

13419

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/CSE/PCC-CS 401/ 2021-22
2022
Discrete Mathematics

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

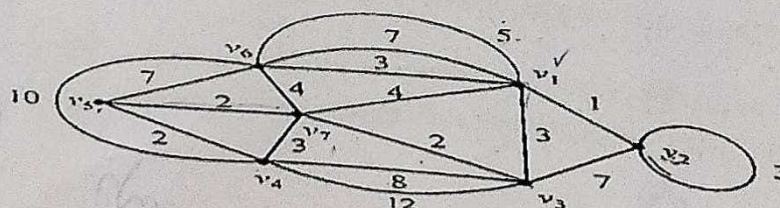
- ✓ 1. Find the remainder when the sum $(1!+2!+3!+4!+\dots+100!)$ is divided by 21.
- ✓ 2. Using principle of mathematical induction prove that $4^{(2n+1)}+3^{(n+2)}$ is divisible by 13.
- ✓ 3. What is Equivalence relation?
- ✓ 4. State Pigeonhole Principle
- ✓ 5. How many ways the letters of the word MATHEMATICS be arranged in each of which the vowels occupy odd positions.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any **five/four** questions

4x15 = 60

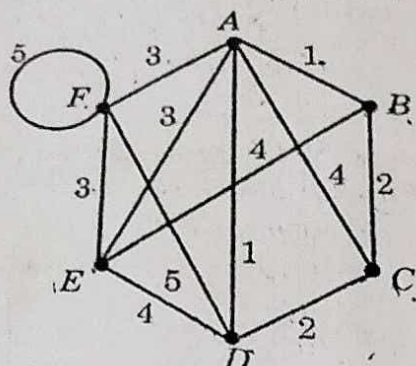
- ✓ 6.a. Prove the following equivalence $p \equiv (p \wedge q) \vee (p \wedge \sim q)$. 5
- ✓ b. Find the total number of integers between 1 and 1000 that are divisible by any of the integers 2, 5 or 7. 5
- ✓ c. Show that the number 8955795758 is divisible by 7, 13 and 37. 5
- ✓ 7.a. Obtain the conjunctive normal form of $\sim(p \vee q) \leftrightarrow p \wedge q$. 5
- ✓ b. State Euclid's Algorithm. Using this Algorithm find the G.C.D. of (1120, 128). 5
- ✓ c. By "Dijkstra's procedure" find the shortest path and the length of the shortest path from the vertex v_2 to v_5 in the following graph. 5



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Find the Kruskal's Algorithm a minimal spanning tree from the following graph.


$$(n) \quad (n+1) \quad (n-1) \quad (n-2) \quad \dots$$

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(~v a) \wedge (PA ~ a)

$$(1) \quad 4x - 1 = 0$$

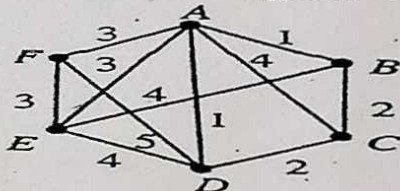
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Consider the statements p : "I will study discrete mathematics", q : "I will go to movie", r : "I am in a good mode". Write the following statements in terms of p , q , r and logical connectives. Construct the truth table. "I will not go to a movie and I will study discrete mathematics if and only if I am in a good mood."

5

5

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5

5

5

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2

5

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COE/B.TECH./CSE/PCC-CS402/2021-22
2022

COMPUTER ARCHITECTURE

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]

5x2=10

Answer all questions

1. A RAM chip has a capacity of 1024 words of 8 bits each ($1K \times 8$). Find the total number of 2×4 decoders with enable lines needed to construct a $16K \times 16$ RAM from $1K \times 8$ RAM? 2+4
2. Derive the speed up for pipeline processing over non-pipeline processing. 4
3. What is 1-byte, 2-byte and 3-byte address instruction. 5
4. A cache memory needs an access time of 30ns and main memory 150ns, what is the average access time of CPU (assume hit ratio = 80%)? 5
5. "Synchronization of all PEs in an SIMD computer is done by hardware rather than by software"- justify the statement. 1+5

GROUP-B

[LONG ANSWER TYPE QUESTIONS]

4x15=60

Answer any four questions

6. i) What is Cache Memory? Define global miss and local miss with a suitable example. 2+4
 ii) Describe different techniques to reduce Miss Penalty. [4] 4
 iii) Describe different techniques to reduce Miss Rate. [5] 5
7. i) Write short notes on vector chain and strip mining with suitable examples. 5
 ii) Compare the register-to-register vector architecture and memory-to-memory vector architecture. 3
 iii) Explain vector gather and scatter instructions with suitable example. 4
 iv) Explain different types of internal data forwarding techniques with example. 3
8. i) What is pipeline hazard? Describe different types of data hazards. 1+5
 ii) State the Bernstein's conditions for parallelism. 2
 iii) Use Bernstein's conditions to detect the parallelism embedded in the following code: 5
 1: $A = B + C$; 2: $C = D + E$; 3: $F = G + E$; 4: $C = A + F$; 5: $M = G + C$; 6: $A = L + C$ 7: $A = E + A$
 Also draw a data flow graph for the above code. 2
9. i) Compare super pipeline with superscalar pipeline. 4
 ii) Consider the following pipelined processor with four stages. 4

	t1	t2	t3	t4	t5	t6	t7
S1	X					X	
S2			X				X
S3		X		X			
S4			X		X		

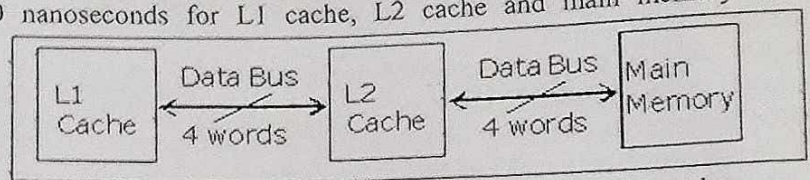
- a. List the set of forbidden latencies and state the initial collision vector. 2
- b. Draw the state diagram which shows all possible latency cycles. 5
- c. List all simple and greedy cycles from the state diagram. 2
- d. What is the value of the minimal average latency (MAL)? 1
- e. What is the maximal throughput of this pipeline? 1

720
 077270
 563993

A/2 = 3.5

10. i) A computer has a 256 KB, 4-way set associative, write back data cache with block size of 32 Bytes. The processor sends 32 bit addresses to the cache controller. Each cache tag directory entry contains, in addition to address tag, 2 valid bits, 1 modified bit and 1 replacement bit.
- (a) What is the number of bits in the tag field of an address? 4
- (b) Find the size of the cache tag directory? 4
- ii) What are the different Cache updation policies? Write short notes on it? 2+5

11. i) A computer system has an L1 cache, an L2 cache, and a main memory unit connected as shown below. The block size in L1 cache is 4 words. The block size in L2 cache is 16 words. The memory access times are 2 nanoseconds, 20 nanoseconds and 200 nanoseconds for L1 cache, L2 cache and main memory unit respectively.



- When there is a miss in L1 cache and a hit in L2 cache, a block is transferred from L2 cache to L1 cache.
- (a) What is the time taken for this transfer? 5
- (b) When there is a miss in both L1 cache and L2 cache, first a block is transferred from main memory to L2 cache, and then a block is transferred from L2 cache to L1 cache. What is the total time taken for these transfers? 5
- ii) A CPU has a 32KB direct mapped cache with 128 byte block size. Suppose "A" is a 2D array of size 512x512 with elements that occupying 8 bytes each consider the following two program segments P1 and P2:

P1	P2
for(i=0; i<512; i++)	for(i=0; i<512; i++)
for(j=0; j<512; j++)	for(j=0; j<512; j++)
x = x + A[i][j];	x = x + A[j][i];

P1, P2 are executed independently with same initial state, i, j and x are in registers. Let the no of cache miss is experienced by P1 is M1 and P2 is M2. Find the value of M1 and M2? 5

12. A disk pack has 19 surfaces. Storage area on each surface has an inner diameter of 22cm and outer diameter of 33cm. Maximum storage density on any track is 2000 bits/cm and minimum spacing between tracks is 0.25mm.
- (a) What is the storage capacity of the pack? 5
- (b) What is the data transfer rate in bytes per second at a rotational speed of 3600 rotation per minute (rpm)? 5
- (c) Consider a direct mapped cache with 8 chae blocks (0-7). If the memory block requests re in the order (3, 5, 2, 8, 0, 63, 9, 16, 20, 17, 25, 18, 30, 24, 2, 63, 5, 82, 17, 24) with order from memory blocks will not be in the cache at the end of sequence? 5

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2022

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]

5x2=10

Answer *all* questions

1. Define the relationship between the following formal languages with their corresponding automata with the help of Venn diagram: Regular languages, Context Free Languages, Context Sensitive Languages.
2. Define Nondeterministic Finite Automata (NFA) with a suitable example.
3. State the Pumping Lemma for Regular Languages and state also the application of this lemma.
4. Define Chomsky Normal Form (CNF) with example.
5. Define Push-down Automata.

GROUP-B

[LONG ANSWER TYPE QUESTIONS]

4x15=60

Answer any *four* questions

6. 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. 5
 iii) Write regular expressions for the following languages on $\{0, 1\}$: 5
 a) $L = \{ \text{all strings ending with } 01 \}$
 b) $L = \{ \text{all strings containing an even number of } 0\text{'s} \}$
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 following language:

$$L = \{a^n b^n : 0 \leq n \leq 4\}$$

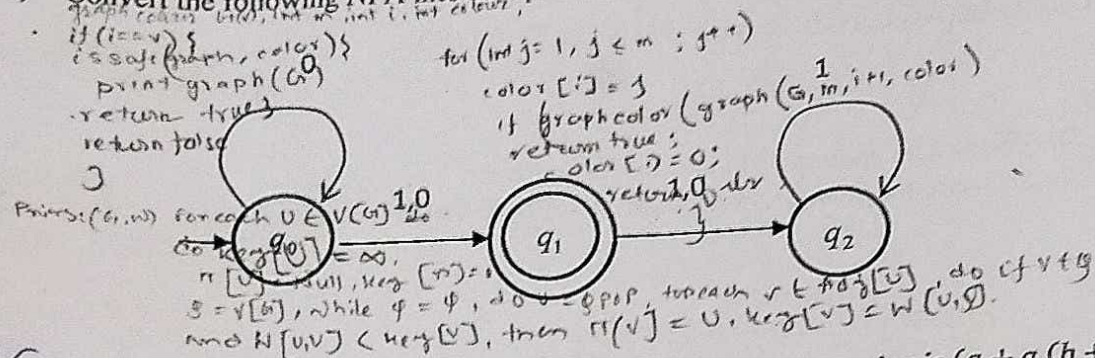
 iii) Construct a regular expression for the following language

$$L = \{a^n b^m : n \geq 0 \text{ and } m \geq 0\} \cup \{a^n b^n : n \geq 0\}$$
8. i) Show that the language $L = \{a^n b^n : 0 \leq n, n \neq 100\}$ 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 following 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.

$$L = \{a^n b^n : n \geq 1\}$$
 4

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



- ii) Construct the finite automata corresponding to the regular expression is $(a + a(b + aa)^*b)^*a$ 5
 iii) Prove that the following given language is not regular language using pumping lemma: 5
 $L = \{a^n b^n : n \geq 0\}$

3x5=15

11. Write short notes on any three of the following topics:

- CNF and GNF
- Turing Machine
- Hierarchical structure of all different kind of Automata & their corresponding languages
- Regular Expression

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2022

DESIGN AND ANALYSIS OF ALGORITHMS

Full Marks: 70

Times: 3 Hours

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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. Analyze the complexity of knapsack algorithm in all cases.
2. Find the time complexity of the recursive factorial algorithm of a positive integer number.
3. How does backtracking help to solve problems?
4. What is the difference between algorithmic complexity and computational complexity?
5. Distinguish between explicit and implicit constraints.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions

4x15=60

6. 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
7. Explain the Bellman-Ford algorithm. Calculate it's time complexity. 6+1
7. 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. Is this method an improvement over the conventional matrix multiplication method? If so, why? 4+4+1+1
8. Explain the Travelling Salesperson problem with an example and solve it with dynamic programming concept. 5
8. What is the 0/1 knapsack problem? How dynamic programming is useful for solving it? 1+8
8. Write down the all pair shortest path algorithm. Calculate it's time complexity. 5+1
9. i) Compare and contrast between greedy method and dynamic programming. Prove that the lower bound on the avg. case time complexity of any comparison based sorting algorithm is $O(n \log n)$. 3+5
9. ii) Prove that the average case time-complexity of quick sort algorithm is $O(n \log n)$. 7
10. i) Explain the strategy to solve the 15-puzzle problem. Also draw the necessary steps required to solve the problem. 5+3
10. ii) Give the solution of graph coloring problem with an example. 5+2
11. i) Write down the kruskal's algorithm to find out the minimal spanning tree of an undirected graph. 3
11. ii) Find the minimum number of operations required for the following matrix chain multiplication using dynamic programming method: $A(4 \times 5) * B(5 \times 3) * C(3 \times 2) * D(2 \times 7)$. 7
11. iii) How would you show that a decision problem is NP-Complete? 5
12. What is the principle of optimality condition? How is it satisfied in travelling salesperson problem? 2+3
12. 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. 4+4+2

END

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2022

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

1. What are resources?
2. What are the objectives of environmental management?
3. What are pathogens? Mention different types of pathogens.
4. Define noise threshold limit value.
5. What do you mean by 'Criteria Air Pollutant'?

5x2=10

2

2

2

2

2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any **four** questions

4x15=60

6. i) What are the main objectives of environmental science? 3
 ii) What is exponential growth of population? For exponential growth prove that, $N_t = N_0 e^{Rt}$ where the symbol has their usual meaning. 2+3
 iii) Show that half life time of population $t_{1/d} = 70 / R_1$ (%). Prove that in the case of similar growth and decay rates, the half-life time and doubling time become equal? 2+3
 iv) The increase in population from 1 million to 10 million took 200 years. For exponential growth at constant rate, find out the growth rate. 2
7. i) What is Eutrophication? In what way does 'eutrophication' occur? What are the harmful effects of eutrophication? How can you prevent eutrophication? 1+2
 ii) Prove that, the relation $BOD_t = C_0(1 - e^{-kt})$ where the terms indicate their usual meaning. +3+3
 iii) Write down the differences between BOD and COD methods. 3
8. i) What do you mean by hardness of water? What are the effects of hardness? How can you remove the hardness? 1+3+3
 ii) What are various processes involved in surface water treatment to make it potable? 3
 iii) A BOD test is run using 50 ml of waste water mixed with 100 ml of pure water. The initial DO of the mixture is 6.0 mg/l and after 5 days it becomes 2.0mg/l. After a long time, the DO remains fixed at 1.0 mg/l. a) What is BOD5 of waste water b) What is the ultimate BOD(BOD_u). c) What is remaining BOD after 5 days? d) What is the reaction rate measured at 200C? e) What would be the reaction rate if measured at 350C? 1 x 5
9. i) Write the differences between photochemical smog and London smog? What is acid rain? What are the harmful effects of acid rain? 2+1+2
 ii) What do you mean by particulate matter? Explain its role on air pollution. 1+4
 iii) What are greenhouse effect and global warming? Write down the different measures to control global warming. 3+2
10. i) Define the term 'noise'. Classify different types of noise. How much is a 100 dB sound louder than a 80 dB sound? 1+1.5
 ii) What is noise pollution? Discuss the adverse effects of noise on human health. +2.5
 iii) Explain on the various causes of flood and landslides. 1+4
 2+3
11. Write short notes on any three of the following: i) Catalytic converter, ii) Ozone layer Depletion, iii) Arsenic pollution and its effect, iv) Population growth, v) Primary and Secondary pollutants. 3 x 5

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2022
BIOLOGY

Full Marks: 70

Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

5x2=10

Answer *all* questions

- | | | |
|----|---|---|
| 1. | Define Biomolecules with examples. | 2 |
| 2. | What do you mean by monomer of proteins, Give examples. | 2 |
| 3. | What biomolecules acts as genetic materials in living organisms. | 2 |
| 4. | Which biomolecule is regarded as main source of energy in our body. | 2 |
| 5. | Define Enzyme with examples. | 2 |

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

4x15=60

Answer any *four* questions

- | | | |
|-----|--|----|
| 6. | Describe different structural aspects of Protein with diagram. | 15 |
| 7. | Describe the Monohybrid Cross on sweet pea plants performed by Mendel along with law of segregation. | 15 |
| 8. | Classify enzyme on the basis of chemical reaction with examples. | 15 |
| 9. | Classify carbohydrate with examples. | 15 |
| 10. | Classify the living organism on the basis of mode of nutrition, cellularity, ultrastructure with examples. | 15 |
| 11. | How does DNA acts as the Genetic material in most of the organism-explain? | 15 |