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Roll No:

(To be filled in by the candidate)

## PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

## MARCH 2022 SEMESTER EXAMINATIONS.

## MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Maximum Marks: 100 Time: 3 Hours

	INSTRUCTIONS:	-0	20	~G *	_					
	Answer ALL questions. Each question carries 25 Marks.									
3	2. Course Outcome : Qn.1 CO1	Qn.2 CO2	Qn.3 CO3	Qn.4 CO4						

- 1. a) What counting techniques to be used for the below scenarios? Find answers and defend it.
  - We need to create a team of 5 players for the competition out of 10 team members. How many different teams is it possible to create?
  - (ii) In a supermarket, each product will be represented by a product code which is string of five-digit code (A, B, C, D, E) with repetition allowed. (For eg: AABDE). How many different possible product codes can be generated?
  - (iii) How many three letter "words" can be made from the letters a, b, and c with no letters repeating?
  - Assume that the word 'offer' occurs in 80% of the spam messages in my account. Also, let's assume 'offer' occurs in 10% of my desired e-mails. If 30% of the received e-mails are considered as a scam, and I will receive a new message which contains 'offer', what is the probability that it is spam?
  - c) i) The frequency distribution for the length, in seconds, of 100 telephone calls was:

I	Time	0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180
ı	(seconds)		1	Ch.		42		140		No.
l	Frequency	0	500	7	14	28	21 ,	13	9	30

Draw Histogram, and ogive. Compute mean, mode, deviation. CH PSG TECH

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ii) The time one has to wait for a bus at a bus stop is observed to a random phenomenon (X) with probability density function

- Let A be the event of person waits between 0 to 2 minutes, B be the event of person waits between 0 to 3 minutes. Show that P(B/A) = 2/3
- Probability of person waits more than 2 minutes
- The expected waiting time of a person
- a) Prove the following using Set Equivalence (laws) or membership table.
  - $(A \cap B) \cup (A B) = A \cap (B \cup (A B))$
  - ((A B) (B C))° ± A°∪ B (ii)
  - b) i) In a fruit feast among 200 students, 88 chose to eat durians, 73 ate mangoes, and 46 ate litchis 34 of them had eaten both durians and mangoes, 16 had eaten durians and litchis, and 12 had eaten mangoes and litchis, while 5 had eaten all 3 fruits. Determine, how many of the 200 students ate none of the 3 fruits, and how many ate only mangoes?

ii) Let R be a relation from N (set of all natural numbers) to N defined by

$$R = \{ (a, b) : a = b^2 \text{ and } a, b \in N \}.$$

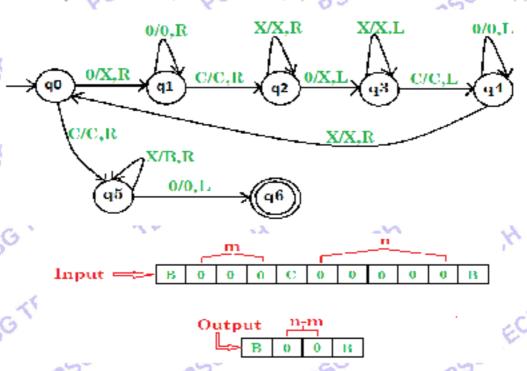
Prove that R is not reflexive, not symmetric, not transitive.

- Use the Principle of Mathematical Induction to prove the following statements. (12)
  - For any positive integer n, 6° 1 is divisible by 5
  - (ii) Find formula for the following sum of series by examining values and prove your formula is correct.

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(iii) Devise a recursive algorithm for computing the greatest common divisor of two
nonnegative integers a and b with a < b using the fact that gcd(a, b) = gcd(a, b a). Prove your algorithm is correct</li>

- a) Find the languages generated by the following grammars or regular expressions.
  - (i) G = ( {S}, {a,b,c}, {S→aSa, S→bSb, S→c}, S )
  - (ii) G: ({S, A, B}, {a, b}, S, {S → aA, A → aA | B, B → ε | bB })
  - (iii) Regular expression 0(0+1)\*0 | 1(0+1)\*1
  - (iv) Regular expression (011 + 1)\*
  - b) Prove that the following Grammar generates all even integers up to 998. Let G = (N, T, P, S), where N = {S, S₁, A, B}, T = {0,1,2,3,...,9} and P consists of S → 0|2|4|6|8, S→AS₁, A→1|2|3|4|5|6|7|8|9, S₁→0|2|4|6|8, S→ABS₁, B→0|1|2|3|4|5|6|7|8|9 (5)
  - c) Exemplify in detail 4 different types of grammars. Construct grammars for the following languages. (12)
    - (i) Context-free grammar for the language L = a<sup>n</sup>b<sup>2n</sup> where n>=1
    - (ii) Parentheses matching in programming language using any grammar
    - (iii) Context sensitive grammar for the language L = { w ∈ {a, b, c} · | Number of a's in w = Number of b's in w = Number of c's in w , Number of a's in w ≥ 1}
- a) Prove that the following Turing machine is doing subtraction of numbers. (Here note
  that the representation 0/X, R means 0 → X, R)

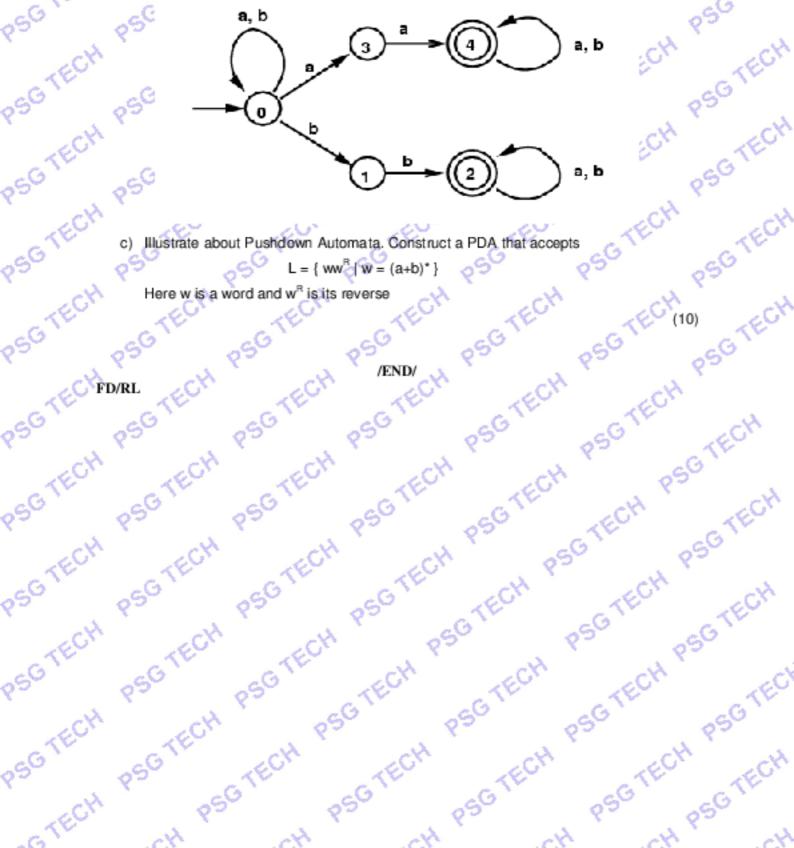


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b) Convert the given NFA machine (M1) into a DFA machine (M2) and then identify the ECH PSG TECH language accepted by both M1 and M2.



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$$L = \{ ww^R | w = (a+b)^* \}$$

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