

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH AND YEAR

Course Code: GAMAT301

Course Name: MATHEMATICS FOR COMPUTER AND INFORMATION SCIENCE – 3

Max. Marks: 60		Duration: 2 hours 30 minutes
----------------	--	------------------------------

PART A

Answer all questions. Each question carries 3 marks

		CO	Marks												
1	<p>The p.m.f. of the amount of memory X (GB) in a purchased flash drive is given.</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse; text-align: center;"> <tr> <td>x</td><td>1</td><td>2</td><td>4</td><td>8</td><td>16</td></tr> <tr> <td>P(x)</td><td>.05</td><td>.10</td><td>.35</td><td>.40</td><td>.10</td></tr> </table> <p>Find the mean and Variance</p>	x	1	2	4	8	16	P(x)	.05	.10	.35	.40	.10		(3)
x	1	2	4	8	16										
P(x)	.05	.10	.35	.40	.10										
2	8 Coins are tossed 256 times. In how many tosses do you expect no heads ?		(3)												
3	<p>The mileage which car owners get with a certain kind of radial tire is a random variable having an exponential distribution with mean 40000 km. Find the probability that one of these tires will last at least 20000 km.</p>		(3)												
4	If X follows $N(3,2)$, find the value of k such that $P(X - 3 > k) = 0.05$		(3)												
5	Suppose we know that the number of items produced in a factory during a week is a random variable with mean 500. If the variance of a week's production is known to equal 100, then what can be said about the probability that this week's production will be between 400 and 600?		(3)												
6	Classify stochastic processes with examples.		(3)												
7	Whether or not it rains follows a 2 state Markov chain. If it rains one day, then it will rain the next with probability 1/2 or will be dry with probability 1/2. Overall, 40 percent of days are rainy. If it is raining on Monday, find the probability that it will rain on Thursday.		(3)												
8	J plays a new game every day. If J wins a game, then she wins the next one with probability 0.6; if she has lost the last game but won the one preceding it, then she wins the next with probability 0.7; if she has lost the last 2 games, then she wins the next with probability 0.2. What proportion of games does J win?		(3)												

PART B					
<i>Answer any one full question from each module. Each question carries 9 marks</i>					
Module 1					
9	a)	Suppose that the number of drivers who travel between a particular origin and destination during a designated time period has a Poisson distribution with parameter $\mu = 20$. What is the probability that the number of drivers will be at most 3 ?			(4)
	b)	If the joint probability density function of random variables of X and Y is given by $f(x,y) = c(2x + 3y)$, $x = 0,1,2$; $y = 1,2,3$. Find (i) the value of c (ii) the marginal probability distributions of X and Y (iii) the probability distribution of $X + Y$.			(5)
10	a)	If 6 of 18 new buildings in a city violate the building code, what is the probability that a building inspector, who randomly selects 4 of the new buildings, will catch (i) none (ii) exactly one of the new buildings that violate the building code?			(4)
	b)	A random variable X takes values -3, -2, -1, 0, 1, 2, 3 such that $P(X = 0) = P(X > 0) = P(X < 0)$ and $P(X = -3) = P(X = -2) = P(X = -1) = P(X = 1) = P(X = 2) = P(X = 3)$. Obtain the probability mass function and distribution function of X .			(5)
Module 2					
11	a)	Buses arrive at a specified stop at 15 min intervals starting at 7 am, that is they arrive at 7, 7:15, 7:30, 7:45 and so on. If a passenger arrives at the stop at a random time that is uniformly distributed between 7 and 7:30 am, find the probability that he waits (i) less than 5 min for a bus (ii) at least 12 min for a bus.			(4)
	b)	The joint pdf of a two-dimensional random variable (X, Y) is given by $f(x,y) = \begin{cases} k(6 - x - y); & 0 < x < 2, 2 < y < 4 \\ 0; & \text{elsewhere} \end{cases}$ Find (i) the value of k , (ii) $P(X < 1, Y < 3)$, (iii) $P(X + Y < 3)$			(5)
12	a)	Let X follows exponential distribution with pdf $f(x) = \begin{cases} \frac{1}{5} e^{-x/5}, & x > 0 \\ 0, & \text{otherwise} \end{cases}$ Evaluate (i) $E(X)$ (ii) $E(Y)$ (iii) $P(X + Y \geq 1)$			(4)

	b)	Suppose the Rockwell hardness of a particular alloy is normally distributed with mean 70 and standard deviation 3. If a specimen is acceptable only if its hardness is between 67 and 75, what is the probability that a randomly chosen specimen has an acceptable hardness?		(5)
--	----	---	--	-----

Module 3

13	a)	Suppose that people immigrate into a territory according to a Poisson process with rate $\lambda = 2$ per day. (a) Find the probability there are 10 arrivals in the following week (of 7 days). (b) Find the expected number of days until there have been 20 arrivals.		(5)
	b)	The lifetime of a special type of battery is a random variable with mean 40 hours and standard deviation 20 hours. A battery is used until it fails, at which point it is replaced by a new one. Assuming a stockpile of 25 such batteries, the lifetimes of which are independent, approximate the probability that over 1100 hours of use can be obtained.		(4)
14	a)	If people arrive at a book stall in accordance with a Poisson process with mean rate of 3 per minute, find the probability that the interval between 2 consecutive arrivals is (i) more than 1 minute (ii) between 1 minute and 2 minutes (iii) 4 minutes or less.		(6)
	b)	Let X_1, X_2, \dots, X_{10} be independent Poisson random variables with mean 1. Use the Markov inequality to get a bound on $P\{X_1, X_2, \dots, X_{10} \geq 15\}$.		(3)

Module 4

15		The TPM of a Markov chain $\{X_n, n \geq 0\}$ having 3 states 1,2 and 3 is $\begin{matrix} 0.2 & 0.3 & 0.5 \\ 0.1 & 0.6 & 0.3 \\ 0.4 & 0.3 & 0.3 \end{matrix}$ and the initial probability distribution is $P(0) = [0.5 \ 0.3 \ 0.3]$. Find (i) $P\{X_2 = 2\}$ (ii) $P\{X_3 = 3, X_2 = 2, X_1 = 1, X_0 = 3\}$ (iii) $p^{(2)}$, the 2 step TPM		(9)

16	<p>Capa plays either one or two chess games every day, with the number of games that she plays on successive days being a Markov chain with transition probabilities</p> $P_{1,1} = 0.2, P_{1,2} = 0.8, P_{2,1} = 0.4, P_{2,2} = 0.6$ <p>Capa wins each game with probability p. Suppose she plays two games on Monday.</p> <p>(a) What is the probability that she wins all the games she plays on Tuesday?</p> <p>(b) What is the expected number of games that she plays on Wednesday?</p> <p>(c) In the long run, on what proportion of days does Capa win all her games.</p>	(9)

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B. TECH DEGREE EXAMINATION, NOVEMBER 2025

Course Code: PCCST302
Course Name: Theory of Computation

Max. Marks: 60

Duration: 2 hours 30 minutes

Part A			
Answer all questions. Each question carries 3 marks.		CO	Marks
1	When you <i>google</i> something, the search engine essentially performs <i>pattern matching</i> : it identifies and retrieves web pages containing the search keyword(s), then displays them in a pre-determined (typically relevance-based) order. Cast this pattern matching as a decision problem. Also write down the language corresponding to your decision problem.	1	(3)
2	Construct a DFA for the language consisting of strings over the alphabet $\Sigma = \{a, b\}$ that contains no more than one occurrence of the string aa . (Note that the string aaa contains two occurrences of aa .)	2	(3)
3	Is the class of languages recognized by NFAs closed under complement? Explain your answer.	1	(3)
4	Give a context-free grammar that generates the language: $L_{pair} = \{a^i b^j c^k \mid i = j \text{ or } j = k, \text{ where } i, j, k \geq 0\}$	3	(3)
5	Construct a PDA to recognize the language generated by the following grammar: $\begin{aligned} S &\rightarrow aA \\ A &\rightarrow aABC \mid bB \mid a \\ B &\rightarrow b \\ C &\rightarrow c \end{aligned}$	3	(3)
6	If G is a context free grammar and w is a string of length ℓ in $L(G)$, how long is a derivation of w in G , if G is in Chomsky normal form? How would your answer change if G is in Greibach normal form?	3	(3)

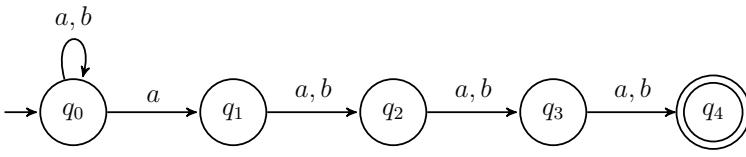
7	For each of the following decision problems about a Turing machine \mathcal{M} , indicate whether it is decidable or not.	5	(3)
	<ol style="list-style-type: none"> 1. Does \mathcal{M} take more than 1008 steps on some input? 2. Does \mathcal{M} accept ϵ? 3. Is $L(\mathcal{M})$ context free? 		

8 Let L_1 and L_2 be Turing-recognizable languages over the same alphabet Σ . Prove that $L_1 \cap L_2$ is also Turing-recognizable.

Part B

Answer any one full question from each module. Each question carries 9 marks.

Module I

9 (a)	Eliminate ϵ -transitions from the ϵ -NFA defined by: $\delta(q_0, a) = \{q_0, q_1\}$ $\delta(q_1, b) = \{q_1, q_2\}$ $\delta(q_2, a) = \{q_2\}$ $\delta(q_1, \epsilon) = \{q_1, q_2\}$ with initial state q_0 and final state q_2 .	2	(4)
(b)	Let R be the regular expression $\Sigma^*1100\Sigma^*$ where $\Sigma = \{0, 1\}$. Let $D = L(R)$ and let $E = \overline{D}$, the complement of D . Give the state diagram of a DFA with at most 5 states that accepts E .	2	(5)
10 (a)	Convert the following NFA to an equivalent DFA:  <pre> graph LR start(()) --> q0((q0)) q0 -- a --> q1((q1)) q1 -- "a, b" --> q0 q1 -- a --> q2((q2)) q2 -- a --> q3((q3)) q3 -- a --> q4(((q4))) q3 -- b --> q4 </pre>	2	(5)
(b)	Construct a finite automaton to accept the string PCCST302 and all its substrings.	2	(4)

Module II

11 (a)	<p>Prove that the class of regular languages is closed under subtraction. That is, show that if L_1 and L_2 are regular languages over some alphabet Σ, then the language</p> $L_1 - L_2 = \{w \in \Sigma^* \mid w \in L_1 \text{ and } w \notin L_2\}$ <p>is also regular.</p>	1	(4)
(b)	<p>Let $\Sigma = \{1, \geq\}$ and consider the language</p> $L = \{1^m \geq 1^n \mid m, n \in \mathbb{N} \text{ and } m \geq n\}.$ <p>(i) Give some specific examples of strings from the language L.</p> <p>(ii) Show that L is not regular.</p>	1	(5)
12 (a)	<p>Let $\Sigma = \{(,)\}$ and let P be the language consisting of all strings of properly nested parentheses. For example, P contains the strings:</p> $"(())", "((()))", "((()(((()))))", ""$ <p>but not:</p> $")()", "(())"$ <p>(i) Give a context-free grammar (CFG) that generates P.</p> <p>(ii) Show that P is not a regular language.</p>	1	(5)
(b)	Find a regular expression that denotes all bit strings whose value, when interpreted as a binary integer, is greater than or equal to 33.	2	(4)

Module III

13 (a)	<p>Convert the following CFG into Chomsky normal form:</p> $S \rightarrow SAB \mid AB \mid SBC$ $A \rightarrow AB \mid a$ $B \rightarrow BAB \mid b$ $C \rightarrow b$	3	(5)
--------	--	---	-----

(b)	Construct a PDA for the language $L_{a \neq b} = \{a^m b^n \mid m \neq n \wedge m, n > 0\}$	3	(4)
14 (a)	Remove unit productions from the following grammar: $\begin{aligned} X &\rightarrow aX \mid Y \mid b \\ Y &\rightarrow bK \mid K \mid b \\ K &\rightarrow a \end{aligned}$	3	(4)
(b)	Let $A = \{a^i b^j c^i \mid i \leq j \leq 2i\}.$ Prove that A is not a context-free language.	3	(5)
Module IV			
15 (a)	Let $\Sigma = \{0, 1\}$ and let $L = \{w \in \Sigma^* \mid w \text{ is a palindrome}\}.$ Design a Turing Machine (TM) that accepts the language L .	4	(4)
(b)	Let $\Sigma = \{0, 1\}$. Consider the problem of testing whether a given PDA accepts some string of the form $10 10^n 1^n \quad \text{for some } n \geq 0.$ Is this problem decidable? Justify your answer with a proof.	5	(5)
16 (a)	Design a TM that acts as an <i>binary incrementer</i> . That is, if the TM starts with the integer n (in binary) on its tape, it should halt with $n + 1$ (in binary) on the tape.	4	(4)
(b)	Let $D = \{\langle \mathcal{M} \rangle \mid \mathcal{M} \text{ is a TM that accepts the input string } 101\}.$ (a) Show that D is undecidable. (b) Show that the complement of D is not Turing-recognizable.	5	(5)

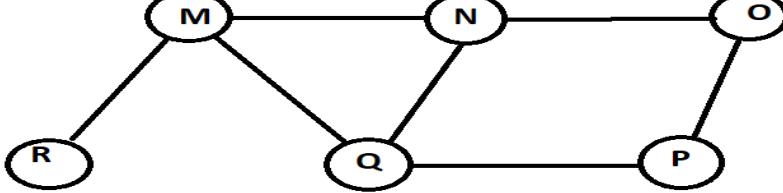
MODEL QUESTION PAPER																																				
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH AND YEAR																																				
Course Code: PCCST303																																				
Max. Marks: 60						Duration: 2 hours 30 minutes																														
		PART A																																		
		Answer all questions. Each question carries 3 marks																																		
1		What is the time complexity of this algorithm? J=1 for (I=1; I<n; I++) while j<I j=j*2																																		
2		What is row-major and column-major memory layouts? How do they apply to 2D array storage?																																		
3		Compare the insertion at head and tail in singly linked list and doubly linked list																																		
4		Write an algorithm to count the number of occurrences of a word in a linked list (each node contains only one word)																																		
5		Compare array and linked list in terms of memory usage and insertion/deletion complexity																																		
6		Draw the binary tree whose sequential representation is given below																																		
		<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>1</td><td>12</td><td>1</td><td>14</td><td>15</td> </tr> <tr> <td>A</td><td>B</td><td>C</td><td>-</td><td>D</td><td>E</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1</td><td>3</td><td></td><td></td><td></td> </tr> </table>					1	2	3	4	5	6	7	8	9	10	1	12	1	14	15	A	B	C	-	D	E	-	-	-	-	1	3			
1	2	3	4	5	6	7	8	9	10	1	12	1	14	15																						
A	B	C	-	D	E	-	-	-	-	1	3																									
7		Let the size of a hash table is 8. The index of the hash table varies from 0 to 7. Assume the keys 73, 54, 15, 48, 89, 66, 37, 18, are mapped using modulo operator. Show how the keys are distributed using hashing																																		
8		Apply the Quick Sort algorithm (using the last element as the pivot) to sort the following list of numbers: [8,4,7,3,10]																																		
PART B																																				
Answer any one full question from each module. Each question carries 9 marks																																				
Module 1																																				
9	a)	Illustrate how an algorithm's time and space complexity can be explained using tables and graphs.																																		
	b)	Write an algorithm to implement a circular queue using array.																																		

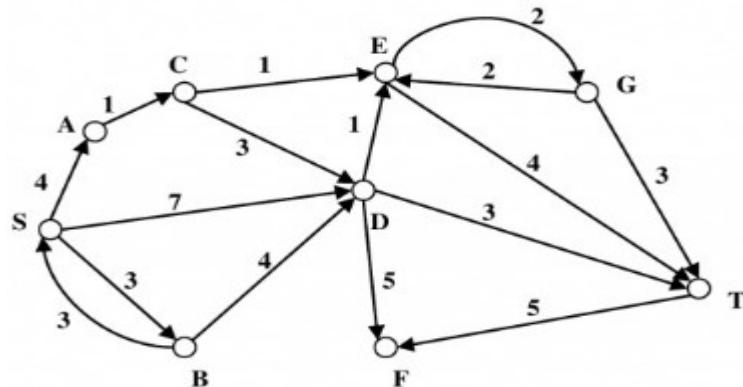
10	a)	Write an algorithm for push and pop stack operation using arrays.	CO1	(5)
	b)	Compare priority queues and deques in terms of structure, use cases, and operations.	CO1	(4)

Module 2

11	a)	Evaluate the given expression using stack $4*5/3-(4\%2)+(1*5)-2$	CO2	(5)
	b)	Write algorithms to insert and delete elements from a double ended queue.	CO2	(4)
12	a)	Write a program using linked lists to solve $(2x^3 + 5x^2 - 4x + 5) + (4x^3 + 2x^2 + 3x - 6)$		(5)
	b)	Given a singly linked list, write an algorithm to insert a node at the beginning and end of a singly linked list.	CO2	(4)

Module 3

13	a)	The Breadth-First Search algorithm has been implemented with the help of a queue. What is a possible order of visiting the nodes of the following graph is	CO3	(4)
	b)		CO3	(5)
14	a)	Consider the directed graph shown in the figure below. There are multiple shortest paths between vertices S and T. Which one will be reported by Dijkstra's shortest path algorithm? Assume that, in any iteration, the shortest path to a vertex v is updated only when a strictly shorter path to v is discovered.	CO3	(5)



- b) Construct the binary search tree with: 52, 35, 11, 7, 10, 90, 21, 16. What is the height of the created tree?

Module 4

15	a)	You are given a hash table with 5 buckets (i.e., indices 0 to 4). Use open hashing (separate chaining) to insert the following set of keys: {12,42,22,52,32}. Use the division method in hashing.	CO4	(4)
	b)	Create a text file that contains the names and marks of students in a class. Then, read the data from the file, apply the Quick Sort algorithm to sort the students based on their marks in decreasing order, and store the sorted data back into a file.	CO4	(5)
16	a)	You are given k sorted linked lists. Your task is to merge them into one sorted list. Use a min-heap (priority queue) to optimize the merging process. Always insert the smallest available element into the result list by extracting it from the heap and then pushing the next element from the same source list, if it exists.	CO4	(6)
	b)	Implement a spell checker that uses a hash table to store a dictionary of valid words, enabling fast lookup to detect and flag misspelled words in a given input text.	CO4	(3)

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH AND YEAR

Course Code: PBCST304

Course Name: Object Oriented Programming

Max. Marks: 40

Duration: 2 hours 30 minutes

PART A

Answer all questions. Each question carries 2 marks

CO **Marks**

1 You compile MyApp.java on Windows into MyApp.class, then copy that same MyApp.class file to both a Linux machine and a macOS system. Without recompiling, you run:
`java MyApp`
on each machine, and it executes successfully.
What is the name of the compiled file format that makes this possible?

CO1 **(2)**

2 What will be the value of *a* after the execution of the following code segment in Java.
`int a = -1;
a = a >> 4;`

CO1 **(2)**

3 You're given this Java code:

```
class Vehicle {
    protected String type = "Generic Vehicle";
    Vehicle() {
        System.out.println("Vehicle created");
    }
}
class Car extends Vehicle {
    protected String type = "Car";
    Car() {
        // **INSERT STATEMENT A HERE**
        System.out.println("Type: " + type);
    }
    void printParentType() {
        System.out.println("Parent Type: " +
    }
```

CO2 **(2)**

	<pre> super.type); } } public class TestSuper { public static void main(String[] args) { Car c = new Car(); c.printParentType(); } } a. What exact statement must replace // **INSERT STATEMENT A HERE** so that when you run TestSuper, you see: Vehicle created Type: Car Parent Type: Generic Vehicle b. In one sentence each, explain: (i) What the statement you inserted does here. (ii) Why super.type prints "Generic Vehicle" while type prints "Car". </pre>		
--	---	--	--

4	Illustrate inheritance in Java.	CO2	(2)
5	Using proper examples, give the difference between interfaces and abstract classes in Java.	CO3	(2)
6	<p>You're given this Java class:</p> <pre> 1 import java.io.*; 2 public class ExceptionDemo { 3 public static int divide(int a, int b) { 4 return a / b; 5 } 6 public static void readFile(String path) throws IOException { 7 FileInputStream fis = new FileInputStream(path); 8 fis.close(); 9 } 10 public static void main(String[] args) { 11 String filePath = args[0]; 12 int x = Integer.parseInt(args[1]); 13 int y = Integer.parseInt(args[2]); </pre>	CO2	(2)

	<pre> 14 try { 15 readFile(filePath); 16 System.out.println("Result: " + divide(x, y)); 17 } catch (Exception e) { 18 e.printStackTrace(); 19 } 20 } 21 }</pre> <p>(i) At which lines in this code might a checked exception be thrown? (ii) At which lines might an unchecked exception occur? (iii) For each case, name the exception class and explain briefly why it's checked or unchecked.</p>		
7	Give the differences between AWT and Swing in Java.	CO5	(2)
8	List the main steps to establish a JDBC connection. What is a PreparedStatement, and why is it preferred over a Statement?	CO5	(2)

PART B

Answer any one full question from each module. Each question carries 6 marks

Module 1

9	a)	<p>Write a Java program that uses command line arguments to calculate area:</p> <ul style="list-style-type: none"> ● If the user enters one argument, the program should treat it as the side of a square and print the area of the square. ● If the user enters two arguments, the program should treat them as the length and breadth of a rectangle and print the area of the rectangle. ● If the number of arguments is not 1 or 2, display an appropriate error message. 	CO1	(4)
	b)	Illustrate the use of <i>this</i> keyword in Java.	CO2	(2)
10	a)	<p>Design a Java class Book with the following attributes: title, author, and price.</p> <ul style="list-style-type: none"> ● Write a parameterized constructor to initialize these values. ● Also write a default constructor that sets default values. ● Create a display() method to print the book details. ● In the main method, create two objects — one using the default constructor and another using the parameterized constructor — and display their details. 	CO2	(4)

	b)	Refactor the Book class so that (i) data validation and (ii) input/output each live in their own classes. Which SOLID principle are you applying, and why?	CO1	(2)
--	----	--	-----	-----

Module 2

11	a)	<p>Create a Java class Calculator that demonstrates method overloading by implementing the add() method in the following ways:</p> <ul style="list-style-type: none"> ● add(int a, int b) — returns the sum of two integers. ● add(double a, double b) — returns the sum of two double values. ● add(int a, int b, int c) — returns the sum of three integers. <p>In the main method, create an object of Calculator and call all the overloaded add() methods with appropriate arguments. Display the results.</p>	CO2	(3)
	b)	<p>Create a Java class Counter that has a static variable count to keep track of the number of objects created. Increment count in the constructor. In the main method, create three objects of the Counter class and display the total number of objects created using the static variable.</p>	CO2	(3)
12		<p>Define a Java base class Animal with a method makeSound() that prints a generic sound. Then, create two subclasses Dog and Cat that override the makeSound() method to print "Bark" and "Meow" respectively. In the main method, create objects of Dog and Cat and call the makeSound() method to show runtime polymorphism.</p>	CO2	(3)

Module 3

13		You have a third-party class AnalyticsService with method sendEvent(String). Write an Adapter so that it conforms to your Logger interface (log(String)). Show both class definitions and the adapter code.	CO4	(6)
14		Implement the Singleton pattern for a Logger class that writes log entries to a file. Show your code and explain how it ensures a single instance.	CO2	(6)

Module 4

15		<p>Design a simple Java Swing GUI application with the following features:</p> <ul style="list-style-type: none"> ● A window with two buttons labeled "Greet" and "Clear". ● A text field where the user can enter their name. ● When the "Greet" button is clicked, display "Hello, [Name]!" in a label. ● When the "Clear" button is clicked, clear the text field and the label. <p>Use appropriate event handling by implementing ActionListener and demonstrate how to register and handle events in Java Swing. In your Swing GUI, the user enters a name and clicks 'Save'. Write the</p>	CO5	(6)
----	--	--	-----	-----

		JDBC code to insert that name into table greetings(name VARCHAR), handling exceptions appropriately. Write the complete code for this application.		
16	a)	Draw an MVC diagram for this Swing+JDBC app.	CO5	(3)
	b)	Describe how you'd apply Dependency Inversion so the Controller can be unit-tested without a real database.	CO5	(3)

MODEL QUESTION PAPER				
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY				
THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH AND YEAR				
Course Code: GAEST305				
Course Name: DIGITAL ELECTRONICS AND LOGIC DESIGN				
Max. Marks: 60				Duration: 2 hours 30 minutes
		PART A		
		<i>Answer all questions. Each question carries 3 marks</i>	CO	Mark s
1		Realize the Boolean expression $F=A'BC+A'B'+BC$ using NOR gates alone.		(3)
2		A weather monitoring station records the temperature as 8-bit signed integer using two's complement representation. If the current temperature is -5 degrees, obtain its two's complement representation. If the temperature increases by 12 degrees, obtain the new temperature after performing the binary addition using two's complement method.		(3)
3		<p>You are given a task to design an industrial press machine's safety system. The press will operate (output $F=1$) only under the following safe conditions.</p> <p>i. The master switch M should be on with the emergency switch either on or off.</p> <p>ii. Two protective guards A and B must be either simultaneously on or either one of them should be on.</p> <p>Create the truth table describing the output F, based on the inputs M,E,A,B. Deduce the simplified Boolean expression in SOP form for the security system</p>		(3)
4		Design a 3 bit code converter circuit with a mode control bit 'M', which converts the input binary code to gray code when $M=0$, and a gray code to		(3)

		its equivalent binary code when M=1. Draw the logic diagram.		
5		Design and realize an 8:1 multiplexer using two 4:1 multiplexers with necessary truth tables and explanations.		(3)
6		Realize a full subtractor circuit using a 3:8 decoder.		(3)
7		Derive the characteristic table, characteristic equation, and excitation table for a JK flipflop		(3)
8		Design an asynchronous mod 5 up counter using JK flipflop. Draw its timing diagram and explain.		(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

Module 1

9	a)	Obtain the following (i) Hexadecimal equivalent of the octal number 745 (ii) Decimal equivalent of the hexadecimal number F52.2B (iii) Binary equivalent of the decimal number 75.925		(5)
	b)	A logic circuit family has all its gates (NAND, INVERTER, NOR) working with the following DC specifications: Output High Voltage (VOH) = 4.5V Output Low Voltage (VOL) = 0.5V Input High Voltage (VIH) = 3.0V Input Low Voltage (VIL) = 1.0V Power Supply (VDD) = 5V Determine the Noise Margin Low and Noise Margin High for this circuit family.		(4)
1	a)	Compute $64_{10} - 100_{10}$ using 8-bit two's complement addition. Provide the 8-bit result and indicate whether two's complement overflow occurred.		(4)

0		Check your result by converting the 8-bit result back to decimal.		
b)		<p>You are using an 8-bit signed fixed-point number system with a Q3.4 format (3 integer bits, 4 fractional bits, 1 sign bit).</p> <p>a. What is the largest positive decimal number that can be represented in this Q3.4 format?</p> <p>b. What is the smallest (most negative) decimal number that can be represented in this Q3.4 format?</p> <p>c. Represent the decimal number 5.75 in this 8-bit Q3.4 format. Show your steps.</p>		(5)

Module 2

1	a)	<p>(i) For the given combinational circuit, determine the logic expression for F.</p> <p>(ii). Obtain the truthtable for F.</p> <p>(iii) Deduce and realize the circuit using NOR gates only.</p> <p>(iv). Deduce and realize the circuit using NAND gates only.</p>		(6)
b)		<p>Simplify the following Boolean expressions to a minimum number of literals and draw the logic diagrams of the circuits that implement the simplified expressions</p> <p>(a). $a'bc + abc' + abc + a'bc'$</p> <p>(b). $wxy'z + w'xz + wxyz$</p>		(5)

1	a)	Using K-map reduction obtain the minimized sum of products (SOP) expression for $F = m(1,3,9,11) + d(0,4,5)$. Also obtain the POS expression for F		(6)
	b)	Write the verilog module for realizing the SOP and POS expressions for F in above question using using the conditional operator (?) in dataflow model.		(3)

Module 3

1	a)	Design and realize a full adder circuit using two half adders.		0
3	b)	Write the complete verilog module for a 2:1 multiplexer using the conditional operator (?) in dataflow model. The module should have two data input 'in0', 'in1', and one selection input 'sel' and one output 'out'.		0
	c)			0
1	a)	Design a logic circuit to realize the boolean expression $F = \sum m(0, 1, 2, 5, 6, 8, 10)$ using <ul style="list-style-type: none"> (i). an 8:1 multiplexer, assuming that the multiplexer works with logic low enable input and produces logic low outputs (ii) 1:16 demultiplexer, assuming that the demultiplexer works with logic low enable input and produces logic low outputs. 		0
4	b)	Design a simple digital circuit that implements a 4 bit unsigned adder with an overflow indicator. The design should adhere to the modern digital design flow using Verilog HDL emphasizing good abstraction.		0

Module 4

1	a)	Design a synchronous sequence generator to generate the sequence 0,2,4,6,0,2,4,6,....		(4)
5	b)	Write the behavioural Verilog code to implement a negative edge triggered D flipflop and hence develop the behavioural model to implement a 4 bit synchronous up counter by instantiating the D flipflop.		(5)

1	a)	Design a mod 10 synchronous counter using JK flipflop. Draw the the circuit and its timing diagram.		(6)
6	b)	Design and develop the logic diagram to convert a D flipflop into a JK flipflop.		(3)
