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Information Technology Department **Four pages**
SIT213 / IT212 / Logic Design **60 minutes / 30 Marks**

Midterm
(29/5/2021)

Note: *None* in the answer means that none of the mentioned solution is right.

A. Using various codes, answer the following (each 1 mark):

1. How is $(2.5)_{10}$ represented in BCD code?
   a. 10.101 b. 0010.0101 c. 1000.1010 d. 0010.101 e. None

2. How is $(01011010)_{7421}$ represented in decimal?
   a. 510 b. 95 c. 59 d. 74 e. None

3. How is $(110)_2$ represented in gray code?
   a. 101 b. 010 c. 111 d. 100 e. None

4. How is $(25)_{10}$ represented in 84-2-1 code?
   a. 01101100 b. 01111011 c. 11101011 d. 10000101 e. None

B. Adding the two binary numbers 0110 1000.0001 and 0010 0101.0111 where the first BCD code (from the left side) in each of the two numbers is represented by A1 and A2, the second is represented by B1 and B2 … etc, meaning that A1= 0110, A2= 0010 (each 1 mark):

5. What is the initial result of adding A1 and A2?
   a. 1110 b. 1010 c. 1000 d. 1101 e. None

6. What is the initial result of adding B1 and B2?
   a. 1000 b. 1101 c. 1010 d. 0101 e. None

7. What is the initial result of adding C1 and C2?
   a. 1010 b. 1011 c. 1000 d. 0111 e. None

8. Which of the initial addition needs the correction step?
   a. A1 & A2 b. B1 & B2 c. C1 & C2 d. No initial results e. None

9. What is the value needed to be added in the correction step (if needed)?
   a. 0100 b. 0101 c. 0110 d. 0111 e. None

10. What is the final result of adding A1 and A2 (after the correction step if needed)?
    a. 1001 b. 1010 c. 1010 d. 1101 e. None

11. What is the final result of adding B1 and B2 (after the correction step if needed)?
    a. 0110 b. 0011 c. 1011 d. 1001 e. None

12. What is the final result of adding C1 and C2 (after the correction step if needed)?
    a. 1010 b. 1011 c. 1001 d. 1000 e. None

C. Using k-map to simplify the following Boolean function as a Sum of Product (SoP) (each 1 mark):

$$F(A,B,C,D) = AC\bar{D} + \bar{C}D + A\bar{B}\bar{C} + d(ACD)$$

13. Which of the following is a minterm of F?
    a. 4 b. 5 c. 6 d. 7 e. None

14. Which of the following is a maxterm of F?
    a. 12 b. 13 c. 14 d. 15 e. None

15. How many terms exit in the simplified function?
    a. 2 b. 3 c. 4 d. 5 e. None

16. Which of the following is a term in the simplified function?
    a. $A\bar{B}\bar{C}$ b. $A\bar{B}C$ c. $A\bar{B}$ d. $A\bar{B}CD$ e. None

17. Which of the following is a term in the simplified function?
    a. $A\bar{B}\bar{C}D$ b. $\bar{C}D$ c. $A\bar{C}D$ d. $\bar{B}\bar{C}D$ e. None

18. Which of the following is a term in the simplified function?
    a. ACD b. $AC\bar{D}$ c. ABC d. $A\bar{B}C$ e. None

19. How many inverters are used to build the simplified function?
    a. 1 b. 2 c. 3 d. 4 e. None

D. Using Tabular method to simplify the following Boolean function as a Product of Sum (PoS) (each 1.25 mark): $F(A,B,C,D)=\Pi_M(0,2,3,7,8,10,11,12,13)$

20. How many groups are initially formed?
    a. 2 b. 3 c. 4 d. 5 e. None

21. Which of the following combined terms is formed in the first iteration?
    a. 0,2 b. 0,7 c. 2,8 d. 10,13 e. None

22. Which of the following combined terms is formed in the first iteration?
    a. 0,12 b. 0,8 c. 8,13 d. 3,8 e. None

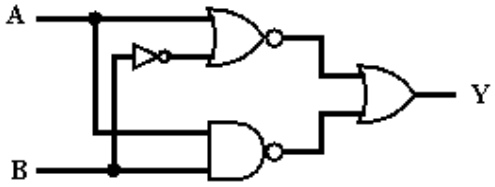
23. Which of the following combined terms is formed in the second iteration?
    a. 0,8,3,11 b. 3,7,12,13 c. 0,8,2,10 d. 10,11,12,13 e. None

24. How many combined terms are formed in the third iteration?
    a. 13,11,12,10,2,3,0,8 b. 7,0,10,3,13,2,11,12 c. 13,10,0,1,2,8,12,3,7 d. 7,11,12,13,0,10,2,3 e. None

25. Which of the following is a term in the simplified function?
    a. $(A + B + D)$ b. $(\bar{A} + B + D)$ c. $(A + B + \bar{C})$ d. $(B + D)$ e. None

26. Which of the following is not a term in the simplified function?
    a. $(B + \bar{D})$ b. $(\bar{A} + C + D)$ c. $(\bar{A} + \bar{B} + C)$ d. $(A + \bar{C} + \bar{D})$ e. None

E. Having this function:



27. Which of the following number of gates are used to implement it using only NANDs (2.25 marks)?
    a. Three 2-input NANDs
    b. Four 2-input NANDs
    c. Five 2-input NANDs
    d. Six 2-input NANDs
    e. None

28. If the propagation delay of NoT, OR, NAND and NOR gates are 3, 10, 13 and 13 nsec respectively. What is the propagation delay of the initial function in the above question (1 mark)?
    a. 23 nsec b. 26 nsec c. 29 nsec d. 39 nsec e. None

F. Using the minimum number of half adder(s) and full adder(s), with no input carry design a combinational circuit that adds six (110) to a 4-bit binary number (A_3 A_2 A_1 A_0) to obtain a sum of (S_3 S_2 S_1 S_0) and a carry. Answer the following (each 1.5 marks):

29. To obtain S_0, the following is needed.
    a. Half adder b. Full adder c. None

30. To obtain S_1, the following is needed.
    a. Half adder b. Full adder c. None

31. To obtain S_2, the following is needed.
    a. Half adder b. Full adder c. None

32. To obtain S_3, the following is needed.
    a. Half adder b. Full adder c. None

33. Inputs to the adder used to obtain S_1 are
    a. A_1 & 0 b. A_1 & 1 c. A_1 & 0 & C_1 d. A_1 & 1 & C_1 e. None

34. Inputs to the adder used to obtain S_2 are
    a. A_2 & 0 b. A_2 & 1 c. A_2 & 0 & C_2 d. A_2 & 1 & C_2 e. None

G. Having the following function: $F(W,X,Y,Z)=\Pi_M(3,5,7,8,11,13,14,15)$ (each 1 mark)

35. What is the optimal multiplexer size used to build the above function?
    a. 32x1 b. 16x1 c. 8x1 d. 4x1 e. None

36. Using WXY as selectors, what is the input to the 1st input to the multiplexer?
    a. 0 b. 1 c. Z d. $\bar{Z}$ e. None

37. Using WXY as selectors, what is the input to the 3rd input to the multiplexer?
    a. 0 b. 1 c. Z d. $\bar{Z}$ e. None

38. Using WXY as selectors, what is the input to the 5th input to the multiplexer?
    a. 0 b. 1 c. Z d. $\bar{Z}$ e. None

39. Using WXY as selectors, what is the input to the 8th input of the multiplexer?
    a. 0 b. 1 c. Z d. $\bar{Z}$ e. None

H. Having a combinational circuit that accepts-four bits number ABCD and generates three outputs (X,Y,Z). The function will output "1" in the X variable if the input can be divided by two. The function will output "1" in the Y variable if the input can be divided by three. The function will output "1" in the Z variable if the input can be divided by five. Of course, more than one output may be equal to 1. Assume that the binary input 1101 (13 in decimal) cannot occurs. Note that the output (XYZ)=000 if the inputs (ABCD)= 0000. Obtain the circuit truth table, then answer the following (each 1 mark):

40. What is the value of the output XYZ in case of ABCD=0110?
    a. 000 b. 101 c. 110 d. 111 e. None

41. What is the value of the output XYZ in case of ABCD=1111?
    a. 000 b. 011 c. 101 d. 110 e. None

42. What is the value of the output XYZ in case of ABCD=1101?
    a. 010 b. 101 c. 110 d. 001 e. None

43. What is the value of the output XYZ in case of ABCD=0111?
    a. 000 b. 011 c. 101 d. 110 e. None

44. What is the value of the output XYZ in case of ABCD=1010?
    a. 001 b. 101 c. 011 d. 011 e. None

45. What is the value of the output XYZ in case of ABCD=0010?
    a. 100 b. 001 c. 010 d. 000 e. None

46. What is the value of the output XYZ in case of ABCD=1001?
    a. 000 b. 100 c. 001 d. 010 e. None

47. What is the value of the input (ABCD) needed to obtain an output (XYZ)=111?
    a. 1010 b. 1100 c. 1111 d. 1110 e. None

48. What is the value of the input (ABCD) needed to obtain an output (XYZ)=110?
    a. 1011 b. 1010 c. 0111 d. 1100 e. None

49. What is the optimal decoder size used to build the above function?
    a. 2x4 b. 3x8 c. 4x16 d. 5x32 e. None

50. In addition to the decoder used in the above question, what is the needed gate to be used?
    a. NOT b. AND c. OR d. XOR e. None

51. Obtaining a simplified function of X as PoS, what is the input that does not appear in this function?
    a. A b. B c. C d. D e. None

52. Obtaining a simplified function of X as PoS, what is the number of terms in this function.
    a. 1 b. 2 c. 3 d. 4 e. None

53. Obtaining a simplified function of X as PoS, what is the number of inverters needed to implement it?
    a. 1 b. 2 c. 3 d. 4 e. None

54. In order to build the simplified function of X as PoS, n-input OR(s) is needed, what is the value of n?
    a. 1 b. 2 c. 3 d. 4 e. None