

B.E. 5th Semester Examination, 2023-2024
Subject : Database Management Systems
Course : PCC-CSE-501

Time: 3 Hours**Full Marks: 70**

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Write all the parts of a question together in one place.

Answer any five questions.

1. (a) List four applications that are used in a real-word scenario where in lieu of a file processing system, a database system is employed to store persistent data.
- (b) What is the significance of Data Independence in RDBMS? Discuss how Logical Data Independence is more difficult to achieve as compared to Physical Data Independence.
- (c) With a neat sketch, explain the *three-tier architecture* of a database system. 4+4+6
2. (a) Differentiate between the following terms:
 - (i) Composite Attribute and Multi-valued Attribute
 - (ii) Total Participation and Partial Participation
- (b) Suppose a Hospital Management System needs to be designed that captures the following requirements:

In a hospital, there are multiple departments. Patients are treated in these departments by doctors assigned to patients. Usually each patient is treated by a single doctor, but in exceptional cases, a treatment necessitates two or three doctors. Healthcare assistants attend patients and provide patients with basic healthcare facilities. Every department has many healthcare assistants. Each patient is required to take a variety of medicines during different part of the day viz. morning, afternoon and night.

Construct a concise ER diagram to capture the afore-mentioned requirements. State any assumptions you have made that affect your design. Ensure that all cardinalities and primary keys are clearly depicted. 4+10

3. (a) State the Armstrong's Inference Rules. Why are they considered to be sound and complete?
- (b) Give proper justifications to support the following statements:
 - (i) Null values are crucial and might be introduced into the database.
 - (ii) In SQL, < > 'all' is identical to 'not in'.

(2)

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- (c) Consider the following relations containing airline flight information:
- Flights (fno: integer, from: string, to: string, distance: integer, departs: time, arrives: time)
- Aircraft (aid: integer, aname: string, cruisingrange: integer)
- Certified (eid: integer, aid: integer)
- Employees (eid: integer, ename: string, salary: integer)

Note that the Employees relation describes pilots and other kinds of employees as well. Every pilot is certified for some aircraft and only pilots are certified to fly. Write the following queries in SQL, relational algebra and QBE:

- (i) Find the eids and names of pilots certified for some "Bharat Veer" aircraft.
- (ii) Find the eids of employees who make the lowest salary.

4. (a) Specifying their utility, state what is "normalization" and "denormalization".
- (b) Define the following terms: Extraneous attributes, Spurious Tuples, Lossless Join, Decomposition and Multivalued Dependency.
- (c) The following is a tabular view of the Price Update List of a grocery store—Good News Grocers. This report is used by the department managers to update the prices that are displayed in the grocery store for these products. Normalize the given table up to 3NF. Do mention proper constraints used while normalizing the table.

4

4+6

Department	Product	Aisle	Price	Unit of Measure
Produce	4081	1	0.35	Lb
Produce	4027	1	0.90	Ea
Produce	4108	1	1.99	Lb
Butcher	331100	5	1.50	Lb
Butcher	331105	5	2.40	Lb
Butcher	332110	5	5.00	Lb
Freezer	411100	6	1.00	Ea
Freezer	521101	6	1.00	Ea
Freezer	866503	6	5.00	Ea
Freezer	866504	6	5.00	Ea

5. (a) List the ACID properties and state the usefulness of each term.
- (b) During its execution, a transaction passes through several states, until it finally commits or aborts. Draw a schematic diagram to showcase all possible sequence of states through which a transaction may pass; citing the occurrence of each state transition.
- (c) With apt examples, explain three well-known problems that might crop up when concurrent execution of transactions is uncontrolled.

4+6

(3)

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6. (a) In the context of concurrency control, explain the working of lock-based protocols through pseudocodes for read lock and write lock operations.

(b) Compare and contrast Immediate Database Modification and Deferred Database Modification schemes.

(c) Discuss about the different *deadlock avoidance* and *deadlock prevention* strategies for mitigating the occurrence of a deadlock when multiple transactions are executed concurrently.

4+4+6

7. (a) In the context of query optimization, what do you mean by the terms "evaluation plan" and "heuristics"?

(b) How is materialized evaluation of a query different from pipelined evaluation? Also explain in brief about the push and pull models of pipelining.

(c) Write down the formats for performing a join operation, a nested-loop join operation and a block nested-loop join operation while processing a query. Analytically compare the performance of the three join operations.

4+4+6

8. (a) Using a suitable example, state how we can integrate a Multimedia Database Model with an Object-oriented Database Model.

(b) In the context of distributed databases, how is data transparency ensured? State the various transparency issues in a relation that is stored in different sites.

(c) Explain the working of Two-Phase Commit Protocol(2PC).

4+4+6

9. Give reasons for the following:

2x7=14

(A) Tuples in a relation are not ordered.

(b) Union, Intersection, and Difference Operations require that the relations on which they are applied must be union compatible.

(C) Practical database designs typically aim for BCNF but not for higher normal forms.

(d) A Two-Phase Locking Protocol ensures serializability.

(E) When a transaction is rolled back under timestamp ordering, it is assigned a new timestamp instead of keeping the old timestamp.

(F) Partial and Transitive dependencies are considered bad in a relational schema.

(g) Redundancy control is not at all an objective for designing distributed database systems, since the same fragment may reside at multiple sites.

B.E. 5th Semester Examination, 2023-2024

Subject : Object Oriented Programming

Course: PCC-CSE 503

Time: 3 Hours

Full Marks: 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

All questions carry equal marks.

Answer any five questions.

1. (a) Define what abstract data types (ADT) are in the context of programming. Explain the importance of ADT's in software design, including their role in data encapsulation and information hiding. 8+6
2. (a) Define the concept of polymorphism in Java and discuss its significance. How can you implement polymorphism through method overriding and interfaces in Java? Provide a Java code example illustrating polymorphism.
(b) Define the concept of encapsulation in object-oriented programming. Explain how encapsulation helps in organizing and protecting data within objects. Provide an example in Java to illustrate the implementation of encapsulation. 8+6
3. (a) Explain the roles of abstract classes and interfaces in inheritance. Discuss how they provide a blueprint for subclasses and establish a contract for methods. Provide examples of both abstract classes and interfaces in Java.
(b) Describe the purpose of the super keyword in Java. Explain how it can be used to access members of the superclass and call superclass constructors. Provide a Java example showcasing the use of the super keyword. 8+6
4. (a) Explain the concept of thread synchronization and its importance in multi-threaded Java programs. Provide a Java code example that demonstrates thread synchronization.
(b) Describe the difference between the Java heap and stack memory. Explain their respective roles in memory management, including how they store data and how memory is allocated and released in each. 8+6
5. (a) Write a Java program which will read from one file and write to another file.
(b) Explain how multiple catch blocks can be used to catch and handle specific exceptions. Describe the order in which catch blocks are evaluated. Provide Java code examples that demonstrate the use of multiple catch blocks. 8+6

6. (a) Discuss the Factory Method design pattern. Explain how it allows the creation of objects without specifying the exact class of object to be created. Provide a Java code example that demonstrates the use of the Factory Method pattern.

(b) Define the concept of design patterns in software engineering. Explain why design patterns are important in the development of software systems and how they contribute to code reusability and maintainability. 8+6

7. (a) Create a sequence diagram to model the interaction between a customer and an online shopping system. Illustrate the steps involved in searching for a product, adding it to the cart and completing the purchase.

(b) Given a software system for an online library, create a UML class diagram that represents the classes, their attributes and associations between them. Include classes for books, library members, authors and transactions. 8+6

8. (a) Implement stack by generic class in Java.

(b) Design an activity diagram to represent the process of booking a flight ticket on a travel booking website. Include activities such as searching for flights, selecting options, entering passenger details and making payment. 8+6

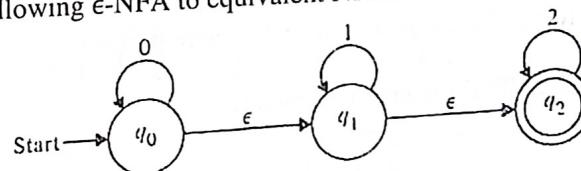
B.E. 5th Semester Examination, 2023-2024
Subject : Formal Language and Automata Theory
Course : PCC-CSE-502

Time: 3 Hours**Full Marks: 70**

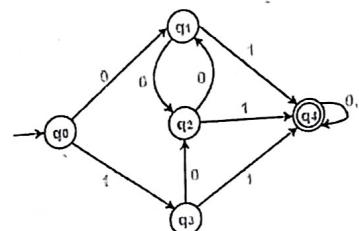
The figures in the margin indicate full marks.
 Candidates are required to give their answers in their own words
 as far as practicable.

Answer any five questions.

1. (a) Find Grammar for $\Sigma = \{a, b\}$ that generate the sets of
 - (i) All strings with exactly one 'a'
 - (ii) All strings with at least one 'a'
 - (iii) All strings with no more than three 'a's
 (b) Write down the difference between Context free languages and regular languages. Define Kleene Star. 9+(3+2)
2. (a) Define ϵ -NFA and write down the difference between ϵ -NFA and ordinary NFA.
 (b) Convert the following ϵ -NFA to equivalent NFA. (2+2)+10



3. (a) Construct a DFA machine over input alphabet = {0, 1}, that accepts:
 - (i) Odd number of 0's or even number of 1's
 - (ii) Odd number of 0's and even number of 1's
 - (iii) Either odd number of 0's or even number of 1's but not the both together
 (b) Explain Arden's Theorem with an example. (3+3+4)+4
4. Write down the algorithm that produces a minimal DFA for any given DFA and also minimise the given DFA. 6+8



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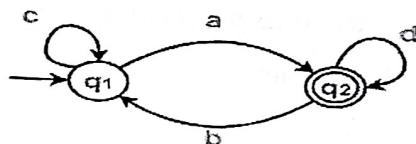
(5.) (a) Obtain the regular expressions for the languages given by

- (i) $L_1 = \{a^m b^m : m > 0\}$
- (ii) $L_2 = \{b^m a b^n : m > 0, n > 0\}$
- (iii) $L_3 = \{w \in \{0,1\}^* \mid w \text{ has no pair of consecutive zeros}\}$
- (iv) $L_4 = \{\text{strings of 0's and 1's begin or end with 00 or 11}\}$

(b) Determine all strings in $\underbrace{(a+b)^* b (a+ab)^*}$ of length less than four.

10+4

(6.) (a) Find the regular expression for the transition system using state elimination method.



(b) Prove that $L = \{a^n b a^n \text{ for } n = 0, 1, 2, \dots\}$ is not regular.

10+4

(7.) (a) Derive the string "aabbabba" for leftmost derivation and rightmost derivation using a CFG given by,

$$S \rightarrow aB|bA$$

$$S \rightarrow a|aS|bAA$$

$$S \rightarrow b|aS|aBB$$

(b) Construct a CFG for the language $L = a^n b^{2n}$, where $n \geq 1$

(c) Find the equivalent CNF of the given grammar:

$$S \rightarrow aAbB$$

$$A \rightarrow aA|a$$

$$B \rightarrow bB|b$$

8. (a) Construct a PDA for the language $L = \{a^n b^n : n > 0\}$.

4+4+6

(b) Construct TM for the language $L = \{0^n 1^n\}$, where $n \geq 1$.

7+7

B.E. 5th Semester Examination, 2023-2024**Subject : Signals & Systems****Course : ESC-EC-501****Time: 3 Hours****Full Marks: 70***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words
as far as practicable.**Answer question no. one and any four questions from the rest.**Answer all part-questions under the same Qn. No. in the same place.* $1 \times 10 = 10$

- 1.** Answer any ten questions:

- (a) How would you define the concept of a signal?
- (b) Explain how step functions and delta functions are interconnected.
- (c) Represent the signals depicted in Figure 1 using unit step functions.

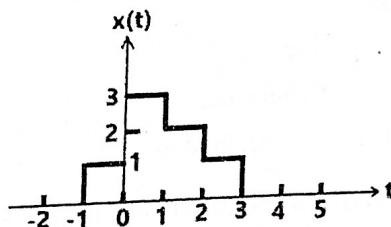


Fig. 1

- (d) What is the effect of time scaling on the unit step signal?
- (e) Explain the property of time shifting as it pertains to a signal.
- (f) Explain the properties of the Dirac delta function.
- (g) Determine both the even and odd components of the signal represented by $x(t) = e^{-t}$.
- (h) Determine the time period of the signal represented by the function $x(t) = 1 + 5e^{j6\pi t}$.
- (i) What does the term "energy signal" mean?
- (j) What is the power level associated with a DC signal?
- (k) What is meant by the term "Complex Exponential Signal with Harmonic Relationships"?
- (l) Define whether the signal: $x(t) = e^{-at}u(t)$ is classified as an energy signal or a power signal.
- (m) What is the Fourier Transform of $\delta(t)$?

- 2.** (a) Distinguish between

- (i) even and odd Signals.
- (ii) periodic and non-periodic signals.

Please Turn Over

(2)

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(b) Determine whether the following signals are periodic, if periodic determine the fundamental period.

(i) $x(t) = \cos(2t) + \sin(3t)$

(ii) $x(n) = \sin(2n)$

(c) Sketch the following signal (fig. 2) for $x(t)$ is shown in figure.

- (i) $x(3t + 2)$
- (ii) $x(2(t + 2))$
- (iii) $x(-2t - 1)$

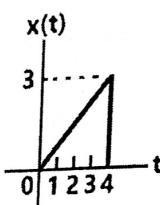


Fig. 2

3. (a) Find the total energy of the following signals:

(i) $x(t) = \begin{cases} A; & -\frac{T}{2} < t < \frac{T}{2} \\ 0; & \text{Otherwise} \end{cases}$

(ii) $x(t) = \begin{cases} \frac{1}{2}[\cos(\omega t) + 1]; & -\frac{\pi}{2} \leq t \leq \frac{\pi}{2} \\ 0; & \text{Otherwise} \end{cases}$

(b) A signal is given as $x(t) = 6 + 8j$. Find \sqrt{x} .

5+5+5

4. (a) Represent the following signal (fig. 3) as a function of the unit step.

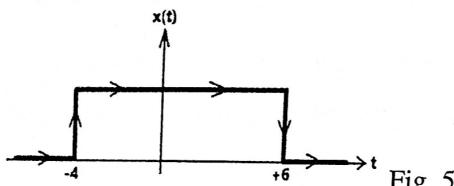


Fig. 3

(b) Express the following signal (fig. 4) into the Ramp function.

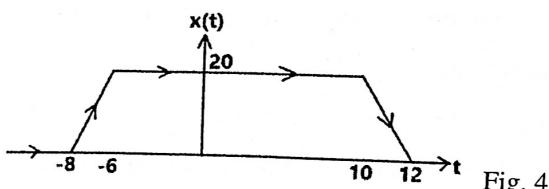


Fig. 4

(c) Draw the waveform for the signal: $x(t) = u(\sin(\omega t))$.

5+5+5

5. (a) The signal $x(t)$ is given in fig. (5). Represent the even and odd parts of $u(t)$ in terms of $x(t)$.

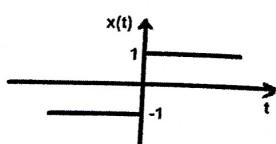


Fig. 5

- (b) Show that the power of any sinusoidal signal is, $P_x = \frac{A^2}{2}$, where A = Magnitude of the signal.
 (c) Show that the power of a step signal with amplitude A is $A/2$. 5+5+5

6. (a) Is the signal depicted in fig. 6 an energy signal or a power signal? Determine the associated energy and power of the signal.

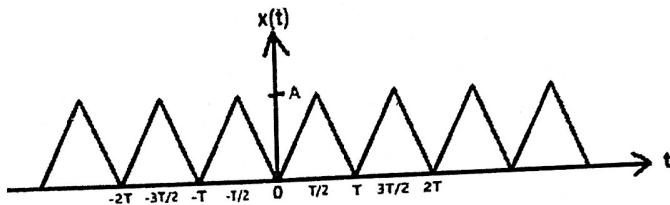


Fig. 6

8+7

- (b) Describe how the energy signal is influenced by the time scaling property.

7. Find the Fourier series coefficients of the signals shown in Fig. 7 and Fig. 8.

15

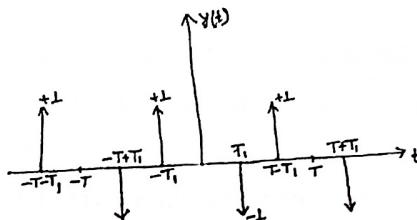


Fig. 7

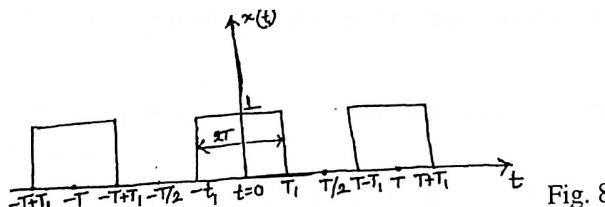


Fig. 8

15

8. Calculate the Fourier transform of the following signals.

- (i) $x(t) = e^{-at}u(t)$
- (ii) $x(t) = e^{-2|t|}$
- (iii) $x(t) = \begin{cases} 1; & |t| \leq 1 \\ 0; & |t| > 1 \end{cases}$

B.E. 5th Semester Examination, 2023-2024**Subject : Constitution of India****Course : MC-HU-501****Time: 3 Hours****Full Marks: 70***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words
as far as practicable.**Answers should be specific and to the point.**All parts of a question must be written together continuously.**Answer any five questions.*

- 1.** (a) Write the Preamble to the Constitution of India. 5+9
 (b) Discuss the salient features of the Constitution of India.
- 2.** (a) Discuss the significance of Directive Principles of State Policy.
 (b) Describe the Articles with respect to Socialist Principles in Directive Principles of State Policy. 5+9
- 3.** (a) Write a short note on Election.
 (b) Distinguish between Lok Sabha and Rajya Sabha Elections in India. 5+9
- 4.** (a) Write a short note of Representation of People's Act 1951.
 (b) Discuss the duties and responsibilities of Chief Election Commissioner. 5+9
- 5.** (a) Discuss broadly Women Empowerment in Constitutional perspective.
 (b) State the difference between Legal and Constitutional Provision. 5+9
- 6.** (a) Discuss the salient constitutional features with reference to Scheduled Tribes in India.
 (b) Discuss the articles with reference to Constitutional Provision of Scheduled Tribe. 5+9
- 7.** (a) Discuss the conditions to Presidential Office Election.
 (b) Share a brief note on Supreme Court and discuss its salient functions. 5+9
- 8.** (a) Describe the various functional duties of the District Magistrate.
 (b) Discuss the Executive Power and Judicial Power of the President of India. 5+9
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