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POSTAL BOOK PACKAGE 2025

CONTENTS

ELECTRICAL ENGINEERING

Objective Practice Sets

Digital Electronics

1 CHAPTER Number Systems and Codes

MCQ and NAT Questions

Q.1 "BAD" is the hexadecimal representation of a binary number. If the number represents only the magnitude, its decimal equivalent is
(a) 2749 (b) 2989
(c) 1213 (d) 111013

Q.2 Which of the following is a self-complementary code?
(a) 8421 code (b) Excess 3 code
(c) Pure binary code (d) Gray code

Q.3 A Gray code is a/an:
(a) Binary weight code
(b) Arithmetic code
(c) Code which exhibits a single bit change between two successive codes
(d) Alphanumeric code

Q.4 If $(211)_x = (152)_8$, then the value of base 'x' is
(a) 3 (b) 5
(c) 7 (d) 9

Q.5 The decimal number 4097 is represented in four forms as shown below. Match **List-I (Type of Representation)** with **List-II (Number)** and select the correct answer:

	List I		List II
A.	Binary	**1.**	0000 0000 0000 1001
B.	BCD	**2.**	0000 0000 0001 0001
C.	Octal	**3.**	0001 0000 0000 0001
D.	Hexadecimal	**4.**	0100 0000 1001 0111

Codes:

	A	B	C	D
(a)	3	1	2	4
(b)	2	4	3	1
(c)	3	4	2	1
(d)	2	1	3	4

Q.6 The range of numbers that can be represented in two's complement mode with four binary digits is
(a) – 15 to +15 (b) – 8 to +8
(c) – 8 to +7 (d) – 7 to +7

Q.7 $(24)_8$ is expressed in Gray code as which one of the following?
(a) 11000 (b) 10100
(c) 11110 (d) 11111

Q.8 The 2's complement representation of –17 is
(a) 101110 (b) 101111
(c) 111110 (d) 110001

Q.9 A number is expressed as 1023 with radix x. Given that the number uses all the symbols of the number system, which of the following is correct?
(a) x = 3 and its decimal value is 37
(b) x = 2 and its decimal value is 14
(c) x = 4 and its decimal value is 15
(d) x = 4 and its decimal value is 75

Q.10 **Statement 1:** The range of unsigned decimal values that can be represented (using binary system) in a byte is 256.
Statement 2: The range of signed decimal values that can be represented (by signed binary using 2's complement) in a byte is 256.
(a) Statement 1 is TRUE
(b) Statement 2 is TRUE
(c) Statement 1 and Statement 2 both are TRUE
(d) Both are FALSE

Q.11 **Statement 1:** 256 different signed decimal values can be represented in a byte.
Statement 2: In 2's complement system.
$1\,1\,1\,1\,0\,1\,0\,0_2 = -12_{10}$
(a) statement 1 is TRUE
(b) statement 2 is TRUE
(c) both statements are TRUE
(d) both statements are FALSE

Q.12 For the given Grey code 10110 what will be the binary equivalent code?
(a) 10110 (b) 11101
(c) 11011 (d) None of these

Answers Number Systems and Codes

1.	(b)	2.	(b)	3.	(c)	4.	(c)	5.	(c)	6.	(c)	7.	(c)
8.	(b)	9.	(d)	10.	(c)	11.	(c)	12.	(c)	13.	(a)	14.	(a)
15.	(c)	16.	(b)	17.	(b)	18.	(c)	19.	(d)	20.	(d)	21.	(d)
22.	(c)	23.	(b)	24.	(d)	25.	(b)	26.	(4)	27.	(–8)	28.	(2)
29.	(8)	30.	(4)	31.	(15)	32.	(b, c)	33.	(c, d)	34.	(a, b, c)	35.	(b, c, d)
36.	(b, d)	37.	(b, c, d)	38.	(c, d)								

Explanations Number Systems and Codes

1. (b)

$$(BAD)_{16} = B \times 16^2 + A \times 16^1 + D \times 16^0$$
$$= 11 \times 256 + 10 \times 16 + 13$$
$$= (2989)_{10}$$

2. (b)

Self complementing code:
Excess – 3 code, 2421, 3221, 4311, 5211
It is one that 9's complement in decimal is the 1's complement in binary.

3. (c)

A Gray code is a code which exhibits a single bit change between two successive codes.

4. (c)

$$(211)_x = (152)_8$$

Converting to decimal

$$2x^2 + x + 1 = 8^2 \times 1 + 8 \times 5 + 2 = 106$$

on solving, $x = 7, -15/2$

5. (c)

Binary: 0001 0000 0000 0001

$$2^{12} + 2^0 = 4097$$

BCD: 0100 0000 1001 0111
↓ 4 ↓ 0 ↓ 9 ↓ 7

Octal: 0000 0000 0001 0001

→ $1 \times 8^4 + 1 \times 8^0$

→ 4097

Hexadecimal: 0000 0000 0000 1001

$$= 1 \times 16^3 + 1 \times 16^0$$
$$= 4097$$

6. (c)

Range of signed magnitude and 1's complement representation for n-bit is $= -(2^{n-1} - 1)$ to $(2^{n-1} - 1)$
for 2's complement : -2^{n-1} to $(2^{n-1} - 1)$

7. (c)

$$(24)_8 \equiv (10100)_2 = (20)_{10}$$

Binary 1 0 1 0 0
⊕ ⊕ ⊕ ⊕
Gray code 1 1 1 1 0

8. (b)

2's complement of a number = 1's complement + 1

$$(17)_{10} = 010001$$

1's complement of $(17)_{10}$ = 1 0 1 1 1 0
\+ 1
2's complement 1 0 1 1 1 1

9. (d)

Given $(1023)_x$
We know that radix x is always greater than any number inside it.
Hence, $x \geq 4$
Now by options check $x = 4$
So, $(1023)_4 = 1 \times 4^3 + 0 \times 4^2 + 2 \times 4^1 + 3 \times 4^0$
$= 64 + 0 + 8 + 3 = (75)_{10}$

10. (c)

In unsigned, range with n bit is 0 to $2^n - 1$
Here, 1 byte = 8 bit
∴ $0 \rightarrow 2^8 - 1$
$= 0 - 255$
for 2's complement $-(2^{n-1})$ to $(2^{n-1} - 1)$

2 CHAPTER Boolean Algebra and Minimization Techniques

MCQ and NAT Questions

Q.1 Karnaugh map is used to
(a) minimise the number of flip-flops in a digital circuit
(b) minimise the number of gates only in a digital circuit
(c) minimise the number of gates and fan-in of a digital circuit
(d) design gates

Q.2 The output of a logic gate is '1' when all its inputs are at logic '0'. Then the gate is either
(a) A NAND or an EX-OR gate
(b) A NOR or an EX-NOR gate
(c) An OR or an EX-NOR gate
(d) An AND or an EX-OR gate

Q.3 Which of the following identities is true ?
(a) $A + BC = (\bar{A} + B)(\bar{A} + C)$
(b) $A + BC = (\bar{A} + B)(A + C)$
(c) $A + BC = (A + B)(\bar{A} + C)$
(d) $A + BC = (A + B)(A + C)$

Q.4 Consider the Boolean expression:
$X = A\,B\,C\,D + A\bar{B}\,C\,D + \bar{A}\,B\,C\,D + \bar{A}\,C\bar{B}\,D$
The simplified form of X is
(a) $\bar{C} + \bar{D}$ (b) BC
(c) CD (d) $\bar{B}C$

Q.5 The minimized expression for the given K map (× : don't care) is

CD \ AB	00	01	11	10
00	0	0	1	1
01	0	×	×	1
11	×	×	1	×
10	1	0	1	1

(a) $A + \bar{B}\,C$ (b) $B + A\,C$
(c) $C + A\,B$ (d) $A\,B\,C$

Q.6 The logic function $f = \overline{(x \cdot \bar{y}) + (\bar{x} \cdot y)}$ is the same as
(a) $f = (x + y)(\bar{x} + \bar{y})$ (b) $f = \overline{(\bar{x} + \bar{y})(x + y)}$
(c) $f = \overline{(x \cdot y)} \cdot (\bar{x} \cdot \bar{y})$ (d) $f = x + y$

Q.7 The minimised expression of the following Boolean function is equal to
$$f = (x\bar{y} + \bar{x}\,\bar{y}) \oplus x$$
(a) $x\,y$ (b) $x \odot y$
(c) $\bar{x} + y$ (d) $x \oplus y$

Q.8 The K-map is built in accordance with
(a) BCD code (b) 2481 code
(c) Gray code (d) none of these

Q.9 **Statement (I):** After grouping a pair, the resultant minimized product term contains $(n - 1)$ variables, where n is the number of variables of K-map.
Statement (II): Grouping a pair of 1's in a K-map eliminates the variable that appears in normal and complemented form in that pair.
(a) Both Statement (I) and Statement (II) are true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are true but Statement (II) is not a correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Q.10 The minimum number of literals that can represent the function,
$$f = \overline{AB} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}D + \overline{AB}C\bar{D}$$
is equal to
(a) 2 (b) 3
(c) 4 (d) 5

Q.11 The minimum Boolean expression for the following circuit is

Answers Boolean Algebra and Minimization Techniques

1. (b)	2. (b)	3. (d)	4. (c)	5. (a)	6. (c)	7. (b)
8. (c)	9. (a)	10. (a)	11. (d)	12. (b)	13. (c)	14. (d)
15. (a)	16. (b)	17. (b)	18. (a)	19. (d)	20. (b)	21. (d)
22. (d)	23. (d)	24. (c)	25. (a)	26. (c)	27. (c)	28. (d)
29. (64)	30. (256)	31. (8)	32. (4)	33. (4)	34. (a, b, c, d)	35. (a, b, c)
36. (b, c)	37. (a, c)	38. (b, c, d)	39. (a, b, d)	40. (b, d)	41. (b, c)	42. (a, b)

Explanations Boolean Algebra and Minimization Techniques

1. (b)

Karnaugh map provides a simple straight forward procedure for minimizing Boolean functions and hence the number of gates to realize the Boolean function are minimized.

2. (b)

NOR

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

EX-NOR

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

3. (d)

$$A + BC = (A + B)(A + C)$$

4. (c)

$$X = ABCD + A\bar{B}CD + \bar{A}BCD + \bar{A}C\bar{B}D$$
$$= ACD(B + \bar{B}) + \bar{A}CD(B + \bar{B})$$
$$= CD(A + \bar{A}) \qquad \because B + \bar{B} = 1$$
$$X = CD$$

5. (a)

CD \ AB	00	01	11	10
00			1	1
01			x	1
11	x	x	1	x
10	1		1	1

$$F = A + \bar{B}C$$

6. (c)

(i) $f = \overline{(x \cdot \bar{y}) + (\bar{x} \cdot y)} = \overline{x \oplus y} = x \odot y$

(ii) $f = \overline{(\bar{x} + \bar{y}) \cdot (x + y)}$

7. (b)

$$f = (x\bar{y} + \bar{x}\,\bar{y}) \oplus x = \bar{y} \oplus x$$
$$= \bar{x}\,\bar{y} + xy = x \odot y$$

8. (c)

The *K* map is built in accordance with Gray code.

9. (a)

Both the statements are correct and reason gives correct explanation.

10. (a)

$$f = \overline{AB} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}D + \overline{AB}C\bar{D}$$
$$= \bar{A} + \bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}D + (\bar{A} + \bar{B})C\bar{D}$$
$$= \bar{A} + \bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}D + \bar{A}C\bar{D} + \bar{B}C\bar{D}$$
$$= \bar{A}(1 + \bar{C}\bar{D} + \bar{B}D + C\bar{D}) + \bar{B}(1 + C\bar{D})$$
$$= \bar{A} + \bar{B} \quad \Rightarrow \quad \text{Two literals}$$

11. (d)

It is combination of series and parallel switching.

$$\therefore \quad Y = A \cdot (B + \bar{C}) + \bar{A}B + (A + \bar{B})C$$
$$= AB + A\bar{C} + \bar{A}B + AC + \bar{B}C$$
$$= B(A + \bar{A}) + A(C + \bar{C}) + \bar{B}C$$
$$Y = B + A + \bar{B}C = A + B + C$$