CS8351 - DIGITAL PRINCIPLES AND SYSTEM DESIGN
TWO MARKS QUESTIONS AND ANSWERS

1. What are the methods adopted to reduce Boolean function?
   a. Karnaugh method
   b. Tabular method or Quine Mccluskey method
   c. Variable entered map technique.
2. State the limitations of Karnaugh map.
   a. It is limited to six variable map.
   b. The map is restricted in its capability since they are useful for simplifying only Boolean expression represented in standard form.
3. State the advantages of Kmap method.
   a. It is fast method for simplifying expressions up to four variables.
   b. Suitable for both SOP and POS forms of reduction.
4. Give the advantage of tabular method.

   This method can be applied to problems with many variables and has the advantage of being suitable for machine computation.
5. Define logic gates.

   Logic gates are electronic circuits that operate on one or more input signals to produce an output signal. Electrical signals such as voltages or currents exist throughout a digital system in either of two recognizable values. Voltage-operated circuits respond to two separate voltage levels that represent a binary variable equal to logic 1 or logic 0.
6. Define duality property.

   Duality property states that every algebraic expression deducible from the postulates of Boolean algebra remains valid if the operators and identity elements are interchanged. If the dual of an algebraic expression is desired, we simply interchange OR and AND operators and replace 1's by 0's and 0's by 1's.
7. Find the complement of the functions F1 = x'yz' + x'y'z and F2 = x(y'z' + yz). By applying De Morgan's theorem as many times as necessary.

   F1' = (x'yz' + x'y'z)' = (x'yz')'(x'y'z)' = (x + y' + z)(x + y +z')

   F2' = [x(y'z' + yz)]' = x' + (y'z' + yz)'

   = x' + (y'z')'(yz)'

   = x' + (y + z)(y' + z')
8. Find the complements of the functions F1 = x'yz' + x'y'z and F2 = x(y'z' + yz). by taking their duals and complementing each literal.

   F1 = x'yz' + x'y'z

   The dual of F1 is (x' + y + z')(x' + y' + z)

   Complementing each literal: (x + y' + z)(x + y + z') F2 = x(y'z' + yz).

   The dual of F2 is x + (y' + z')(y + z).

Complement of each literal: x' + (y + z)(y' + z')

9. State De Morgan's theorem.
   De Morgan suggested two theorems that form important part of Boolean algebra. They are,
   1) The complement of a product is equal to the sum of the complements.
      (AB)' = A' + B'
   2) The complement of a sum term is equal to the product of the complements.
      (A + B)' = A'B'

10. Reduce A.A'C
    A.A'C = 0.c [A.A' = 1]= 0

11. Convert the given expression in canonical SOP form Y = AC + AB + BC Y=AC+AB+BC
    =AC(B + B') + AB(C + C') + (A + A')BC
    =ABC + ABC' + AB'C + AB'C' + ABC + ABC' +
    ABC =ABC + ABC' +AB'C + AB'C' [A + A =1]

12. Convert the given expression in canonical POS form Y = (A + B)(B + C)(A + C) Y=(A+B)(B+C)(A+C)
    =(A+B+C.C')(B+C+A.A')(A+B.B'+C)
    =(A+B+C)(A+B+C')(A+B+C)(A'+B+C)(A+B+C)(A+B'+C)
    =(A+B+C)(A+B+C')(A'+B+C)(A'+B+C)(A+B'+C)

13. Find the minterms of the logical expression Y = A'B'C' + A'B'C + A'BC + ABC'
    Y = A'B'C' + A'B'C + A'BC + ABC'
    =m0 + m1 +m3 +m6 = m (0,1,3,6)

14. Write the maxterms corresponding to the logical expression
    Y=(A+B+C')(A+B'+C')(A'+B'+C)
    Y=(A+B+C')(A+B'+C')(A'+B'+C)
    =M1.M3.M6 = M (1,3,6)

15. Convert $(4021.2)_5$ to its equivalent decimal.
    $(4021.2)_5 = 4 \times 5^3 + 0 \times 5^2 + 2 \times 5^1 + 1 \times 5^0 + 2 \times 5^{-1} = (511.4)_{10}$

16. What are called don't care conditions?
    In some logic circuits certain input conditions never occur, therefore the corresponding output never appears. In such cases the output level is not defined, it can be either high or low. These output levels are indicated by 'X' or'd' in the truth tables and are called don't care conditions or incompletely specified functions.

17. What are the different classifications of binary codes?
    1. Weighted codes
    2. Non - weighted codes
    3. Reflective codes

4. Sequential codes
5. Alphanumeric codes
6. Error Detecting and correcting codes.

18. What are error detecting codes?

Codes which allow only error detection in the transmitted binary data are called error detecting codes.

19. What are sequential codes? Give examples.

In sequential codes, each succeeding code is one binary number greater than its preceding code. 8421, excess-3 codes are sequential.

20. What are reflective codes?

A code is said to be reflective when the code for 9 is the complement for the code for 0, 8 for 1, 7 for 2, 6 for 3 and 5 for 4. Excess-3 code is an example for reflective code.

21. What are weighted codes?

Weighted codes are one in which each digit position of the number represents a specific weight. The codes 8421, 2421 and 5211 are all weighted codes.

22. What are alphanumeric codes?

The codes which consist of both numbers and alphabetic characters are called alphanumeric codes. The most commonly used alphanumeric codes are ASCII, EBCDIC and Hollerith code.

23. What is meant by parity bit?

A parity bit is an extra bit included with a message to make the total number of 1's either even or odd.

24. Define binary logic

Binary logic consists of binary variables and logical operations. The variables are designated by the alphabets such as A, B, C, x, y, z, etc., with each variable having only two distinct values: 1 and 0. There are three basic logic operations: AND, OR, and NOT.

25. Define Positive Logic

When high voltage or more positive voltage level is associated with binary '1' and while the low or less positive level is associated with binary '0' then the system adhering to this is called positive logic.

26. Define Negative Logic.

When high voltage level is associated with binary '0' and while the low level is associated with binary '1' then the system adhering to this is called negative logic.

27. List the characteristics of digital Ics.

i) propagation delay
ii) power dissipation

iii) Fan-in
iv) Fan-out
v) Noise margin

28. What is a universal gate?
Universal gate is one using which any logic function can be implemented. NAND and NOR gates are universal gates.

29. Why is a NAND gate a universal gate?
The NAND gate is a universal gate as it can be used to construct an AND gate, an OR gate, an inverter or any combination of the functions.

30. What is a multiplexer?
Multiplexer is a digital switch that allows digital information from several sources to be routed onto a single output line. The selection of a particular input line is controlled by a set of selection lines.

31. List out the applications of multiplexer?
The various applications of multiplexer are
a. Data routing.
b. Logic function generator.
c. Control sequencer.
d. Parallel-to-serial converter 32.

What is De-multiplexer?
A De-multiplexer is a circuit that receives information on a single line and transmits this information on one of 2^n possible output lines 33.

Give the applications of De-multiplexer
i) It finds its application in Data transmission system with error detection.
ii) One simple application is binary to Decimal decoder.

34. Mention the uses of De-multiplexer.
De -multiplexer is used in computers when a same message has to be sent to different receivers. Not only in computers, but any time information from one source can be fed to several places.

35. Can a decoder function as a De-multiplexer?
Yes. A decoder with enable can function as a De-multiplexer if the enable line E is taken as a data input line A and B are taken as selection lines.

36. What is the function of the enable input in a Multiplexer? The function of the enable input in a MUX is to control the operation of the unit.

37. What are combinational circuits?

A combinational circuit consists of logic gates whose outputs at any time are determined from the present combination of inputs. A combinational circuit performs an operation that can be specified logically by a set of Boolean functions. It consists of input variables, logic gates, and output variables.

38. Give the design procedures for the designing of a combinational circuit
The procedure involves the following steps,
From the specification of the circuit, determine the required number of inputs and outputs and assign a symbol to each.
Derive the truth table that defines the required relationships between inputs and outputs.
Obtain the simplified Boolean functions for each output as a function of the input variables.
Draw the logic diagram and verify the correctness of the design.

39. Define half adder.
A combinational circuit that performs the addition of two bits is called a half adder. A half adder needs two binary inputs and two binary outputs. The input variables designate the augend and addend bits; the output variables produce the sum and carry.

40. Define full adder
A combinational circuit that performs the addition of three bits is a full adder. It consists of three inputs and two outputs.

41. Define binary adder
A binary adder is a digital circuit that produces the arithmetic sum of two binary numbers. It can be constructed with full adders constructed in cascade, with the output carry from each full adder connected to the input carry of the next full adder in the chain.

42. Define magnitude comparator.
A magnitude comparator is a combinational circuit that compares two numbers, A and B, and determines their relative magnitudes. The outcome of the comparison is specified by three binary variables that indicate whether a>b, A = b, or A < B.

43. List out the applications of comparators? The following are the applications of comparator
a. Comparators are used as a part of the address decoding circuitry in computers to select a specific input/output device for the storage of data.
b. They are used to actuate circuitry to drive the physical variable towards the reference value.
c. They are used in control applications.

44. What are decoders?
A decoder is a combinational circuit that converts binary information from n input lines to a maximum of 2n unique output lines. If the n bit coded information has unused combinations, the decoder may have fewer than 2n outputs.

45. List out the applications of decoder? The applications of decoder are
    a. Decoders are used in counter system.
    b. They are used in analog to digital converter.
    c. Decoder outputs can be used to drive a display system.

46. What are encoders?
    An encoder is a digital circuit that performs the inverse operation of a decoder. An encoder has 2n and n output lines. The output lines generate the binary code corresponding to the input value.

47. Define priority encoder
    A priority encoder is an encoder circuit that includes the priority function. The operation of priority encoder is such that if two or more inputs are equal to 1 at the same time, the input having the highest priority will take precedence.

48. Define binary decoder.
    A decoder which has an n- bit binary input code and a one activated output out-of -2n output code is called binary decoder. A binary decoder is used when it is necessary to activate exactly one of 2n outputs based on an n-bit input value.

49. What are the advantages of 1's complement subtraction?
    1) The 1's complement subtraction can be accomplished with an binary adder. Therefore, this method is useful in arithmetic logic circuits.
    2) The is complement of a number is easily obtained by inverting each bit in the number.

50. Show that the NAND connection is not associative. The NAND connection is not associative says that A.B.CA.B.C
    A.B+CA+BC
    AB+CA+BC

51. List basic types of programmable logic devices.
    1. Read only memory
    2. Programmable logic Array
    3. Programmable Array Logic

52. Define ROM
    A read only memory is a device that includes both the decoder and the OR gates within a single IC package.

53. Define PAL.
    PAL programmable logic device with fixed OR array and a programmable AND array. Because only AND gates are programmable, PAL is easier to program, but it is not as flexible as PLA.

54. Define address and word.
    In a ROM, each bit combination of the input variable is called on address. Each bit combination that comes out of the output lines is called a word.

55. Compare PROM, PLA and PAL.

SNO	PROM	PLA	PAL
1	AND array is fixed and OR array is programmable	Both AND and OR arrays are programmable.	OR array is fixed and AND array is programmable.
2	Cheaper and simpler	Costliest and complex than PAL	Cheaper and simpler

56. What are the types of ROM?
    1. Masked ROM.
    2. Programmable Read only Memory
    3. Erasable Programmable Read only memory.
    4. Electrically Erasable Programmable Read only Memory.

57. What is programmable logic array? How does it differ from ROM?
    PLA is a programmable logic device which consists of programmable AND and OR array. A PLA is similar to a ROM in concept; however it does not provide full decoding of the variables and does not generates all the minterms as in the ROM.

58. Define parity bit.
    A parity bit is used for the purpose of detecting errors during transmission of binary information. A parity bit is an extra bit included with a binary message to make the number of 1s either odd or even.

59. What are parity generator and parity checker?
    A parity bit is used for the purpose of detecting errors during transmission of binary information. A parity bit is an extra bit included with a binary message to make the number of 1s either odd or even. The circuit that generates the parity bit in the transmitter is called a parity generator. The circuit that checks the parity in the receiver is called a parity checker.

60. What is a sequential circuit?
    A sequential circuit is one in which the output variables dependent not only on the present input variables but they also depend up on the past history of the input variables.

61. What are the types of sequential circuits?
    1. Synchronous sequential circuit: Change in input signals can affect the memory elements only at discrete instants of time.
    2. Asynchronous sequential circuit: Change in input signals can affect memory element at any instant of time.

62. Define flip flop.
    Flip flop is a device with two stable states 0 or 1. A flip flop maintains its output state until directed by an input signal to change its state. Since it can store 1-bit of information, it is also called 1-bit memory unit.

63. What are the types of flip flops?
    1. SR Flip flop
    2. JK Flip flop
    3. Delay (D) Flip flop
    4. Toggle (T) Flip flop

64. Give the excitation of JK flip flop.

Q(t)	Q(t+1)	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

65. Give the excitation of SR flip flop.

Q(t)	Q(t+1)	J	K
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0

66. Give the excitation of T flip flop.

Q(t)	Q(t+1)	T
0	0	0
0	1	1
1	0	1
1	1	0

67. Give the excitation of D flip flop.

Q(t)	Q(t+1)	D
0	0	0
0	1	1
1	0	0
1	1	1

68. What is a latch?

A latch is a memory device without clock signal.

69. What is a characteristic table?

A characteristic table defines the logical property of the flip-flop and completely characteristic its operation.

70. Give the characteristic equation of a SR flip-flop.

Q(t+1)=S+R'Q

71. Give the characteristic equation of a D flip-flop.

Q(t+1)=D

72. Give the characteristic equation of a JK flip-flop.

Q(t+1)=JQ'+K'Q

73. Give the characteristic equation of a T flip-flop.

Q(t+1)=TQ'+T'Q

74. What is the difference between truth table and excitation table.

i) An excitation table is a table that lists the required inputs for a given change of state.

ii) A truth table is a table indicating the output of a logic circuit for various input states.

75. What are the types of triggering a flip flop?
The types of triggering a flip flop are, 1. Level triggering
2. Edge triggering.

76. What is edge triggering in flip flops?
Edge triggering means that the flip flop changes state either at the positive edge(rising edge) or at the negative edge (falling edge) of the clock pulse and is sensitive to its inputs only at this transition of the clock.

77. What is meant by level triggering?
In level triggering the output of the flip-flop changes state or responds only when the clock pulse is present.

78. What is race around condition?
In JK flip flop output is fed back to the input and therefore changes in the output results change in the input. Due to this, in the positive half of the clock pulse if J and K are both high then output toggles continuously. This condition is known as race around condition.

79. Define propagation delay.
Propagation delay is the time required for the output to change after application of the input.

80. What are shift registers?
A register is a group of flip flops to store a word. The binary information in a register can be moved from stage to stage upon application of clock pulses. This gives rise to group of registers called shift registers. This type of bit shifting is essential for certain arithmetic and logic operations used in microprocessors.

81. What is a counter?
A counter is a register capable of counting the number of clock pulses arriving at its clock input. Count represents the number of clock pulses arrived.

82. What is ripple or asynchronous counter?
Ripple counter is one in which first flip flop is clocked by the external clock pulse and then each successive flip flop is clocked by the output of previous flip flop.

83. What is meant by modulus of a counter?
By the term modulus of a counter we say it is the number of states through which a counter can progress.

84. A counter has 14 stable states 0000 through 1101. If the input frequency is 50KHz what will be its output frequency?

Output frequency = 50 / 14 = 3.57 KHz.

85. Compare synchronous and asynchronous counters.

SNO	SYNCHRONOUS COUNTERS	ASYNCHRONOUS COUNTERS
1	In this counter, common clock input is connected to all the flip flops. Thus they are clocked simultaneously.	In this counter, first flip flop is clocked by the external clock pulse and then each successive flip flop is clocked by the output of previous flip flop.
2	Propagation delay is equal to the delay of single flip flop.	Propagation delay is the cumulative sum of Propagation delay of all flip flops.
3	Also called parallel counters	Also called ripple or serial counters

86. What is a ring counter?

A counter formed by circulating a 'bit' in a shift register whose serial output has been connected to its serial input.

87. What is Johnson counter?

It is a ring counter in which the inverted output is fed into the input. It is also known as a twisted ring counter.

88. What are the two models of synchronous sequential circuits?

The two models of synchronous sequential circuits are,

1. Moore model
2. Melay model

89. Compare Moore and Melay models.

SNO	MOORE MODEL	MELAY MODEL
1	Its output is a function of present state only	Its output is a function of present state as well as present input.
2	Input changes does not affect the output	Input changes may affect the output