# JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/CSE/PCC-CS402/ 2023-24
2024
## DESIGN AND ANALYSIS OF ALGORITHMS

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 the time complexity of the recurrence relation $T(n) = 2T(\sqrt{n})+1$?
2. Prove that the complexity of the function n! is $O(n^n)$.
3. Is "P=NP"- Justify your answer.
4. What are heuristics? Do they always guarantee solutions?
5. What are implicit and explicit constraints?

### GROUP-B
### [LONG ANSWER TYPE QUESTIONS]

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

6. i) Explain the algorithm development life cycle (ADLC) with examples in each phase. 5
   ii) Prove that the average case time-complexity of quick sort algorithm is O(n log n). 7
   iii) Explain different types of SAT problem. 3

7. 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. 5
   ii) Discuss the procedure for Strassen's matrix multiplication to evaluate the product of two nxn matrices. Find the resulting recurrence relation for the same and calculate it's time complexity. Is this method an improvement over the conventional matrix multiplication method? If so why? 4+4+1+1

8. i) Explain the Bellman-Ford algorithm with an example. 6
   ii) Write down the all pair shortest path algorithm. Calculate it's time complexity. 5+1
   iii) Compare and contrast between greedy method and dynamic programming concept. 3

9. i) What is Turing's halting problem? Prove that halting problem is an undecidable problem. 2+3
   ii) How you will solve the 0/1 knapsack problem using dynamic programming algorithm? 5
   iii) Explain the Travelling Salesperson problem with an example and solve it with dynamic programming concept. 5

10. i) Prove that Clique Decision Problem (CDP) is a NP-complete problem? 5
    ii) Explain the strategy to solve the 15-puzzle problem. Also draw the necessary steps required to solve the 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 $f(n)=\Omega(n^m)$. 5

11. i) Write down the Prim's algorithm to find out the minimal spanning tree of an undirected graph. 3
    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). 7
    iii) How would you show that a decision problem is NP-Complete? 5

12. i) What do you mean by the reducibility? Give some examples to clear this concept? 2+3
    ii) Explain the 8-queens problem and state some feasible solution of the problem. 5
    iii) Draw one solution of the state space tree for 4 queen's problem using backtracking algorithm. 5

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# JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
COE/B.TECH./CSE/PCC-CS404/2023-24
2024
## FORMAL LANGUAGE & AUTOMATA THEORY

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. Define Turing Machine.
2. Define Deterministic Finite Automata (NFA) with a suitable example.
3. State the Pumping Lemma for Context free Languages and state also the application of this lemma.
4. Define Greibach Normal Form (GNF) with example.
5. Define Push-down Automata.

### GROUP-B
### [LONG ANSWER TYPE QUESTIONS]

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

6. i) Construct a Turing machine for the following language 10
$$L = \{a^n b^n c^n : n \geq 1\}$$
ii) Prove that the family of context-free languages is not closed under intersection. 5

7. i) Prove that $(1 + 00^*1) + (1 + 00^*1)(0 + 10^*1)^*(0 + 10^*1) = 0^*1(0 + 10^*1)^*$. 5+5+5=10
ii) Design a NFA to accept the language: $L = \{b^n a^n : 0 \leq n \leq 3\}$
iii) Construct a regular expression for the following language
$$L = \{a^n b^m : n \geq 0\} \cup \{a^n b^n : n \geq 0\}$$

8. i) Show that the language $L = \{a^n b^n : 0 \leq n, n \neq 50\}$ is context free. 5
ii) Prove that every regular language is also a context free language, but vice-versa is not true. 5
iii) Define formal grammar and formal language with examples 5

9. i) Prove that the family of context-free language is closed under union, concatenation, and star-closure. 3x2=6
ii) Construct a NPDA for the language., $L = \{ww^R : w \in \{a, b\}^*\}$ 5
iii) Is it possible to construct a regular expression for the following language? Justify your answer. 4
$$L = \{a^n b^n : n \geq 1\}$$

10. i) Write the subset construction algorithm to convert a given NFA into an equivalent DFA 5
ii) Prove the following grammar is ambiguous grammar: 5
$G = (V, T, P, S)$, where $V = \{E, I\}, T = \{a, b, c, +, *, (, )\}$, with productions
$E \to I, E \to E + E, E \to E * E, E \to (E), I \to a, I \to b, I \to c$
iii) Prove that the following given language is not regular language using pumping lemma: 5
$$L = \{a^n b^n : n \geq 0\}$$

11. i) Prove that the following language is context-free language but not regular language 5
$$L = \{a^n b^{2n} : n \geq 0\}$$
ii) Prove that the family of regular languages is closed under intersection.
iii) Write regular expressions for the following languages on {0, 1}: 5
a) $L$ = { all strings ending with 01}
b) $L$ = { all strings containing an even number of 0's} 5

P.T.O.

3x5=15

12. Write short notes on any three of the following topics:
    i. Closures properties of context free languages
    ii. Regular Grammar
    iii. Hierarchical structure of all different kind of Automata & their corresponding languages
    iv. Regular Expression

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# JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/CSE/ PCC-CS403/ 2023-24
2024
## 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. What do you mean by thread? [2]
2. Define friend function and friend class? [2]
3. What are command line arguments? How they are useful? [2]
4. What is inline function? [2]
5. Define constructor chaining? [2]

### GROUP-B
### [LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions 4x15 = 60

6. i. What is Object Oriented Programming? State the differences between Object Oriented Programming and Structure Oriented Programming. [1+4]
   ii. Explain different features of Object Oriented programming. [5]
   iii. What is operator overloading? Overload pre- increment and post- increment operators with suitable code snippet. [1+4]

7. i. Explain the different levels of access modifiers available in Object Oriented Programming with examples. [6]
   ii. What do you mean by method overloading and method overriding? Explain with examples. [4]
   iii. Compare different types of polymorphisms with examples. [5]

8. i. Explain different types of base class access controls used in inheritance with programming code snippet. [6]
   ii. What is the main drawback of multiple-inheritance for classes and how can it solve? Explain with proper example. [1+4]
   iii. When do you declare a class member static? Explain with an example. [4]

9. i. What is an exception? Describe try-catch block and finally block used in exception handling? [1+5]
   ii. Define an exception "NoMatchException" that is thrown when a given string is not present in a list of string objects. Write a program that uses this exception. [5]
   iii. What do you mean by compile time exception and run time exception? Explain with proper examples. [4]

10. i. Why thread is called light weight process? Explain the complete life cycle of a thread object with proper diagram. [1+5]
    ii. Explain different ways of implementing thread class in Object oriented programming? Explain with suitable programming code. [6]
    iii. Explain copy constructor with proper code snippet. [3]

11. i. What is the order in which constructor and the destructor are executed in inheritance? Explain the execution of constructor and destructor in multi-level and multiple-inheritance with suitable examples. [1+5]
    ii. Explain the differences between abstract class and interface in Object Oriented Programming with examples. [4]
    iii. What is an interface? Give an example where interfaces are used to support multiple-inheritance. [1+4]

12. i. Explain call by value, call by address and call by reference with examples. [6]
    ii. What are pure virtual functions? When they should be used? Explain with programming code. [1+4]
    iii. Explain constructor overloading with examples. [4]

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# JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH./CSE/PCC-CS401/2023-24
2024
## COMPUTER ARCHITECTURE

Full Marks: 70 Time: 3 Hour

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

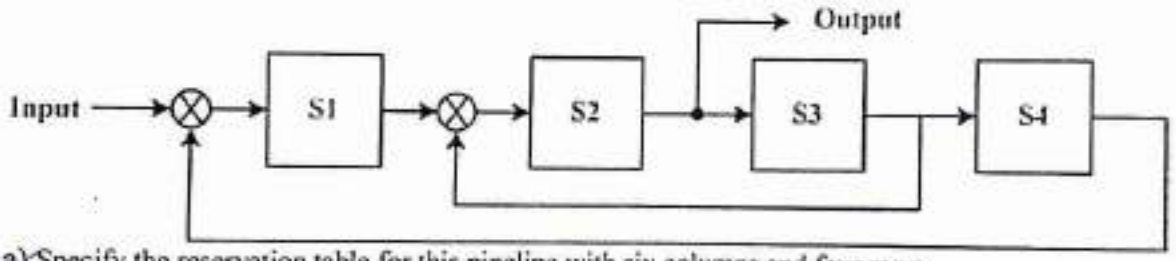
Answer all questions 5x2=10

1. Define pre-fetch buffer. 2
2. What is array processor? 2
3. What is 90-10 rule for program execution? 2
4. Define vector stride. 2
5. What is VLIW? 2

### GROUP-B
### [LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions 4x15=60

6. i) Derive speed up ratio of pipeline processing over non-pipeline processing. 2
ii) Consider the following pipelined processor with four stages. All successor stages must be used after each clock cycle. Assume the clock time t=20 ns.




a) Specify the reservation table for this pipeline with six columns and four rows. 3
b) Derive the forbidden latencies, permissible latencies and initial collision vector from the reservation table. 3
c) Draw the state diagram which shows all possible latency cycles. 3
d) Find all greedy cycle and compute the minimum average latency. 2
e) Compute the throughput in MIPS of the above pipeline processor. 2

7. i) Explain the working principle of data flow computers. List some potential problems with data flow computer implementation. 5+2
ii) Show the data flow execution of X=(a+b)(a-b) considering a=20, b=10. 5
iii) How data flow computer is different from control flow computer? 3

8. i) What is the difference between linear and non-linear pipelining? Discuss different stages of instruction pipelining. 2+3
ii) Write a short note on pipeline hazards. 5
iii) Determine the number of clock cycles that a pipeline processor takes to process 501 instructions in a six-segment pipeline. Compute the total execution time and throughput when clock time t=20 ns. 2+3

9. i) Explain the memory hierarchy pyramid, showing register, cache, primary and secondary memories in the diagram and also explain the relationship of cost, speed and capacity. 5
ii) What is locality of reference property of memory hierarchy? How does it improve the performance of a computer system? 5
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? 5

b) Find effective access time $t_{eff}$ of this memory system when h=0.9, t1=.40 ns and t2= 10 ms.

10. i) Define multiprocessor and multicomputer system. Differentiate them with respect to memory sharing and message passing mechanisms. 4+2

ii) Describe UMA, NUMA and COMA with their architectural diagram. 5

iii) Draw a diagram of SIMD architecture and explain its working principle. 4

11. i) What is virtual memory? 2

ii) State Belady's Anomaly with a suitable example. 3

iii) State the Optimal algorithm for page replacement. Find the page fault for the following page sequence with four frames using FIFO, LRU and Optimal algorithms. 02, 01, 05, 01, 03, 07, 03, 05, 05, 09, 10, 07, 06, 11, 10, 09, 11, 01, 07, 06, 09, 10. 10

12 Write short notes on the following topics. (Any three) 5x3 =15

i) Flynn's classification of computer
ii) Internal data forwarding
iii) Gather and scatter instructions
iv) Inclusion and coherence properties
v) Bernstein's conditions

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# JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/CSE/PAPER CODE:BS-M 401/2023-24
2024
## MATHEMATICS III

Full Marks: 70 Times: 3 Hours

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

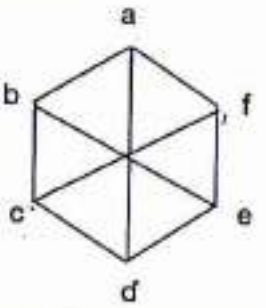
Answer ***all*** questions: $5 \times 2 = 10$

1. Transform the differential equation $xy\cos x^2\,dx + 2\sin x^2\,dy = 0$ into an exact differential equation. 2
2. Examine the convergence of the series $\sum_{n=1}^{\infty} \frac{n^n}{n!}$. 2
3. Draw a graph which is neither Eulerian nor Hamiltonian. Justify your claim. 2
4. Using Green's theorem, show that $\frac{1}{2}\oint_C (x\,dy - y\,dx)$ = 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) Solve: $(xy - x^2y^2)ydx + (xy + 2x^2y^2)xdy = 0$. 4
   (ii) Solve: $x^4\frac{dy}{dx} + x^3y = y^2$. 4
   (iii) Find the general solution and singular solution of the differential equation $y = px + \sqrt{49p^2 + 25}$ where $p = \frac{dy}{dx}$. 4
7. (i) Define the complement $\bar{G}$ of a simple graph G. Draw the complement of the graph G with vertices a, b, c, d, e, f given below: 1+2




   (ii) Show that the maximum number of edges in a simple graph with n vertices and m components is $\frac{1}{2}(n-m)(n-m+1)$. 5
   (iii) If a graph G has exactly two vertices of odd degree, show that there must be a path joining these two vertices. 4

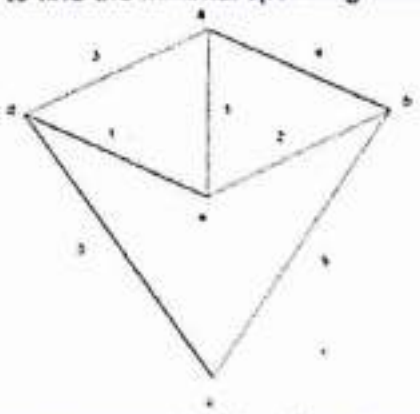
8. (i) Test the series for convergence: $\frac{x}{1}+\frac{1}{2}\cdot\frac{x^2}{3}+\frac{1\cdot3}{2\cdot4}\cdot\frac{x^3}{5}+\frac{1\cdot3\cdot5}{2\cdot4\cdot6}\cdot\frac{x^4}{7}+\cdots\cdots (x>0)$. 4

(ii) Show that the infinite series $\frac{1}{1\cdot3}-\frac{2}{3\cdot5}+\frac{3}{5\cdot7}-\frac{4}{7\cdot9}+\cdots\cdots$ converges conditionally. 4

(iii) Expand the function $f(x)=\log_e(1+x)$ in infinite series in powers of x stating the conditions under which the expansion is valid. 4

9. (i) Define a spanning tree of a connected graph. Prove that a graph G has a spanning tree if and only if G is connected. 1+1+2

(ii) Use Prim's algorithm to find the minimal spanning tree in the graph G given below: 5



(iii) Find the number of dependent vertices in a binary tree with n vertices. 2

10. (i) Solve: $(D^2-5D+6)y=x^2e^{3x}$ where $D\equiv\frac{d}{dx}$. 4

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

(iii) Solve: $(D^3-D^2+3D+5)y=e^x\cos x$ where $D\equiv\frac{d}{dx}$. 4

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

(ii) Solve: $x^3\frac{d^3y}{dx^3}+3x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+8y=65\cos(\log x)$. 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 real numbers). 4

12. (i) Evaluate the line integral $\oint_C (2xy-x^2)dx+(x+y^2)dy$ where C is the closed curve of the region bounded by $y=x^2$ and $y^2=x$. 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) Evaluate $\iint_S \vec{F}.\hat{n}ds$ where $\vec{F}=z\hat{i}+x\hat{j}-3y^2z\hat{k}$ and S is the surface of the cylinder $x^2+y^2=16$ included in the first octant between $z=0$ and $z=4$. 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) Evaluate $\int_C \vec{F}.d\vec{r}$ by Stoke's theorem, where $\vec{F}=y^2\hat{i}+x^2\hat{j}-(x+z)\hat{k}$ and $C$ is the boundary of the triangle with vertices at (0,0,0), (1,0,0), (1,1,1). 4

(iii) Evaluate by Gauss Divergence theorem $\iint_S \vec{F}.\hat{n}ds$ where $\vec{F}=x^2\hat{i}+y^2\hat{j}+2z(xy-x-y)\hat{k}$ and S is the surface of the cube $0\le x\le 1$, $0\le y\le 1$, $0\le z\le 1$. 4

Roll No.: | | | | | | | | | | | Name:

**JALPAIGURI GOVERNMENT ENGINEERING COLLEGE**
**[A GOVERNMENT AUTONOMOUS COLLEGE]**
JGEC/B.TECH/ CSE/ 2023-24/2024

**Paper name: ENVIRONMENTAL SCIENCES** **Paper code: MC-401**

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]** 5x2=10

Answer ***all*** questions

1. Write down all the non-conventional resources.
2. What are the main objectives of environmental science?
3. Name the different types of diseases caused by water pollution.
4. Name six greenhouse gases.
5. What do you mean by temperature lapse rate?

**GROUP-B**
**[LONG ANSWER TYPE QUESTIONS]** 4x15 = 60

Answer any ***four*** questions

6. i) What is population growth? what is the necessity of population growth study? 1+2
   ii) What is the nature and scope of environmental science and engineering? 3
   iii) Define doubling time of population. Prove that in the case of similar growth and decay rates, the half-life time and doubling time become equal in exponential growth model? 2+4
   iv) In India the increase in population from 33 billion to 120 billion took 60 years. For exponential growth at constant rate, what will be the growth rate? 3

7. i) Define eco-system? What are the components of eco-system? 2+3
   ii) Write down the main differences between water cycle, gaseous cycle and sedimentary. 5
   iii) Discuss nitrogen cycle. 5

8. i) What do you mean by pesticides? Name some pesticides. Why they are so dangerous for living organisms? What could be the remedy for pesticides? 1+2+3+3
   ii) Discuss the bio-chemical effects of heavy metals (cadmium, mercury, and lead). 3
   iii) What are the effects of acidification of water (effect of pH)? 3

9. i) What is the importance of dissolve oxygen in as water quality parameter. 2
   ii) What are the factors responsible for deficiency of oxygen in a river? In what way do organic wastes affect river water quality and aquatic life? 2+3
   iii) Write down the differences between BOD and COD. 3
   iv) The BOD reaction rate constant is 0.30/day. Calculate the expected $BOD_5$ if the two-day BOD is 150 mg /l. (suppose temperature is constant). 3
   v) Write in brief about biological diversity act, 2002. 2

10. i) How would you divide the structure of atmosphere based on temperature and based on composition. 4+1
    ii) Describe the role of ozone layer in stratosphere. 2
    iii) What is greenhouse effect? 4
    iv) Why do some gases behave as greenhouse gases and others do not? 4

11. i) What is global warming? 3
    ii) What do you mean by particulate matter? Explain its role on air pollution. 1+3
    iii) What is PAN? Outline the harmful effects of PAN on human beings. 1+3
    iv) Write the difference between photochemical smog and London smog. 4

12. Write short notes on any three of the following: i) Logistic growth model of population ii) Eutrophication iii) Hardness of water iv) Electrostatic precipitator v) Primary and Secondary pollutant vi) Catalytic converter. 3x5

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