function $f(z) = u(r,\theta) + iv(r,\theta)$, where $v(r,\theta) = -r^3 sin3\theta$ express the result as a function of z. **12**

c. Evaluate $\int \frac{z+4}{z^2+2z+5} dz$ where c is the circle $|z+1| = 1$. **10**

Question –3

a. State and prove the Cauchy's integral theorem for analytic function. **10**

b. Evaluate $\int_{-i}^{2+i} (2x+iy+1)\,dz$ along the curve x= t+1, y=$2t^2$-1 **12**

c. Evaluate $\int \frac{z-1}{(z+1)^2(z-2)} dz$, where c is the circle $|z-i| = 2$. **13**

Question–4

a. Determine the poles and residue at each pole of function $f(z) = \frac{12z-7}{(z-1)^2(2z+3)} dz$ and hence $\int \frac{12z-7}{(z-1)^2(2z+3)} dz$, where c is the circle $|z+i| = \sqrt{3}$. **15**

b. Expand $(z) = \frac{1}{(z-1)(z-2)}$ Laurent's series valid for **20**

(i) $1 < |z| < 2$; (ii) $|z| > 2$.

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Short Term Final Examination (Improvement): Jan 2019

Subject: EECE- 269, Electrical Drives and Instrumentation

Time: 3.00 hours **Full Marks: 210**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks.**
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. Show that, for a simplex lap wound generator, the EMF is **11**

$$E_g = \frac{\omega \varphi z}{2\pi}\left(\frac{P}{A}\right)$$

b. Compare briefly the characteristics and applications of series and shunt motors. **12**

c. A shunt generator delivers 140A at terminal potential difference of 400V. The armature resistance and shunt filed resistances are 0.05 Ω and 40 Ω respectively. The iron and friction losses equal 1075 W. Determine, **12**

(i) Generated E.M.F.
(ii) Cu losses
(iii) Commercial, mechanical and electrical efficiencies

Question – 2

a. Describe briefly the working principle of a transformer. **05**

b. Show the phasor diagrams of a transformer with resistance & leakage reactance for resistive, capacitive and inductive loads. **10**

c. Explain that, a transformer will have maximum efficiency when its iron loss and cu loss will be equal to each other. **10**

d. A transformer has a primary winding of 1000 turns and a secondary winding of 200 turns. When the load current 100A at 0.5 power factor lagging, the primary current is 40A at 0.707 power factor lagging. Determine the no load current of the transformer and its phase with respect to the voltage. **10**

Question – 3

a. Why does the rotor of an induction motor rotate, explain with appropriate diagram.

b. Deduce the relation of full load and starting torque with maximum torque of an induction motor respectively.

c. Summarize the variation of terminal voltage of a loaded alternator with appropriate diagrams according to power factor.

d. A 3-phase, 11-KVA, 15MW, Y connected synchronous generator has synchronous impedance of (0.5 + j 9.0) ohm per phase. If the excitation is such that the open circuit voltage is 18 KV. Determine the maximum output of the generator.

Question – 4

a. Draw the equivalent circuit of a synchronous motor and also show that, the gross mechanical power developed by a synchronous motor is

$$p_m = \frac{3E_bV}{X_s}\sin\alpha$$

b. Briefly summarize the characteristics of a stepper motor.

c. With appropriate diagrams describe the principle of operation of synchronous motor.

d. A stepper motor has a step angle of 4.5^0. Determine the (i) resolution (ii) number of steps required for the shaft to make 50 revolutions if the stepping frequency is 3600 pps.

SECTION-B

Question – 5

a. Define electric transducer. Discuss the advantages of electric transducers.

b. Create a list of electrical transducers with inductance as the electrical parameter. Write down their principle of operation and typical applications.

c. Summarize the factors affecting the choice of transducers.

d. Draw the diagrams of (i) rotary POT and (ii) heliport with necessary notations.

Question –6

a. For a piezoelectric transducer show that the voltage, $E_o = gtp$

b. Devise the output voltage equation of an instantaneous amplifier with three amplifier configuration. Draw the appropriate circuit for this purpose.

c. Show that for a differential amplifier, the difference mode gain,

$$A_d = \frac{v_o}{v_d}$$

Question –7

a. With appropriate diagram briefly describe the working principle of an x-y recorder. **10**

b. Explain the components of a magnetic tape recorder with appropriate figure. **15**

c. A barium titanate pickup has the dimensions of 7mm × 7mm × 2mm. The force acting on it is 6N. The charge sensitivity of barium titanate is 150 pc/ N and its permittivity is 12.5×10^{-9} F/m. If the modulus of elasticity of barium titanate is 12×10^6 N/m^2, calculate the strain, charge and capacitance. **10**

Question–8

a. With appropriate block diagram, explain the basic components and their functions of a digital data acquisition system. **12**

b. Brifely describe seven segment display and a 3×5 Dot matrix. **05**

c. List down the uses of acquisition system. **08**

d. An operational amplifier is used as an integrator to produce a ramp signal of -15 v/ms. Design the circuit to get this output. **10**

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Short Term Final Examination: Jan 2019

Subject: CSE-203, Data Structure

Time: 3.00 hours | Full Marks: 210

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks**.
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. Briefly discuss different types of data structure. **05**

b. Define the Big-O, Big-Omega and Theta notation with appropriate figures. **12**

c. What is an array? Write the properties and parameters of an array. **08**

d. Sort this given array with Bubble Sort: 5, 3, 8, 4, 6 and find the numbers of comparisons. **10**

Question – 2

a. What is stack? Write some real life examples of stack. **05**

b. Define pop( ) and push( ) functions of a stack. Implement these functions with single liked list. **15**

c. Briefly discuss the common errors for stack. **05**

d. What are the Full and empty Queue problems? How can these problems be solved? **10**

Question – 3

a. What are the advantages and disadvantages of using linked-list over array? **05**

b. Illustrate the pointer assignment operations with appropriate figures where linked-list has atleast 3 needs: **15**
   (i) Insert a data at head
   (ii) Delete a data at a given location
   (iii)Insert a data at a given location

c. Explain the following linked lists: **15**
   (i) Circularly linked list
   (ii) Doubly linked list

   Write down the functions for deleting a data from a given location of each of the above linked lists.

Question – 4

a. What is a tree in terms of Data Structure? Write the tree terminologies with proper figures. 08

b. Prove that, in a proper binary tree T, the number of external node is 1 more than the number of internal nodes. 12

c. Construct the binary tree whose inorder and postorder traversals are given as: 10
Inorder: g b h j o k n p a c d f e l m q i
Postorder: g o p n k j h b c f m l q i e d a

d. Construct the binary tree for this following arithmetic expression: 05
$$(5 \times (d - 9) + (6 \times c))$$

SECTION-B

Question – 5

a. Write down the properties of a binary search tree (BST). What are the advantages of a BST? 03+02=05

b. Explain the three cases of deletion operation in a binary search tree. Delete the nodes 8, 30 and 25 from the binary search tree shown in Figure 5(b) and show the process step-by-step with necessary diagrams. 20

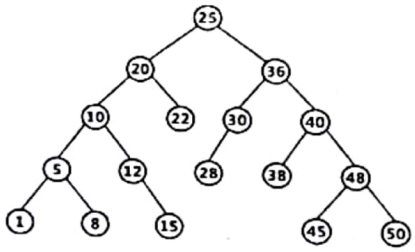


Figure: 5(b)

c. What is a 'pivot'? Write down the Quick sort algorithm. 10

Question – 6

a. Define a priority queue. What are the basic operations of a 'Max-Priority' queue? 02+08=10

b. Build a 'Max-Heap0' from the array A given below and show all the steps with necessary diagrams. 15
A= { 15, 9, 10, 3, 7, 1, 5, 12, 13, 6}

c. Is heap a complete binary tree? Explain why. Write the algorithm for implementing the 'Max-Heapify' function. 03+07=10

Question – 7

a. Prove that for an undirected graph, the sum of the degrees of the vertices equals twice the number of edges. **05**

b. Consider the graph G in Figure 7(b) and answer the following questions: **10+10+05 =25**

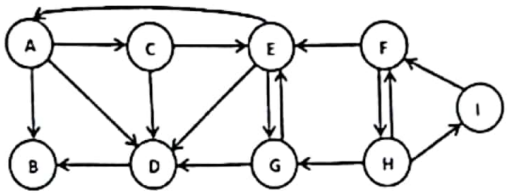


Figure: 7(b)

(i) Find the adjacency matrix and adjacency list.
(ii) Considering 'A' as the source vertex, draw the DFS forest from the graph G.
(iii) Find out the tree edge, back edge, forward edge and cross edge of the graph G.

c. Analyze the run-time complexity of the Heap-sort algorithm. **05**

Question – 8

a. Sort the following array of numbers step-by-step using the Merge sort algorithm. **10**

{ 12, 35, 87, 26, 9, 28, 7, 1, 95}

b. Analyze the best-case, worst-case and average-case time complexity of the Quick sort algorithm. **10**

c. Discuss the two solutions for reducing $O(n^2)$ run-time of Quick sort algorithm on already-sorted array. **05**

d. **10**

Consider the skip list shown in Figure 8(d). Draw the skip list that results from inserting 15 with i=2, deleting 19, inserting 22 with i=1, and then inserting 54 with i=4 in the given skip list.

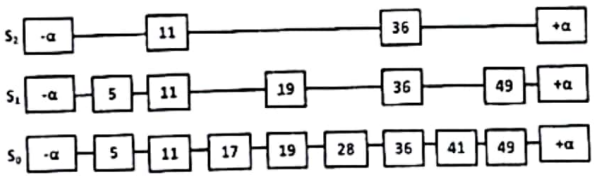


Figure: 8(d)

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Short Term Final Examination: Jan 2019

Subject: CSE-215, Algorithms

Time: 3.00 hours

Full Marks: 210

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks.**
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. What is an algorithm? What do you analyze of an algorithm? Define O-notation, Ω-notation and θ-notation. **10**

b. Write the Bellman Ford algorithm for finding shortest paths in a directed weighted graph. Prove the time complexity and correctness of algorithm. **15**

c. Write a backtracking algorithm for coloring a map with no more than four colors. Explain the main idea of Branch and Bound technique. **10**

Question – 2

a. Write the principles of greedy strategy. **05**

b. Present the Kruskal's algorithm to compute a minimum spanning tree and prove the correctness of the algorithm. **15**

c. Solve the following instance of 0/1 Knapsack problem using the branch and bound approach with a state-space tree. Assume that the knapsack capacity is 15. **15**

Item	Weight	Value
1	7	84
2	6	72
3	3	90
4	4	160

Question – 3

a. Write the Prim's algorithm that computes a minimum spanning tree of a weighted graph. Analyze the time complexity of the algorithm. **15**

b. Draw a minimum spanning tree of the graph G shown in Figure 1 by running (i) Prim's algorithm, and (ii) Kruskal's algorithm. Write the order of the edges in each case (whenever there is a choice of vertices always uses alphabetic ordering). **15**

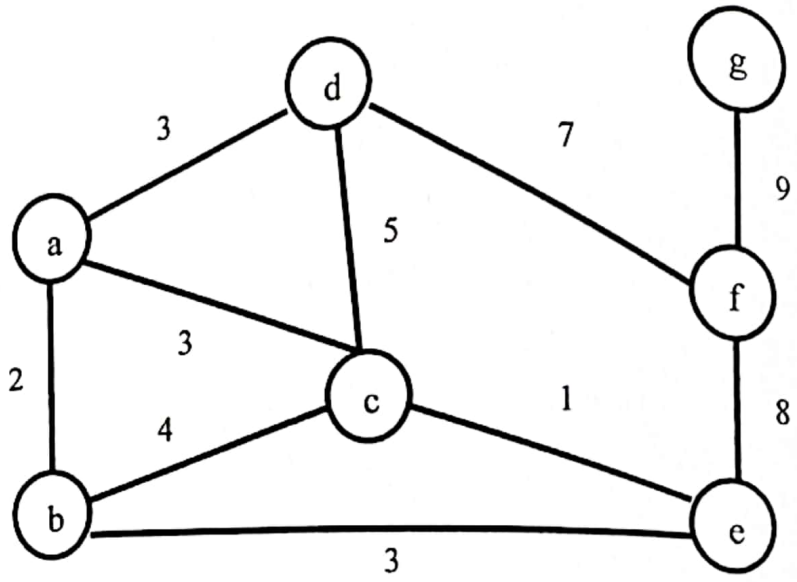


Figure: 01

c. Write the theorem of the Parenthesis structure of a DFS visit of a graph.

Question – 4

a. Prove that $O(n^3) + O(n) = O(n^3)$

b. Prove that the largest common subsequence problem have both the overlapping subproblems property and the optimal substructure property. Calculate the number of the subproblems of two sequences X_a and Y_a.

c. Write an algorithm for the breadth first search of a disconnected graph.

SECTION-B

Question – 5

a. Define the single source shortest path problem. Write the other variations of the shortest path problem. **05**

b. Write and prove the optimal substructure property of shortest path problem. **15**

c. Write a parallel algorithm for computing the sum of n numbers. Also write a parallel algorithm to multiply two n×n matrices that runs in O($logn$) time. **15**

Question – 6

a. Write the Edmonds-Karp algorithm that solves the maximum flow problem. Analyze the time complexity of the algorithm. **15**

b. Explain how a network flow algorithm allows us to find the maximum bipartite matching. **10**

c. Write an algorithm for the breadth-first search of a disconnected graph. **10**

Question – 7

a. Compare the techniques of the brute-force algorithms, heuristics and approximation algorithm for coping with hard problems. Why do we prove NP-completeness of a hard problem? **15**

b. Define five well known NP-complete problems. **10**

c. Write a polynomial time approximation algorithm for the travelling-salesman problem with triangle inequality. **10**

Question – 8

a. Why do we need parallel processing? Classify parallel computers based on data flow and instruction flow. **10**

b. What is the vertex-cover problem? Write a polynomial-time approximation algorithm for the vertex-cover problem. Analyze the approximation ratio of the algorithm. **15**

c. What is flow network? Find the value of maximum flow using residual network. **10**

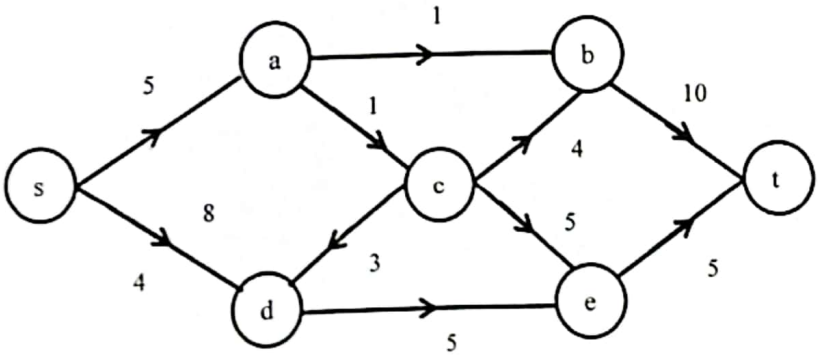


Figure: 02

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BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering
Short Term Final Examination: Jan 2019

Subject: EECE- 269, Electrical Drives and Instrumentation

Time: 3.00 hours

Full Marks: 210

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. Answer any **THREE** questions from each section out of **FOUR.**
c. Figures in the margin indicate full **marks**.
d. Assume reasonable data if necessary.
e. **Symbols** used have their usual meanings.

SECTION-A

Question – 1

a. Show that, for a simplex lap wound generator, the EMF is **11**

$$E_g = \frac{\omega \varphi z}{2\pi}\left(\frac{P}{A}\right)$$

b. Compare briefly the characteristics and applications of series and shunt motors. **12**

c. A shunt generator delivers 140A at terminal potential difference of 400V. The armature resistance and shunt filed resistances are 0.05 Ω and 40 Ω respectively. The iron and friction losses equal 1075 W. Determine, **12**

(i) Generated E.M.F.
(ii) Cu losses
(iii) Commercial, mechanical and electrical efficiencies

Question – 2

a. Describe briefly the working principle of a transformer. **05**

b. Show the phasor diagrams of a transformer with resistance & leakage reactance for resistive, capacitive and inductive loads. **10**

c. Explain that, a transformer will have maximum efficiency when its iron loss and cu loss will be equal to each other. **10**

d. A transformer has a primary winding of 1000 turns and a secondary winding of 200 turns. When the load current 100A at 0.5 power factor lagging, the primary current is 40A at 0.707 power factor lagging. Determine the no load current of the transformer and its phase with respect to the voltage. **10**

Question – 3

a. Why does the rotor of an induction motor rotate, explain with appropriate diagram. **10**

b. Deduce the relation of full load and starting torque with maximum torque of an induction motor respectively. **10**

c. Summarize the variation of terminal voltage of a loaded alternator with appropriate diagrams according to power factor. **10**

d. A 3-phase, 11-KVA, 15MW, Y connected synchronous generator has synchronous impedance of (0.5 + j 9.0) ohm per phase. If the excitation is such that the open circuit voltage is 18 KV. Determine the maximum output of the generator. **05**

Question – 4

a. Draw the equivalent circuit of a synchronous motor and also show that, the gross mechanical power developed by a synchronous motor is **10**

$$p_m = \frac{3E_b V}{X_s} \sin\alpha$$

b. Briefly summarize the characteristics of a stepper motor. **08**

c. With appropriate diagrams describe the principle of operation of synchronous motor. **12**

d. A stepper motor has a step angle of 4.5^0. Determine the (i) resolution (ii) number of steps required for the shaft to make 50 revolutions if the stepping frequency is 3600 pps. **05**

SECTION-B

Question – 5

a. Define electric transducer. Discuss the advantages of electric transducers. **10**

b. Create a list of electrical transducers with inductance as the electrical parameter. Write down their principle of operation and typical applications. **10**

c. Summarize the factors affecting the choice of transducers. **10**

d. Draw the diagrams of (i) rotary POT and (ii) heliport with necessary notations. **05**

Question –6

a. For a piezoelectric transducer show that the voltage, Eo = gtp **15**

b. Devise the output voltage equation of an instantaneous amplifier with three amplifier configuration. Draw the appropriate circuit for this purpose. **10**

c. Show that for a differential amplifier, the difference mode gain, **10**

$$A_d = \frac{v_o}{v_d}$$

Question –7

a. With appropriate diagram briefly describe the working principle of an x-y recorder. **10**

b. Explain the components of a magnetic tape recorder with appropriate figure. **15**

c. A barium titanate pickup has the dimensions of 7mm × 7mm × 2mm. The force acting on it is 6N. The charge sensitivity of barium titanate is 150 pc/ N and its permittivity is 12.5×10^{-9} F/m. If the modulus of elasticity of barium titanate is 12×10^{6} N/m^2, calculate the strain, charge and capacitance. **10**

Question–8

a. With appropriate block diagram, explain the basic components and their functions of a digital data acquisition system. **12**

b. Brifely describe seven segment display and a 3×5 Dot matrix. **05**

c. List down the uses of acquisition system. **08**

d. An operational amplifier is used as an integrator to produce a ramp signal of -15 v/ms. Design the circuit to get this output. **10**

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering, Term Final (Spring) Examination 2022: Aug 2022
Student Group: 36 < Earned Credit Hours ≤ 72
Subject: MATH-205, Differential Equation, Laplace Transform and Fourier Transform

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory
c. Answer any other **TWO** questions out of **THREE** from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. Define Homogeneous function. Solve the following differential equation: 15

$$(2x^2 + 2xy + y^2)dx + (2x^2 + 2xy - y^2)dy = 0$$

b. Obtain the differential equation of the circles tangent to the $X-$ axis and sketch several representative members of the family. 15

Question 2

a. Define exact differential equation. For which value of $N(x, y)$the following differential equation is exact 20

$$(x^3 + xy^2)dx + N(x, y)dy = 0$$

Also solve the obtained exact differential equation.

b. The human population of a certain island satisfies the logistic law 10

$$\frac{dx}{dt} = kx - \lambda x^2$$

with $k = 0.03$, $\lambda = 3 \times 10^{-8}$ and time t measured in years.
If the population in 1980 is 200,000 then find a formula for the population in future years and what will be the population in the year 2030?

Question 3

a. Given that $y = x$ is a solution of 15

$$(x^2 - 1)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 0$$

Find out the general solution.

b. Define fundamental set of solutions and general solution. Set up the correct linear combination of y_p for the following equation: 15

$$\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = 2x^2 + e^x + 2xe^x + 4e^{3x} + 4sinx$$

Question 4

a. Define partial differential equation. 17
Using Charpit's method solve and find a complete integral of

$$z = px + qy + p^2 + q^2$$

b. A circuit is in series with a constant electromotive force of $100V$, a resistor of 10Ω and a capacitor of 2×10^{-4} Farads. The switch is closed at time $t = 0$ and the change on the capacitor at this instant is zero. Find the charge and current at time $t > 0$. 13

SECTION-B

Question 5 (Compulsory)

a. Define Laplace Transform. Find the Laplace transforms of 10
   (i) te^{-t}
   (ii) $tsin2t$

b. Find the inverse Laplace transform of $\frac{3s-7}{s^2-2s-3}$ 08

c. Define Fourier series. Find the Fourier series expansion of $f(x) = x^2$ in the interval of $-\pi \le x \le \pi$ 12

and hence show that $\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$

Question 6

a. Find the Laplace transforms of $\int_t^{\infty} \frac{cosu}{u} du$. 08

b. State convolution theorem. Using this theorem or otherwise, evaluate $\mathcal{L}^{-1}\{\frac{1}{s^2(s+1)^2}\}$ 10

c. Using Laplace transform, solve the following ODE 12

$$Y'' + 9Y = cos2t$$
$$Y(0) = 1,\ Y'(0) = 2$$

Question 7

a. Define complex form of Fourier series. Find the Fourier series expansion of the function 12

$$f(x) = \begin{cases} 0, & -\pi < x \le 0 \\ x, & 0 < x \le \pi \end{cases}$$

hence show that, $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \cdots$

b. Define Fourier integral. Find the Fourier integral of the function 10

$$f(x) = e^{-x}, \quad x > 0$$

hence show that, $\int_0^{\infty} \frac{xsinx}{1+x^2} dx = \frac{\pi}{2} e^{-1}$.

c. Find the Fourier cosine transform of e^{-x^2}, $x \ge 0$ 08

Question 8

a. State Dirichlet's conditions. Expand $f(x)$ in the Fourier series, where 15

$$f(x) = \begin{cases} -\pi, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$$

Hence deduce that, $\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \cdots$

b. Using Fourier Transform, solve the BVP 15

$$\frac{\partial U}{\partial t} = 4\frac{\partial^2 U}{\partial t^2}$$

with the boundary conditions:

$$U(0,t) = 0, \quad U(2,t) = 0, \quad t > 0$$
$$U(x,0) = x, \quad 0 < x < 2$$

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science Engineering
Term Final (Spring) Examination 2022: Aug 2022

Student Group: 36 < Earned Credit Hours ≤ 72

Subject: EECE-269 ,Electrical Drives and Instrumentation

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory
c. Answer any other **TWO** questions out of **THREE** from each section.
d Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. Explain a typical no load magnetization curve for a DC generator. Summarize the reasons why a DC shunt generator may fail to build up the desired voltage and outline the solution of each case. **08**

b. Briefly explain the purpose of commutator and brush in a DC generator. **04**

c. Demonstrate various stages of a DC generator by necessary flow chart. Develop the necessary condition for maximizing the efficiency of a DC generator. Also make use of this condition to evaluate the corresponding load current at the maximum efficiency. **10**

d. A 4-pole, DC shunt generator with a shunt field resistance of 100Ω and an armature resistance of 1Ω has 378 wave-connected conductors in its armature. The flux per pole is 0.02 wb. If a load resistance of 10Ω is connected across the armature terminals and the generator is driven at 1000 rpm, calculate the power absorbed by the load. **08**

Question 2

a. Briefly explain the basic operation of a transformer. Derive the expression for induced emf of a transformer. **10**

b. Demonstrate the equivalent circuit of a transformer. **04**

c. Explain the significance of concentrating both the resistances in any one winding of a transformer and hence define the term equivalent primary resistance as referred to secondary. **05**

d. Justify the requirement of considering all day efficiency for a distribution transformer. A 100 kVA lighting transformer has a full-load loss of 3 kW, the losses being equally divided into iron and copper. During a day, the transformer operates on a full-load for 3 hours, One half load for 4 hours, the output being negligible for the remainder of the day. Evaluate the all day efficiency of the transformer. **11**

Question 3

a. Explain the significance of back emf in a DC motor for making it self regulating. 04

b. Discuss a suitable method for speed control of a DC shunt motor with necessary circuit diagram, which makes use of a thyristor, silicon unilateral switch (SUS) and a free wheeling diode. 10

c. Explain why induction motors can be treated as rotating transformers. Discuss the operating principle of 3-phase motor and explain how it is inherently self starting. 08

d. A 230-V dc shunt motor has an armature resistance of 0.5 Ω and field resistance of 115 Ω. At no load, the speed is 1200 rpm and the armature current 2.5 A. On application if rated load, the speed drops to 1120 rpm. Determine the line current and power input when the motor delivers rated load. 08

Question 4

a. "Alternators have stationary armature unlike a DC generator." - explain the significance of having stationary armature in alternators. 05

b. Show that frequency of an alternator can be expressed by $f = \frac{PN}{120}$ Hz. 06

c. Briefly discuss the applications of stepper motors. 05

d. Describe three basic differences between synchronous motors and induction motors. 06

e. A 4-pole, 3-phase induction motor operates from a supply whose frequency is 50 Hz. Calculate the following: 08

(i) The speed at which the magnetic field of the stator is rotating.
(ii) The speed of the rotor when the slip is 0.04.
(iii)The frequency of the rotor currents when the slip is 0.03.
(iv) The frequency of the rotor currents at standstill.

$f = \frac{\text{cycle}}{\text{sec}}$

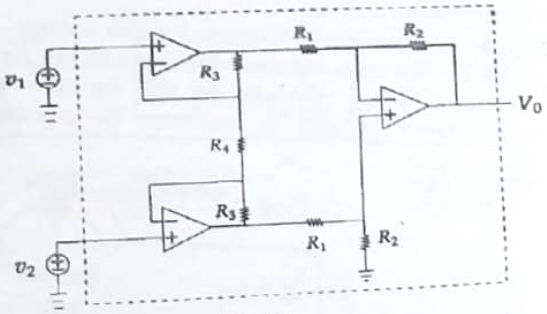
$= \frac{\text{cycle}}{\text{rev}} \times \frac{\text{rev}}{\text{sec}}$

SECTION-B

Question 5 (Compulsory)

a. The circuit diagram shown in Fig. 5(a) is an instrumentation amplifier which is used to provide large amount of gain for very low-level signals. Derive the following expression where V_o is the output and V_1 and V_2 are the inputs to the amplifier. (10)

$$V_o = \frac{R_2}{R_1}\left(1+\frac{2R_3}{R_4}\right)(v_2-v_1)$$



Block C

Fig: 5(a)

b. In a measurement system for a chemical plant, a thermocouple is used as a transducer to measure temperature variation. As output from the thermocouple produces very low level signal, an instrumentation amplifier is used after to provide large gain. In addition to that, to ensure reliability of the measured data, the output from the transducer is taken 3 times at particular time intervals and the values taken are averaged to get the final value. The total system is shown in fig. 5(b) where the block "C" is the block shown in fig. 5(a) (12)

The 3 readings of the transducer output are given in tabular form in Table-1.Evaluate the final output of the system V_{output} if $R_1 = 1\Omega$, $R_2 = 5\Omega$, $R_3 = 7\Omega$, $R_4 = 1\Omega$, $R_5 = 2\Omega$, $R_6 = 6\Omega$

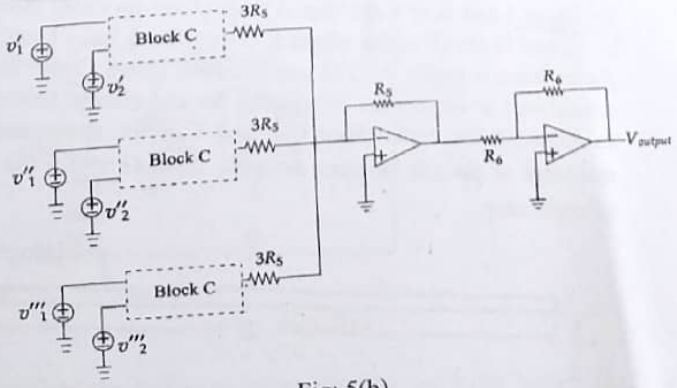


Fig: 5(b)

Table: 1

Readings	Value
First Reading of differential input: $v_2' - v_1'$	2.1 mV
Second Reading of differential input: $v_2'' - v_1''$	2.3 mV
Third Reading of differential input: $v_2''' - v_1'''$	2.7 mV

c. To measure the effect of the thermal noise in the system mentioned in question 5(b), a parameter called "noise voltage" should be calculated which will help to design filters to eliminate noise from the system. Formulate the following expression of noise voltage V_n. 08

$$V_n = \sqrt{4kTBR_L}$$

Where, k= Boltzmann's Constant, T= Temperature, B= Noise Bandwidth, R_L= Load Resistance.

Question 6

a. Fig. 6(a) shows a secondary transducer which consists of two stages where the first stage includes a bourdon tube and the second stage includes a LVDT. Demonstrate that the conversion of pressure to voltage happens in two stage by explaining the operation. 12

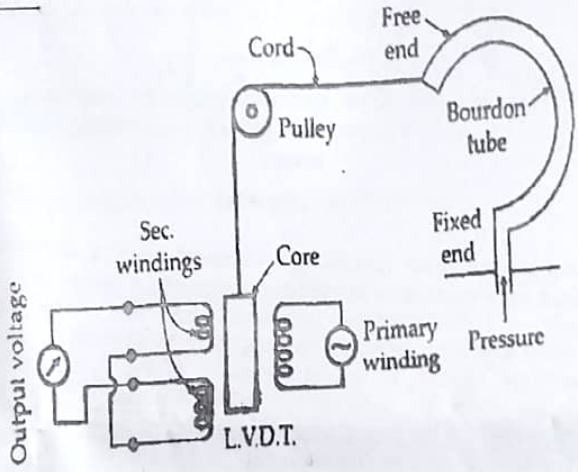


Fig: 6(a)

b. A push-pull non-contact capacitive transducer is shown in Fig. 6(b). It consists of four parallel plates separated by air. Plates A, C, and D are fixed plate and plate B can be moved. Plate B has a thickness t and is at a distance d from plates on either side. Plates B, C, and D are all of the length l, while plate A has a length 2l. All plates have a width w. The gap between plates C and D can be considered as negligible. Neglecting the end effects, formulate the expressions for capacitance C_{AC} and C_{AD} for movement of the midpoint of plate B between $x = \pm l/2$. Assume x=0 is the position of symmetry. 12

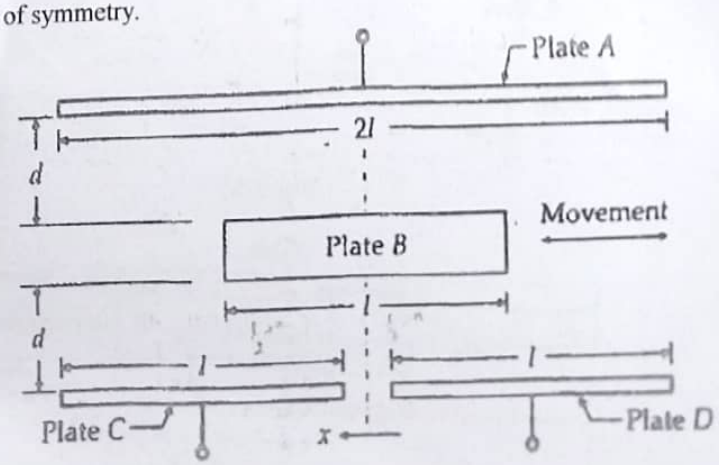


Fig: 6(b)

c. Fig. 6(c) shows a segment of a wire used in strain gauge transducer before and after stress is applied along the horizontal axis. Evaluate the gauge factor G_f and poisson's ration v. Assume resistance change due to piezoresistive effect $\frac{\Delta\rho/\rho}{\varepsilon} = 0.01$. 06

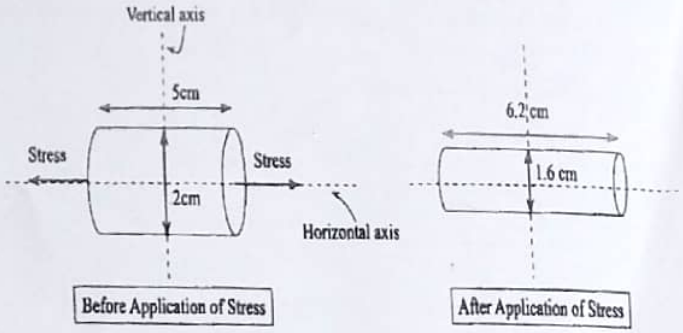


Fig: 6(c)

Question 7

a. The circuit diagram shown in fig. 7(a) is used in the signal conditioning stage of a measurement system to convert analog data. Explain the operation of the circuit and draw-back of the designed circuit if Block 'B' is not included in the design. 08

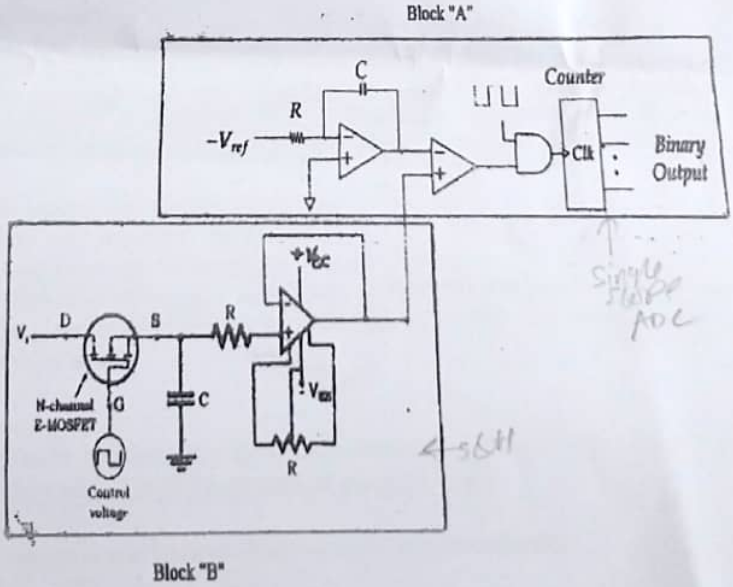


Fig: 7(a)

b. Formulate the following expression for an R-2R ladder DAC if input bit sequence 1001 is fed into the DAC. 15

$$V_o = (-\frac{R_f}{R})(\frac{V_{ref}}{16} + \frac{V_{ref}}{2})$$

Where, V_{ref} is the reference voltage, R_f is the feedback resistance of op-amp and V_o is the output of the DAC. Also, deduce the expression if the bit sequence is first passed through an inverter.

c. The reference voltage to a 3-bit flash ADC is 8V and input voltage is 6.3V. Determine the output bit-sequence of the ADC with the help of a neat sketch. 07

Question 8

a. In a measurement system, to measure the variation of temperature, a resistance temperature detector (RTD) is used in one arm of a wheatstone bridge. Due to temperature variation when the resistance value changes in RTD, there is deflection in the DVM as shown in fig. 8(a). Explain the operating principle of a ramp type DVM with neat sketch and justify why it would be suitable for this kind of system. 12

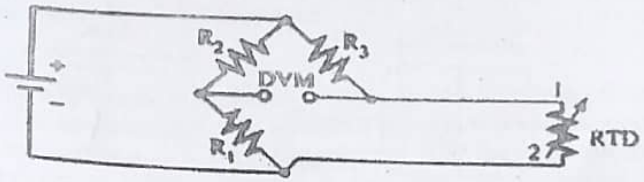


Fig: 8(a)

b. For analysis of noise in a measurement system, one need to first understand what kind of noise it is, then quantify the amount of noise in the system followed by investigation of how the noise is entering the system and finally take necessary steps for noise mitigation. Briefly explain the terms associated with each of these steps shown in fig. 8(b); in context of a real measurement system. 18

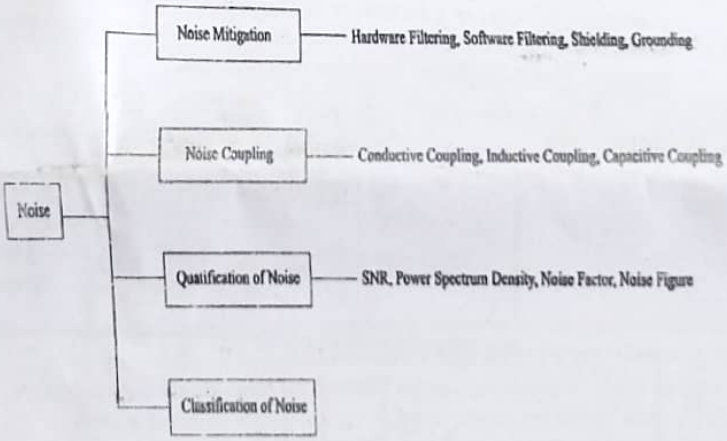


Fig: 8(b)

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering, Term Final (Spring) Examination 2022: Aug 2022

Student Group: 36 < Earned Credit Hours ≤ 72

Subject: CSE–205, Object Oriented Programming Language

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory
c. Answer any other **TWO** questions out of **THREE** from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

Consider the following code segment and answer the questions from Question-1(a) to Question-1(d).

```
#include<iostream>
#include<string.h>
using namespace std;

class X{
    char *s1, *s2;
public:
    X(char *s1, char *s2){
        this->s1 = new char[strlen(s1)+1];
        strcpy(this->s1, s1);
        this->s2 = new char[strlen(s2)+1];
        strcpy(this->s2, s2);
        cout<<"Constructor for "<<s1<<"-"<<s2<<endl;
    }
    X(const X &ob){
        this->s1 = new char[strlen(ob.s1)+1];
        strcpy(this->s1, ob.s1);
        this->s2 = ob.s2;
        cout<<"Copy constructor for "<<ob.s1<<"-"<<ob.s2<<endl;
    }
    void print(){
        cout<<this->s1<<"-"<<this->s2<<endl;
    }
    friend void f(X);
};

void f(X ob){
    strcpy(ob.s1, "KBC");
    strcpy(ob.s2, "01");
}

int main(){
    X ob1("ABC", "00"), *ob2;
    ob2 = new X("ABC", "02");
    ob1 = *ob2;
    X ob3 = ob1;
    X ob4("ABC", "01");
    f(*ob2);
    f(ob4);
    ob1.print();
    ob2->print();
    ob3.print();
    ob4.print();
}
```

a. Identify why *f* been defined as friend function of class-X. 5

b. Suggest two ways for executing the code without any error if *f* is not declared as the friend function of class-X. 5

getter ()

c. Write down the output of the code snippet with appropriate explanation of each line. 10

d. Identify the possible problems if "call by value" is used for passing an object of class-X to any function. Extend the design of class-X to solve problems. 10

Question 2

a. Define inline functions and explain the cases when a compiler may ignore the inline feature of a function. 8

b. Briefly explain the features of Object Oriented Programming Language and highlight two major advantages of Object Oriented Programming Language over Structured Programming Language. 10

c. Assignment operator (=) by default performs bitwise copy of one operand to another. Write a code in C++ language where such copying creates problems. 12

Question 3

a. Explain why a destructor cannot be overloaded in a class. 7

b. Explain why default parameters are placed as the last parameters of a function. 7

c. Describe the advantages of new and delete operators over *malloc* and *free* functions. 7

d. Consider the following two global functions with the same name *print* written in a program. 9

```
void print(int a, float b)
{
    cout<<a<<b;
}

void print(float a, int b)
{
    cout<<a<<b;
}
```

Describe whether this type of function overloading can create any problem in the program or not. Is yes, then suggest a technique to overcome this problem without creating any class in the program.

Question 4

a. Describe different types of access specifiers in Object Oriented Programming Language. 7

b. Illustrate a scenario where the forward declaration of a class is mandatory. 7

c. Explain why it is mandatory to write a default constructor of a class if an array of objects of that class is declared where the size of the array is a variable. 7

d. Consider the following declaration of a map ***m*** belonging to the standard template library of C++ language. 9

```
map <int, vector<int> > m;
```

Now write a function in C++ language that iterates over all the elements of ***m*** and sorts all the vectors in ***m*** in ascending order. You may use the built-in function in C++ for sorting a vector. The required header file is #include<algorithm>

SECTION-B

Question 5 (Compulsory)

Suppose after graduating from MIST, you joined a startup company that's making an application that may revolutionizes the small boutique shops.

As a junior software engineer, you were asked to conduct client interviews to gather insights on the boutique shops information architecture.

From your interview, you identified the structure isn't that complex. Here's the description of the structure that you reported.

"Shops" have the attributes of ID, name and license number. They should also have the feature to "view-info( )". However, this method isn't defined.

"Regular-shops" are shops that haven't gone online yet. They have the same attributes as "Shops" but additionally, showroom-address also needs to be stored.

Then there are "online-shops". They also have all the features and attributes line "Shops". Additionally, an online-link to their facebook page or website needs to be stored.

"view-info" is defined for both ("regular-shops") and ("online-shops").

Lastly there are some shops that have both physical showroom and online website. They have the combination of the attributes of "online-shops" and "regular-shops".

Now based on the description above, answer the following questions.

a. Analyze the scenario to form four different classes. Then, draw a simple inheritance diagram to connect the classes as per your understanding. **10**

You don't need to worry about access specifiers and method definition.

b. Now, in the diagram that you drew in answer to question 5(a), denote the following **5**
   (i) Multiple and multilevel inheritance
   (ii) Interface(s), Abstract class(es) and Concrete class(es).

c. In your drawn diagram, if a child class inherits the parent class in private mode, would there be any problem in accessing the parent's functions using an object of child class? **5**

   If so, how may we solve it?

d. Analyze the given inheritance scenario and discover where "diamond problem" exists here. **10**

   Why is it bad in term of memory efficiency? Demonstrate how this may be solved particularly for this scenario.

Question 6 10

a. Consider the scenario given in question 5.

Based on your solution, demonstrate the call sequence of constructors and destructors if we were to declare an object of "hybrid-shops". 10

b. Take a look at the code snippet below.

```
void display(Shops *obj)
{
    obj->view_info( );
}

int main( )
{
    Shops *ptr;
    Online_shops s1;
    ptr = &s1;
    s1.view_info( );
    display(&s1);
    ptr->view_info( );
}
```

Which of the calls to view_info( ) and display( ) would work?

For the calls that you think will generate errors, explain why that is your deduction.

c. Analyze the code snippet in question 6(b) once again and comment on how late binding may be beneficial in this case. 10

Taking the given scenario as an example, also explain how late binding is implemented internally.

Question 7 5x4 = 20

a.

```
1  #include <iostream>
2  using namespace std;
3  class Subject
4  {
5      int partI;
6      int partII;
7  public:
8      Subject(int p1, int p2)
9      {
10         partI = p1;
11         partII = p2;
12     }
13
14 };
15 int main()
16 {
17     Subject cse205(80,80);
18     Subject cse203(70,65)
19
20     int res = cse205-cse206; ///CSE203's(partI+partII) - CSE206's(partI+partII)
21     int bonus = 10 + cse205 ///both partI and partII will be increased by 10 and sum of them to be returned.
22     cse206--; ///decreases the value of partI and  II by 5 marks.
23     int re = cse203[1] ///returns the value of partI if 1 is passed and partII if 2 is passed.
24     int total_marks = cse205; ///stores partI+partII in total_marks
25
26 }
```

Take a look at the code snippet above. Now, modify the code in such a way so that lines 20 to 24 work as intended. Follow the comments given with the code for each line.

For each operation, decide whether to use member or non-member functions and if address need to be returned. Explain your choices accordingly.

Constructing appropriate code snippets as necessary would be sufficient.

b. Explain the concept of "functors" in C++ programming language with the help of appropriate code snippet. **10**

Question 8

a. Consider the scenario given in question 5. If you wanted to store the information of a hybrid shop in a file for future reference, how would you do it? **10**

Demonstrate with example.

b. Explain when random file access may be necessary for a C++ program. **5**

c. If we wanted to redirect the "stderr" stream to a user-created file "log.txt" how would we do it? Explain when this may be helpful. **7**

d. "Exception handling doesn't call to the "catch( )" method, it jumps the control execution"-justify the statement. **8**

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering, Term Final (Spring) Examination 2022: Aug 2022

Student Group: 36 < Earned Credit Hours ≤ 72

Subject: CSE–217 , Theory of Computation

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory
c. Answer any other **TWO** questions out of **THREE** from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. What are the usages of finite automata? Analyze and comment on the language recognition capability of Non-deterministic Finite Automata (NFA) and Deterministic Finite Automata (DFA) with relevant examples. **2+5 = 07**

b. DFA D_1 has an alphabet $\Sigma=\{a,b\}$. D_1 accepts the strings that contains at least two consecutive a's and does not contain two consecutive b's. As such strings like aa, aab, babaa will be accepted and bb, abb, abab will be rejected. Sketch the state diagram of D_1. **15**

c. Write down the formal definition of NFA. **08**

Question 2

a. Construct the following NFA to an equivalent DFA: **10**

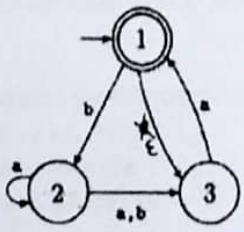


Fig 2(a)

b. Prove that, the class of regular languages is closed under union operation. **12**

c. Define the following: **08**
i. Language
ii. Alphabet
Write down the differences between complexity and computability.

Question 3

a. We have got an NFA $N_1 = \{Q_1, \Sigma, \delta_1, q_1, F_1\}$ which recognizes the language L_1. We want to construct $N = \{Q, \Sigma, \delta, q_0, F\}$ to recognize L^*. In this process, we defined δ for N such that for any $q \in Q$ and any $a \in \Sigma_\varepsilon$. **20**

$$\delta(q,a) = \begin{cases} \delta_1(q,a) & q \in Q_1 \text{ and } q \notin F_1 \\ \delta_1(q,a) & q \in F_1 \text{ and } a \neq \varepsilon \\ \delta_1(q,a) \cup \{q1\} & q \in F_1 \text{ and } a = \varepsilon \\ \{q1\} & q = q_0 \text{ and } a = \varepsilon \\ \varnothing & q = q_0 \text{ and } a \neq \varepsilon \end{cases}$$

Explain clearly in plain English (stressing on the purpose) each of the conditions (at right) in the above transition.

b. Define regular expression. Convert the regular expression $(a \cup b)^*aba$ into equivalent NFA by showing the state diagram. **10**

Question 4

a. Convert the following DFA into an equivalent regular expression. **10**

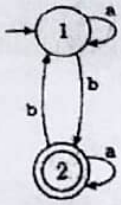


Fig 4(a)

b. Define non-regular language with an example. Explain how the pumping lemma for regular languages can be used to detect irregular languages explaining each part of the lemma. **08**

c. Prove that the language $L=\{0^n1^n2^n \mid n \geq 0\}$ is not regular by using pumping lemma. **12**

SECTION-B

Question 5 (Compulsory)

a. Design Context Free Grammar (CFG) for each of the following languages: **10**

(i) $L_1 = \{0^n1^m \mid m,n \geq 0;\ 2n < m < 3n\}$

(ii) $L_2 = \{0^n1^m \mid m,n \geq 0;\ n \neq m\}$

b. Derive the leftmost and rightmost derivation of string a*(a+b00) by using the following CFG. **10**

1. $E \rightarrow I$
2. $E \rightarrow E + E$
3. $E \rightarrow E * E$
4. $E \rightarrow (E)$

5. $I \rightarrow a$
6. $I \rightarrow b$
7. $I \rightarrow Ia$
8. $I \rightarrow Ib$
9. $I \rightarrow I0$
10. $I \rightarrow I1$

Fig 5(b)

Also construct the corresponding parse tree for each of the derivation for the same string.

c. Define ambiguous grammar. Prove that the following grammar is ambiguous. **10**

$S \rightarrow AS \mid \epsilon$

$A \rightarrow 0A1 \mid A1 \mid 01$

Question 6

a. Write down the formal definition of Chomsky Normal Form (CNF). List the main steps of conversion to CNF from a CFG. **08**

b. Convert the following CFG into Chomsky Normal Form. **12**

$S \rightarrow aA \mid bB \mid b$

$A \rightarrow Baa \mid ba$

$B \rightarrow bAAb \mid ab$

c. Covert the following DFA to equivalent CFG: **10**

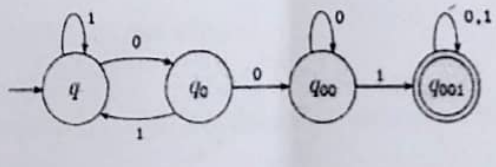


Fig 6(c)

Question 7

a. Why do we need Push Down Automata? Mention the difference between Push Down Automata (PDA) and Finite Automata (FA). **08**

b. Design Push Down Automata (PDA) for each of the following languages: **10**

(i) $L = \{0^n 1^n \mid n \geq 0\}$

(ii) $L = \{a^i b^j c^k \mid i=j;$ or $i=k\}$

c. State pumping lemma for context free languages. Using pumping lemma prove whether the language $L = \{0^n 1^n 2^n \mid n \geq 1\}$ is context free or not. **12**

Question 8

a. Design Turing Machine that decides each of the following languages: (state diagram only) **20**

(i) $D = \{0^{2^n} \mid n \geq 0\}$

(ii) $E = \{0^n 1^n \mid n \geq 0\}$

b. Define the following terminologies with example where necessary. **10**

(i) Turing Recognizable

(ii) Turing decidable