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DICT LEVEL I

COMPUTER MATHEMATICS

MONDAY: 21 May 2018.

Time Allowed: 3 hours.

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

- (a) Convert the following numbers to their respective equivalents:
- (i) 23724_{10} to binary form. (1 mark)
 - (ii) 7189_{10} to base 16. (1 mark)
 - (iii) $275.B02_{16}$ to base 10. (2 marks)
 - (iv) $10\ 0001\ 1011\ 1011\ 0110\ 0101_2$ to hexadecimal form. (2 marks)
 - (v) $BADCODE_{16}$ to binary form. (2 marks)
- (b) Add the following octal digits:
- (i) $4 + 3$. (1 mark)
 - (ii) $3 + 6$. (1 mark)
 - (iii) $45376_8 + 36274_8$. (2 marks)
- (c) Evaluate the following using complements:
- $A57913_{16} - 64EE00_{16}$ (3 marks)
- (d) Perform the following binary arithmetic operations:
- (i) $110.1101 + 1011.101$. (1 mark)
 - (ii) $10101010 - 110011$. (1 mark)
 - (iii) $1011 \div 11$. (2 marks)
- (e) Determine the nine's and ten's complements of the following decimal number:
- 78923019 . (1 mark)

(Total: 20 marks)

QUESTION TWO

- (a) Find the radix-minus-one (15 's) complement and the (16 's) complement of:
- $5D309_{16}$. (2 marks)
- (b) Decode each numeric, encoded in the 5-4-2-1 BCD codes below:
- (i) $1010\ 0010\ 1001$. (1 mark)
 - (ii) $1011\ 0001\ 0100\ 1100$. (1 mark)

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- (c) Find the two's complement of the binary number 1001 1001. (2 marks)
- (d) Perform the following operations on binary numbers:
- (i) 1010×1001 . (2 marks)
- (ii) $100001 \div 110$. (2 marks)
- (e) Solve the following linear equation:
- $$\frac{y+2}{3} - 1 + \frac{y}{8} = \frac{-y}{2} + 3$$
- (3 marks)
- (f) Solve the following set of simultaneous equations using the substitution method:
- $$\begin{aligned} 3a - 2b &= 11 \\ 5a + 7b &= 39 \end{aligned}$$
- (3 marks)
- (g) Use a truth table to prove that $(A \wedge B) \Rightarrow A$ is a tautology. (4 marks)
- (Total: 20 marks)**

QUESTION THREE

- (a) Write the following types of codes in full and give a two-point description of each:
- (i) BCD. (3 marks)
- (ii) ASCII. (3 marks)
- (b) Perform the following conversions:
- (i) 1101_2 to decimal. (2 marks)
- (ii) $B2D_{16}$ to decimal. (2 marks)
- (c) Use truth table to show that:
- (i) $(P \rightarrow Q) \vee (Q \rightarrow P)$ is a tautology. (3 marks)
- (ii) $P \rightarrow Q$ and $\sim P \vee Q$ are logically equivalent. (3 marks)
- (d) Find the transpose of the following matrix:
- $$X = \begin{pmatrix} 2 & 4 & -1 \\ 5 & 0 & 2 \end{pmatrix}$$
- (2 marks)
- (e) Find the inverse of matrix A where:
- $$A = \begin{pmatrix} 4 & 5 \\ 2 & 3 \end{pmatrix}$$
- (2 marks)
- (Total: 20 marks)**

QUESTION FOUR

- (a) Solve for a and b in the following matrices:
- $$3 \begin{pmatrix} -a & -4 \\ 3 & -1 \end{pmatrix} + \begin{pmatrix} 2 & 0 \\ -2 & -b \end{pmatrix} = \begin{pmatrix} 6 & -12 \\ 3 & 0 \end{pmatrix}$$
- (4 marks)
- (b) Given the following matrices:
- $$x = \begin{pmatrix} 0 & -1 \\ 2 & -5 \end{pmatrix}, y = \begin{pmatrix} -3 & 6 \\ 3 & 8 \end{pmatrix}, z = \begin{pmatrix} 1 & 4 \\ -2 & 6 \end{pmatrix}$$
- Simplify $x \begin{pmatrix} y+z \end{pmatrix}$ (3 marks)

(c) Find the value of a in the following singular matrix:

$$\begin{pmatrix} 2a - b & 3b + 4 \\ -1 & 3 \end{pmatrix}$$

(3 marks)

(d) Solve the following simultaneous equations using the matrix algebra method:

$$4y - 6x = 10$$

$$4x - y = -5$$

(4 marks)

(e) A bag contains 4 white balls and 2 black balls. Another bag contains 3 white balls and 5 black balls. One ball is drawn from each bag at random.

Required:

Find the probability that:

(i) Both are white balls.

(2 marks)

(ii) Both are black balls.

(2 marks)

(iii) One is a white ball and the other is a black ball.

(2 marks)

(Total: 20 marks)

QUESTION FIVE

(a) A die is rolled 20 times resulting in the following data:

1, 4, 4, 1, 1, 4, 4, 2, 4, 6, 6, 5, 5, 1, 2, 3, 3, 3, 1, 5

Required:

(i) Construct a frequency chart for the above data.

(3 marks)

(ii) Construct a histogram to represent the data obtained in (a)(i) above.

(3 marks)

(b) The table below shows the intelligence quotients (IQ^s) of 480 school children at a certain elementary school:

Marks (x)	70	74	78	82	86	90	94	98	102	106	110	114	118	122	126
Frequency (f)	4	9	16	28	45	66	85	72	54	38	27	18	11	5	2

Required:

(i) The mean.

(3 marks)

(ii) The standard deviation.

(4 marks)

(c) Suppose X and Y are events with:

$$P(X) = 0.4, \quad P(Y) = 0.5 \quad \text{and} \quad P(X \cap Y) = 0.3$$

Find the probability that:

(i) X or Y occurs.

(2 marks)

(ii) Neither X nor Y occurs.

(2 marks)

(d) Convert into hexadecimal numbers:

(i) 5280_{10} .

(1 mark)

(ii) $1001\ 0110\ 1010_2$.

(1 mark)

(e) Convert the following number into binary:

$COFFEE_{16}$.

(1 mark)

(Total: 20 marks)