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# National Institute of Technology, Delhi

Mid Semester Examination (Spring, 2023)

Branch	: CSE	Semester	: IV
Title of the Course	: DIGITAL ELECTRONICS & LOGIC DESIGN	Course Code	: ECB 257
Time	: 1.5 Hours	Maximum Marks	: 25

- All questions are compulsory.
- All questions should be answered in the same sequence as mentioned in the paper: You have to answer Q1 first, then Q2, so on, and finally Q5. **ELSE QUESTIONS SHALL NOT BE EVALUATED.**

Q1. Differentiate between the combinational and sequential circuits. [2]

Q2. Boolean expression  $WZ + W'YZ'$  is the reduced version of the expression  $V'WZ + WXYZ + WX'Y'Z + V'W'YZ' + W'X'YZ'$ . Determine the don't care minterms for the above expression. [4]

Note: Vairable' represent compliment of that variable, e.g.,  $W'$  implies compliment of  $W$

Q3. Perform the following operations on the given binary numbers as specified [6]

1.  $110.01 + 1.011$
2. Convert  $11101.01$  to decimal.
3.  $11100.101 - 101.01$  using 2's complement.
4. Convert  $111000$  to octal.
5. Convert  $111000$  to hexadecimal.
6. What is the output of the XOR gate with inputs  $x$  and  $y$ .

Q4. [6]

1. Reduce boolean expression  $x + x'y$
2. Simplify  $F_1(A, B, C) = A(A' + C)(A'B + C)(A'BC + C')$
3. Simplify  $F_2(x, y, z) = x'y'z + x'yz + xy'$

Note: Vairable' represents the complement of that variable, e.g.,  $x'$  is the complement of  $x$ .

Q5. Reduce the function  $F(A, B, C, D, E) = \sum(0, 2, 4, 6, 9, 13, 21, 23, 25, 29, 31)$ . [7]

# National Institute of Technology, Delhi

Name of the Examination: B. Tech 2<sup>nd</sup> year (Mid Semester), 2023

Branch : CSE

Semester: 4<sup>th</sup>

Title of the Course: Communication Systems

Course Code: ECB-256

Time: 1.5 Hours

Maximum Marks: 25

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Introduction of various amplitude modulation and demodulation schemes and analyzing their spectrum using Fourier transform.	Analyzing (Level IV)
CO2	Analyze the various generation and detection methods of narrow and wideband frequency modulation.	Analyzing (Level IV)
CO3	Understand the concepts of pulse modulation, sampling process, delta modulation and ADCM	Evaluating (Level-V)
CO4	Understand the concepts of source coding and data compression techniques, Line coding schemes and analysis of ISI Mitigation Techniques	Understanding (Level-II)
CO5	Understand the concepts of source coding and data compression techniques, Line coding schemes and analysis of ISI Mitigation Techniques	Understanding (Level-II)

Course Outcomes(CO's)	CO1	CO2
Questions No.	Q.1, Q.2	Q.3, Q.4, Q.5

**Note: Attempt all questions**

**(5×5=25)**

Q.1 Explain the phase and frequency error in synchronous detection of DSB-SC signal.

Q.2 For an amplitude modulated signal given by:

$$\phi_{AM}(t) = 10 \cos(2\pi 10^6 t) + 5 \cos(2\pi 10^6 t) \cos(2\pi 10^3 t) + 2 \cos(2\pi 10^6 t) \cos(4\pi 10^3 t)$$

Find the total modulated power, sideband power and net modulation index.

Q.3 Explain the principle of Armstrong FM generation. How is narrow band FM converted to wideband FM to achieve desired carrier frequency as well as deviation.

Q.4 Discuss the effect of nonlinear distortion on amplitude and angle modulation.

Q.5 A message signal with 10 kHz bandwidth is lower sideband modulated with carrier frequency  $f_{c1} = 10^6$  Hz. The resulting signal is then passed through a narrow band frequency modulator with carrier frequency  $f_{c2} = 10^9$  Hz. Find the bandwidth of the output signal.

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# National Institute of Technology Delhi

Name of the Examination: Mid Sem Examination (March 2023)

Branch: (B.Tech. CSE)

Title of the Course: Theory of Computation

Time: 1.5 Hours

Note:1. Attempt all questions. 2. Read all questions carefully 3. Missing parameters or values may be assumed.

Semester: IV

Course Code: CSL 251

Maximum Marks: 25

1. (a) For each of the following sets of strings over the alphabet  $\{a, b\}$ , answer the following questions (1) Is  $\epsilon$  (the empty string) in the set? (2) What's an example of a string over  $\{a, b\}$  of length at least 2 that is in the set (or why isn't there such an example)? (3) What's an example of a string over this alphabet of length at least 2 that is not in the set (or why isn't there such an example)? (3)
- $\{w \in \{a, b\}^* \mid \exists y (w = yy)\}$
  - $\{a, b\} \circ \{aa, bb\}$
  - $\{a, b\} \cup \{aa, bb\}$
- (b) Consider the DFA,  $M$ , whose state diagram is given by Fig. ?? (5)

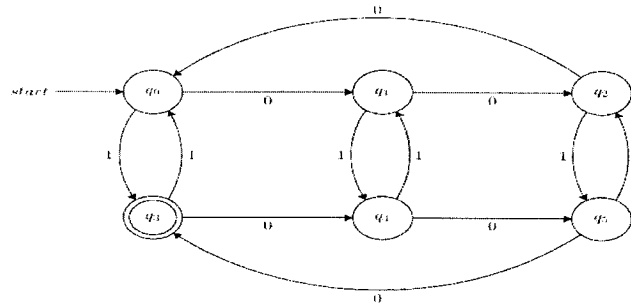


Figure 1: DFA

- What is the language recognized by  $M$ ? Give an informal description in English and briefly justify your answer.
- Are there strings  $x \in L(M)$ , such that if the bits of  $x$  are flipped (changing 0 to 1 and 1 to 0), the resulting string will also be in  $L(M)$ ? Why or why not? Is this true for every string  $x \in L(M)$ ?
- Write the formal definition of  $M = (Q, \Sigma, \delta, q_0, F)$ . Use a table to define  $\delta$ .

2. (a) Design Context free grammar for the following language, (3)  
The set  $\{a^i b^j c^k | i \neq j \text{ or } j \neq k\}$  that is, the set of strings of a's followed by b's followed by c's, such that there are either a different number of a's and b's or a different number of b's and c's, or both.
- (b) The following grammar generates the language of regular expression  $0^*1(0+1)^*$  (3)  
:  
 $S \rightarrow A1B$   
 $A \rightarrow 0A | \epsilon$   
 $B \rightarrow 0B | 1B | \epsilon$   
Give rightmost and leftmost derivations for the following strings,  
i. 00101  
ii. 00011
- (c) In Fig. ?? is the transition table of DFA. (4)

	0	1
$\rightarrow A$	B	A
B	A	C
C	D	B
*D	D	A
E	D	F
F	G	E
G	F	G
H	G	D

Figure 2: DFA to be minimized

- i. Draw the table of distinguishabilities for the automation.  
ii. Construct the minimum-state equivalent DFA.
3. (a) Prove that following languages are not regular languages (using pumping lemma), (3)  
i.  $\{0^n | n \text{ is a perfect cube}\}$   
ii. The set of strings 0's and 1's that are of the form  $ww^R$ , that is, some string followed by its reverse.
4. (a) Convert  $00(0+1)^*$  regular expression into  $\epsilon$ -NFA. Further convert it into an equivalent DFA. (2)
- (b) Write regular expressions for the following languages, "The set of strings of 0's and 1's whose number of 0's are divisible by 5 and whose number of 1's is even." (2)

**National Institute of Technology, Delhi**  
**Name of the Examination: B. Tech Second Year (AY 2022-2023)**  
**Mid Semester Examination (Spring Semester)**

Branch: CSE

Semester: IV

Title of the Course : Object Oriented Programming

Course Code : CSB273

Time: 90 Minutes

Maximum Marks: 25

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Que1: Answer in brief (1 Mark each)

1. What is the difference between Procedural programming and OOPS.
2. Are class and structure the same? If not, what's the difference between a class and a structure?
3. Are there any limitations of Inheritance? Justify your answer.
4. What is the difference between overloading and overriding?
5. What are access specifiers and what is their significance?
6. What are the various types of constructors? Explain in brief.
7. What are all the operators that cannot be overloaded?
8. What are a base class, subclass, and superclass?
9. What are the different types of Polymorphism?
10. What are the differences between Abstraction and encapsulation?
11. Explain the concept of friend function and friend classes.
12. Explain with an example THIS pointer.
13. Explain implicit and explicit type conversions in C++

Que2: Write a C++ program for the following. (3 Marks each)

1. To display the reverse of a number using constructor and destructor.
2. Illustrate the concept of increment ++ and Decrement -- Operator Overloading.
3. Write a program to illustrate the concept of Polymorphism.
4. Write a program to illustrate the concept of Inheritance.

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**Mid Semester Examination (Spring, 2023)**

Branch	: B. Tech	Semester	: 4th
Title of the Course	: Software Engineering	Course Code	: CSE 253
Time	: 1.5 Hour	Maximum Marks	: 25

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- Q1.** With respect to the prototyping model for software development, answer the following: [CO1] [4]
- a) What is a prototype?
  - b) Is it necessary to develop a prototype for all types of projects?
  - c) If you answer to part (b) of the question is no, then mention under what circumstances is it beneficial to construct a prototype.
  - d) If you answer to part (b) of the question is yes, then explain does construction of a prototype always increase the overall cost of software development.
- Q2.** a) Explain incremental process model. Justify that it is appropriate for business software systems but less appropriate for real time systems. [CO1] [2+2]  
b) Explain why the spiral life cycle model is considered to be a meta model.
- Q3.** Explain the following aspects of rapid application development (RAD) SDLC model: [CO1] [3]  
(a) What is a time box in a RAD model?  
(b) How does RAD facilitate faster development?  
(c) Identify the key difference between the RAD and the prototype model.
- Q4.** Briefly explain the agile software development model. Give an example of a project for which the agile model would be suitable and one project for which the agile model would not be appropriate. [CO1] [3]
- Q5.** Instead of having a onetime testing of a software at the end of its development, why are three different levels of testing- unit testing, integration testing and system testing are necessary? What is the main purpose of each of these different level of testing? [CO1] [3]
- Q6.** a) Define Software requirement engineering. [CO2] [2+2+4]  
b) Explain the need of SRS in any project.  
c) What is the difference between the functional and the non-functional requirements of a software system? Identify atleast two functional requirements of a bank automated teller machine (ATM) system. Also identify one non-functional requirement for an ATM system.

**National Institute of Technology, Delhi**  
**Name of the Examination: Design and Analysis of Algorithms**  
**Mid-Semester Examination (Spring Semester 2023)**

**Branch: CSE**

**Semester: IV<sup>th</sup>**

**Title of the Course: Design and Analysis of Algorithms**

**Course Code: CSB-252**

**Time: 1.5 hours**

**Maximum Marks: 25**

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**Section I: Each question carries 1 mark**

**Q.1** A B-tree of order 4 and of height 3 will have a maximum of \_\_\_\_\_ keys.

**Q.2** What is the advantage of binary search over linear search? Also, state limitations of binary search.

**Q.3** Given a heap of  $n$  nodes. The maximum number of tree for building the heap is \_\_\_\_\_.

**Q.4** Sort the following list using Radix sort algorithm:

329, 355, 436, 457, 657, 720, 839

What is the output of the algorithm after second pass?

**Q.5** The time complexity of an efficient algorithm to find the longest monotonically increasing subsequence of  $n$  numbers is

(A)  $O(n)$

(B)  $O(n \lg n)$

(C)  $O(n^2)$

(D) None of the above

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**Section II: Each question carries 2 marks**

**Q.1.** Write an algorithm for counting sort? Illustrate the operation of counting sort on the following array:  $A = \{4, 0, 2, 0, 1, 3, 5, 4, 1, 3, 2, 3\}$ .

**Q.2** Show the results of inserting the keys F, S, Q, K, C, L, H, T, V, W, M, R, N, P, A, B, X, Y, D, Z, E in order into an empty B-tree. Use  $t=3$ , where  $t$  is the minimum degree of B- tree.

**Q.3** What is the max degree in a binominal heap of  $n$  nodes? Justify your answer,

**Q.4** Perform insertion operation in an empty red-black tree for the following keys 5, 16, 22, 25, 2, 10, 18, 30, 50, 12, 1.

**Q.5** Take the following list of functions and arrange them in ascending order of growth rate. That is, if function  $g(n)$  immediately follows function  $f(n)$  in your list, then it should be the case that  $f(n)$  is  $O(g(n))$ .



$f_1(n)=n^{2.5}$ ,  $f_2(n)=\sqrt{2}^n$ ,  $f_3(n)=n+10$ ,  $f_4(n)=10n$ ,  $f_5(n)=100n$ , and  $f_6=n^2\log n$ .

**Q.6** Draw the B-tree of order 3 and order 4 created by inserting the following data arriving in sequence.

92, 24, 6, 7, 11, 8, 22, 4, 5, 16, 19, 20, 78

**Q.7** Prove that the maximum degree of  $n$ - node in a binomial tree is  $\log_2 n$ .

**Section III: Each question carries 6 marks**

**Q.8** Show the resulting Binomial heap and steps when the remove min operation is performed on the following Min Binomial heap.

