JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH./CSE/PCC-CS401/2022-23

COMPUTER ARCHITECTURE

Full Marks: 70 Time: 3 Hour

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer all questions 5x2=10

1. What is the speed up of a 5-stage pipeline processor with a clock rate of 25 MHz over an equivalent non-pipelined processor when 1500 instructions are being executed? 2
2. State the Bernstein's conditions for parallelism 2
3. What is 90-10 rule? 2
4. Define vector strip mining. 2
5. What is the function of TLB? 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***four*** questions 4x15=60

6. i) Discuss the vector gather and vector scatter instructions with diagram. 5
   ii) Write the advantage and disadvantage of register-register vector architecture and memory-memory vector architecture? 5
   iii) Draw a diagram of vector processor and explain the working principle of instruction execution through vector processor. 5

7. i) Define data flow, control flow and reduction computers. 5
   ii) List some potential problems with data flow computer implementation. 2
   iii) If the size of MAR and MBR are 32-bit and 16-bit respectively, what is the size of main memory? 3
   iv) Show the data flow execution of X = (a + b) / (a - b) considering a=10, b=5. 5

8. i) What is non-linear pipelining? Discuss different types of data forwarding techniques to improve the performance of instruction pipelining. 1+4
   ii) What is pre-fetch buffer? How does pre-fetch buffer help to improve the throughput of instruction pipeline? 2+3
   iii) What is vector chain? Show the vector chaining implementation of the following equation with a diagram. $S_k = \sum_{i=1}^{k} A_i * B_i$ for i=1 to k and S_0=0. 2+3

9. i) Define memory hierarchy. What are the common objectives of memory hierarchy? 1+1
   ii) Explain inclusion, coherence and locality of reference properties of memory hierarchy. 7
   iii) Consider a two level memory hierarchy, M1 and M2. Denote the hit ratio of M1 as h. Let c1 and c2 be the costs per KB, s1 and s2 the memory capacities, and t1 and t2 the access times, respectively.
      a) Under what conditions will the average cost of the entire memory system approach c2?
      b) Find effective access time t_{eff} of this memory system.
      c) Let r = t2/t1 be the speed ratio of the two memories. Let E = t1/ t_{eff} be the access efficiency of the memory system. Express E in terms of r and h. 6

10. i) Describe UMA, NUMA and COMA with their architectural diagram. 8
    ii) How shared memory system is different from distributed memory system? 2
    iii) Implement the data routing logic of SIMD architecture to compute 5
    $S_k = \sum_{i=0}^{k} A_i$ for i=0 to k and k=0 to N-1

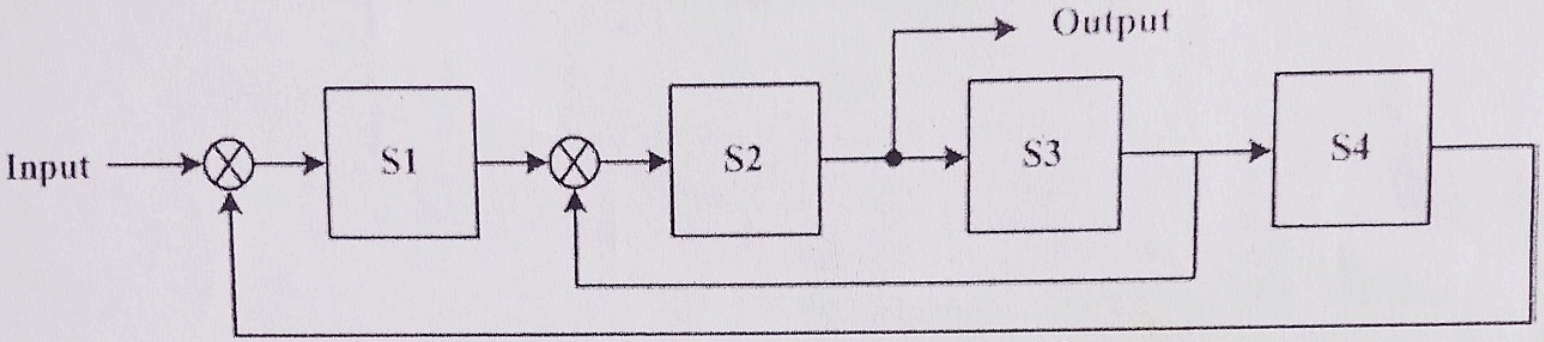
11. i) What are logical address and physical address? If segment no. is 8, page no. is 04, word no. is 40. Segment no. 8 hold 30 and page no. 30 hold 019, what will be corresponding physical address? Answer with diagram. 2+3

ii) What is Belady's Anomaly? Give an example.

iii) State the LRU algorithm for page replacement. Find the page fault for the following page sequence with four frames. 01,03,07,03,05,05,09,10,07,06,11,10,09,11,01,07,06,09,10 3+

12 i) Define super pipeline and superscalar pipeline with the help of stage-clock diagram. 4

ii) Consider the following pipelined processor with four stages. This pipeline has a total evaluation time of six clock cycles. All successor stages must be used after each clock cycle.



a) Specify the reservation table for this pipeline with six columns and four rows. 3

b) Derive the initial collision vector and draw the state diagram which shows all possible latency cycles. 5

c) Find all greedy cycle and compute the minimum average latency. 3

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JGEC/B.TECH/CSE/PCC-CS403/2022-23

2023

Object Oriented Programming

Full Marks: 70 Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions 5x2=10

1. Why a final class is called a complete class? [2]
2. What is the meaning of super keyword? [2]
3. What is byte code? [2]
4. Define pure virtual function. [2]
5. "Threads are called light weight process"- Explain. [2]

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***four*** questions 4x15=60

6. i. What do you mean by structure oriented programming and object oriented programming? Explain different features of object oriented programming. [2+4]
   ii. How are static and non-static members accessed in Object Oriented programming? Explain with suitable example. [6]
   iii. What is copy constructor? Explain with programming code snippet. [3]

7. i. Explain different forms of inheritance in Object Oriented Programming. [6]
   ii. What is constructor chaining? How are constructor and destructor executed in inheritance? Explain with suitable programming code. [1+5]
   iii. State the reason for making a class virtual with the help of example. [3]

8. i. Overload '+' and '*' operators to carry out addition and multiplication of two matrices using friend functions. [3+3]
   ii. What is an interface? How to overcome multiple inheritances using interface? Explain with example. [1+4]
   iii. Explain the differences between java stand-alone application program and java applet program. [4]

9. i. What is an exception? Describe throw and throws statement used in exception handling? [1+4]
   ii. Define a custom exception class "OverflowException" that is thrown when a stack is overflow. Write a code snippet that uses this exception. [1+5]
   iii. What do you mean by checked and unchecked exception? Explain with proper examples. [4]

10. i. What is a thread? Explain the complete life cycle of a thread object with proper diagram. [1+4]
    ii. What are the two ways of implementing thread in Object oriented programming? Explain with suitable programming code. [6]
    iii. What is thread synchronization? When do we use it? Explain with example. [4]

11. i. Discuss the various levels of access modifiers available for packages. [6]
    ii. What do you mean by method overloading and method overriding? Explain with examples. [6]
    iii. How do we add a class to a package? Explain with programming code. [3]

12. i. Explain the differences between abstract class and interface. [5]
    ii. State the reason for making a class friend with the help of example. [4]
    iii. What is command line argument? Write a program to arrange a set of strings in alphabetical order where string constants are given by command line argument. [1+5]

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2023

DESIGN AND ANALYSIS OF ALGORITHMS

Full Marks: 70 Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are requested to write their answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer *all* questions 5x2=10

1. What is the difference between optimal solution and feasible solution?
2. Why path compression technique is used?
3. What are heuristics? Do they always guarantee solutions?
4. What is the difference between algorithmic complexity and computational complexity?
5. Do solutions exist for one, two, and three queen problems? - Justify your answer.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions 4x15=60

6. i) Given the weight vector(15,25,35,45,55) and the profit vector(10,20,30,40,50) and a knapsack of capacity 100, find out the optimal solution for the knapsack problem of five objects — 8
   ii) Explain the Bellman-Ford algorithm. Calculate it's time complexity. — 6+1
7. i) Discuss the procedure for Strassen's matrix multiplication to evaluate the product of nxn matrices. Find the resulting recurrence relation for the same and calculate it's time complexity. — 3+3
   ii) Explain the Travelling Salesperson problem with an example and solve it with dynamic programming concept. — 5
   iii) How you will solve the 0/1 knapsack problem using dynamic programming algorithm? — 4
8. i) What is Turing's halting problem? Prove that halting problem is an undecidable problem. Explain the concept of polynomial time reduction with an example. — 2+3+5
   ii) Write down the all pair shortest path algorithm. Calculate it's time complexity. — 4+1
9. i) Compare and contrast between greedy method and dynamic programming. Write down the recursive and non-recursive approach of backtracking algorithm. — 3+6
   ii) Prove that the average case time-complexity of quick sort algorithm is O(n log n).
10. i) Explain the strategy to solve the 15-puzzle problem. Also draw the necessary steps required to solve the problem. — 6
    ii) Prove that SAT is NP-complete problem? — 5
    iii) If $f(n)=a_m n^m + a_{m-1} n^{m-1} + \ldots + a_1 n + a_0$, where $a_m > 0$, then show that $f(n)=O(n^m)$. — 5
11. i) Write down the kruskal's algorithm to find out the minimal spanning tree of an undirected graph. — 5
    ii) Find the minimum number of operations required for the following matrix chain multiplication using dynamic programming method: A(4X5)*B(5X3)*C(3x2)*D(2X7). — 3
    iii) How would you show that a decision problem is NP-Complete? — 7
12. i) What is the principle of optimality condition? How is it satisfied in graph coloring problem? — 5
    ii) Trace the steps to solve the 4-Queens problem by backtracking method. For each step draw the 4x4 matrix showing the positions of queens in it. Show where you apply backtracking. Draw the portion of the state space tree for n = 4 queens using backtracking algorithm. — 2+3

2+2+2+4

END

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
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COE/B.TECH./CSE/PCC-CS404
2023
FORMAL LANGUAGE & AUTOMATA THEORY

Full Marks: 70 Times: 3 Hours

The figures in the margin indicate full marks.
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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions 5x2=10

1. Define context free grammar with a suitable example.
2. Define Nondeterministic Pushdown Automata (NPDA) with a suitable example.
3. State the Pumping Lemma for Context Free Languages.
4. Define an extended function of NFA with example.
5. Define regular expression with a suitable example.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

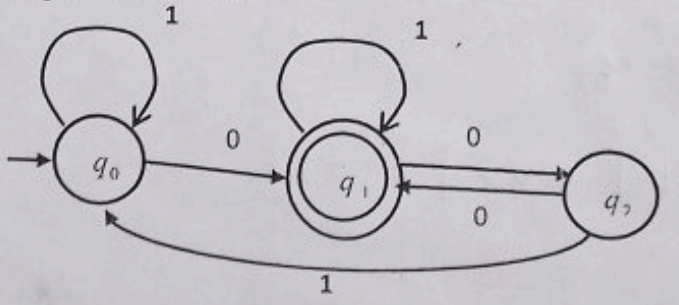
Answer any ***four*** questions 4x15=60

6. i) Prove that the following language is context-free language. 5
$$L = \{a^n\, b^m : n, m \geq 0\}$$
ii) Prove that the family of context free languages is closed under union, concatenation and star closure. 5
iii) Prove that the following language is not regular language using pumping lemma for regular languages: $L = \{ a^{n!} : n \geq 0 \}$ 5

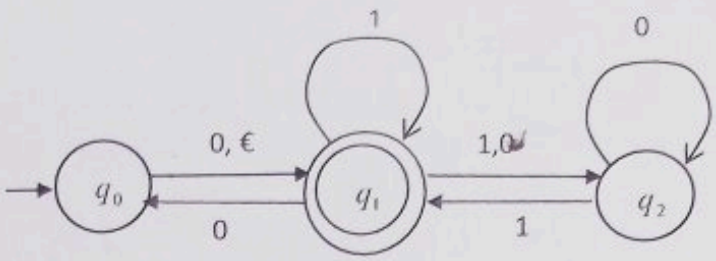
7. i) Define Greibach normal form (GNF) and Chomsky normal form (CNF) with suitable examples. 5
ii) Convert the following grammar into Chomsky normal form:
$G = (V, T, P, S), where\ V = \{S, A, B\}, T = \{a, b\}, P = \{S \rightarrow ABa, A \rightarrow aab, B \rightarrow Ac\}$ 5
iii) Construct the finite automata for the following language:
$L = \{a^n\, b^m : n \geq 0\} \cup \{a^n\, b^n : n \geq 0\}$ 5

8. i) Construct the NPDA mentioning all seven tuples for the following language: 5
$$L = \{ a^n\, b^{2n} : n \geq 1 \}$$
ii) Prove that the following language is not context free language using pumping lemma for context free languages: $L = \{ 0^n 1^n 2^n : n \geq 0 \}$ 10

9. i) Construct a Turing Machine (TM) over the input alphabet $\sum = \{0,1,\#\}$, where 0 indicates blank, which takes a non-null string of '1' and '#' and transfer the rightmost symbol to the left hand end. Thus, 000#1#1#1000 becomes 0001#1#1#000. 5
ii) Define Nondeterministic Turing Machine, Universal Turing Machine, and Unrestricted grammar. 4
iii) State the Arden's Theorem and construct the regular expression for the following diagram by the algebraic method using Arden's Theorem: 6



10. i) Convert the following NFA into an equivalent DFA. 10



ii) Construct the finite automata corresponding to the regular expression is $L((a+b)^*)$ 5

11. i) Define an ambiguous Grammar explaining the reasons with a suitable example. 5

ii) Construct the DFA for the following language:

$$L = \{w \in \{a,b\}^* : |w| \ mod \ 3 \geq 0\}$$ 5

iii) Prove that every regular language is a context free language, but the vice versa is not true. 5

12. Write short notes on any three of the following topics: 3x5=15

i. Negative properties of Context Free Languages.
ii. Finite Automata.
iii. Hierarchical structure of all different kind of Automata & their corresponding languages (explain with a Venn diagram).
iv. Turing's Thesis.

$S \rightarrow aSb \quad S \rightarrow \varepsilon$

EG -> $S \rightarrow aSb \mid abb \mid aab \mid \varepsilon$

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/ CSE /BS-M401/2022-23
2023
MATHEMATICS - III

Full Marks: 70 Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions $5 \times 2 = 10$

1. What is the size of a cubic graph on 10 vertices? Draw the graph. 2

2. Give an example of a graph which is Hamiltonian but not Eulerian and an example of a graph which is Eulerian but not Hamiltonian. 2

3. Find the radius of convergence of the series $x + \frac{1!}{2^2}x^2 + \frac{2!}{3^3}x^3 + \frac{3!}{4^4}x^4 + \cdots$ 2

4. Using Green's theorem, show that $\frac{1}{2}\oint_C (xdy - ydx)$ = area of the region enclosed by the closed curve C. 2

5. Change the order of integration and then evaluate $\int_{y=0}^{1} dy \int_{x=0}^{y} e^{\frac{y}{x}} dx$. 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***five*** questions $12 \times 5 = 60$

6.(i) Test the convergence of the series 4

$$\frac{x}{1} + \frac{1}{2}.\frac{x^3}{3} + \frac{1.3}{2.4}.\frac{x^5}{5} + \frac{1.3.5}{2.4.6}.\frac{x^7}{7} + \cdots\cdots\cdots (x > 0.$$

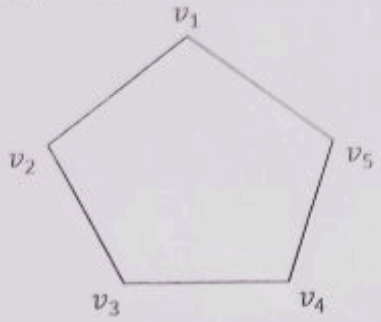
(ii) Prove that the series $x - \frac{x^2}{2} + \frac{x^3}{3} - \cdots\cdots\cdots$ is absolutely convergent when $|x| < 1$ and conditionally convergent when $x = 1$. 4

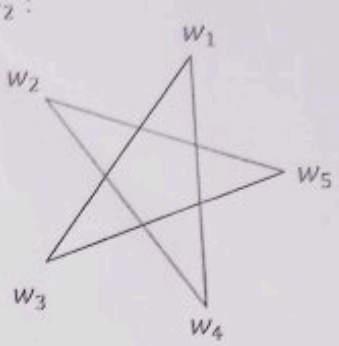
(iii) Check the convergence of the sequence $\{a_n\}$ where 4

$$a_n = 1 + \frac{1}{2!} + \frac{1}{3!} + \ldots\ldots\ldots + \frac{1}{n!}.$$

1+1+2

7. (i) Find the adjacency matrices of the graphs G_1 and G_2 :





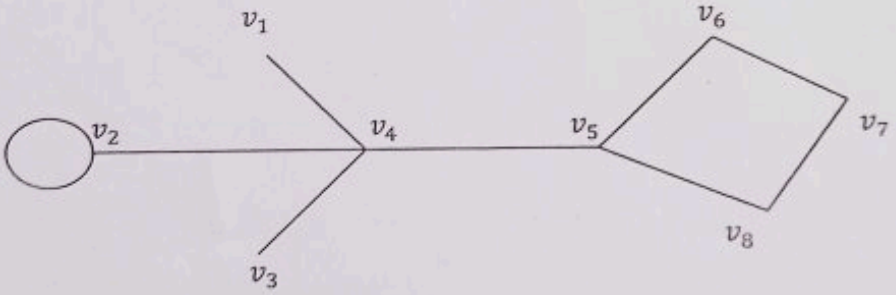
Examine whether the graphs are isomorphic or not .

(ii) If a graph G has exactly two vertices of odd degree , show that there must be a path joining these two vertices. 4

(iii) Show that a tree with n vertices has $n-1$ edges. 4

8. (i) Show that every connected graph has at least one spanning tree. 4

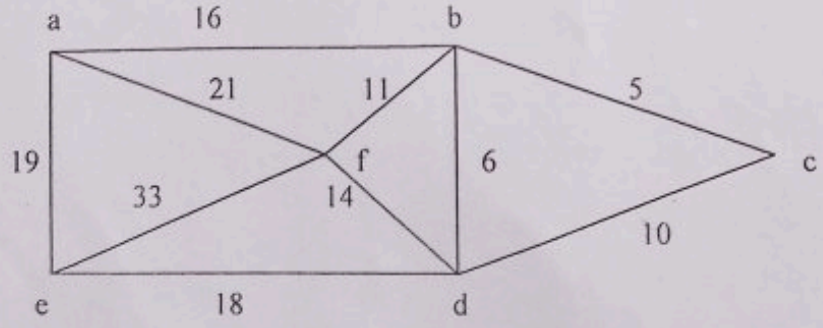
(ii) Find all the spanning trees of the following connected graph : 4



(iii) 4

Use Prim's algorithm to find the minimal spanning tree in the graph G given below :

G :



9. (i) Show that the differential equation $(x^3 - 3x^2y + 2xy^2)dx - (x^3 - 2x^2y + y^2)dy = 0$ is exact. Hence solve it, given that $y = 1$ at $x = 1$. 6

(ii) Solve: $\left(xy^2 - e^{\frac{1}{x^3}}\right)dx - x^2ydy = 0.$ 6

10. (i) Solve: $p^3x - p^2y - 1 = 0.$ 4

(ii) Solve: $\frac{dy}{dx} - \frac{tany}{1+x} = (1+x)e^x secy.$ 4

(iii) Solve: $(x^2y - 2xy^2)dx + (3x^2y - x^3)dy = 0.$ 4

11. (i) Solve: $(D^2 - 5D + 6)y = x^2e^{3x}.$ 4

(ii) Solve: $(D^2 - 2D)y = e^x sinx.$ 4

(iii) Show that if $l\frac{d^2\theta}{dt^2} + g\theta = 0, \theta = \alpha$ and $\frac{d\theta}{dt} = 0$ when $t = 0$, then $\theta = \alpha cos\sqrt{\frac{g}{l}}t$ (g, l are positive). 4

12. (i) Solve by method of variation of parameters: $\frac{d^2y}{dx^2} + y = xsinx.$ 4

(ii) Solve: $x^2\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = (logx)^2 - logx^2.$ 4

(iii) Obtain the general and singular solution of $y = px + \sqrt{4p^2 + 9}.$ 4

13. (i) Using Green's theorem evaluate $\oint_C (xydx + y^2xdy)$, where C is the closed curve bounded by $y = x$, $y = 0$ and $x = 1$. 4

(ii) Determine $\iint_R (x^2 + y^2)dxdy$ where R is the region bounded by the curves $y = x^2$, $x = 2$ and $y = 1$. 4

(iii) State Stoke's theorem. Evaluate $\int_C \vec{F}.d\vec{r}$ by Stoke's theorem, where $\vec{F} = y^2\hat{\imath} + x^2\hat{\jmath} - (x+z)\hat{k}$ and C is the boundary of the triangle with vertices at (0,0,0), (1,0,0), (1,1,1). 4

$y = e^z \quad z = \log y$

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[A GOVERNMENT AUTONOMOUS COLLEGE]

JGEC/B.TECH/CSE/MC-401/2022-23

2023

ENVIRONMENTAL SCIENCES

Full Marks: 70 Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions 5x2=10

1. What is bio-geochemical cycle?
2. Write down the components of environmental management.
3. Define the terms COD and BOD.
4. Mention some air pollutants produced by humans?
5. Name six greenhouse gases.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***four*** questions 4x15=60

6. i) What are resources? In how many categories can resources be classified? Discuss in brief. 2+5
   ii) Why is coal considered to be a resource? Discuss in details about 'energy resources'. 2+4
   iii) What are main sources of air pollutants and its consequences? 2

7. i) What is exponential growth of population? Prove that for exponential growth $Nt = N_0e^{Rt}$. the symbol has their usual meaning. 2+3
   ii) What is doubling time of population? Prove that doubling time of population $t_d = 70 / R$ (%). R is population growth rate constant. 2+3
   iii) In what condition the doubling time and half life time of population be same? Write down the differences between exponential growth model and logistic growth model of population. 2+3

8. i) What is thermal pollution? How does thermal pollution affect the environment? How can you control thermal pollution? 1+3+3
   ii) Write down the importance of dissolve oxygen in as water quality parameter. 2
   iii) In a $(BOD)_5$ test- (a) Why it is necessary to cover bottle with a stopper? (b) What is the necessity of diluting of waste water sample? (c) What will be the ratio of (BOD)5 at 20 °C, to that of (BOD)2.5 at 35 °C. 2+2+2

9. i) What do you mean by environmental auditing? What are the types of environmental audit? What are benefits of auditing? Name some important international agreements and treaties. 2+2+3+2
   ii) Discuss in brief about (a) Montreal protocol (b) Kyoto Protocol. 3+3

10. i) Explain the various layer of atmosphere. Define the term temperature lapse rate. 4+1
    ii) How does air pollution affect human health? What are the measures for control of air pollution? 3+4
    ii) "Central pollution control board play an important role in protection of environment" Justify the statement. 3

11. i) What is Global Warming? Explain factors responsible for it. 1+4
    ii) What is acid rain? Name the gases responsible for acid rain. 3+1
    iii) What is Smog and how is it created? Also, mention the types of smog. 4+2

Jalpaiguri Government Engineering College
Unit Test-II, Even Semester 2023
Design and Analysis of Algorithms (PCC-CS402)

Full Marks: 15 **Time Allotted: 45 Minutes**

Answer any three questions: 5×3=15

1. How you will solve the 4-queens problem using backtracking method? Show every steps of your solution. 3+2
2. Find the minimum number of operations required for the following matrix chain multiplication using dynamic programming: A(5X4)*B(4X7)*C(7X3)*D(3X9). 5
3. Explain the Bellman-Ford algorithm with an example? What is it's time complexity? 4+1
4. What is an LC search? How is it useful to solve the 15-puzzle problem? 2+3

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE

Subject: Object Oriented Programming **Subject code: PCC-CS403**

Full Marks: 15 **Time: 45 minutes**

Answer all questions:

1. What do you mean by checked and unchecked exceptions? Create a custom exception class **"MyException"** which is explicitly thrown when a stack is overflow and print a stack trace **"Stack is Overflow"**. [2+3]
2. Describe different types of access modifiers available in object oriented programming with suitable code. [5]
3. What is the main drawback of multiple inheritances for classes? Explain the major differences between interface and abstract class. [1+4]

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE

Second Class Test, Formal Language & Automata Theory (PCC-CS-403)

Answer any three questions: 5 x 3=15

1. State the pumping lemma for Regular Languages and pumping lemma for Context Free Languages.
2. Prove that the following language is not regular language using pumping lemma for regular languages:

$$L = \{ a^n b^n : n \geq 0 \}$$

3. Prove that the following language is not context free language using pumping lemma for context free languages:

$$L = \{ 0^n 1^n 2^n : n \geq 0 \}$$

4. Construct the NPDA mentioning all seven tuples for the following language:

$$L = \{ ww^R : w \in \{a, b\}^* \}$$

5. The family of context free languages is closed under union.