**N. B. :**

    **1)**    Attempt **ANY SIX** questions.

    **2)**    Figures to the right indicate **FULL** marks.

    **3)**    Use of calculator is **NOT ALLOWED**.

    **4)**    Assume suitable data, if necessary.

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**Q. 1**    **a)**    Write the negation of each statement symbolically and in plain language as simply as possible:    **(04)**

        **i)**    Paris is in France and London is in England.

        **ii)**    7 is greater than 4 or 6 is less than 7.

        **iii)**    "Everyone who lives in India is an Indian".

        **iv)**    All triangles are equilateral triangles.

    **b)**    **i)**    Define the terms "tautology" and "contradiction" in the context of propositional logic.    **(02)**

        **ii)**    Verify whether the proposition:    **(04)**

$$(p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p)$$

**Q. 2**    **a)**    Determine the validity of the argument:    **(04)**

$$p \rightarrow q, \neg p \vdash \neg q$$

    **b)**    Consider the following arguments:

        A1: "If I'm guilty, I must be punished; I'm not guilty. Thus I must not be punished".

        A2: "If I'm guilty, I must be punished; I must not be punished. Thus I'm not guilty".

        A3: "If I'm guilty, I must be punished; I must be punished. Thus I'm guilty".

        **i)**    Represent the above arguments symbolically.    **(02)**

        **ii)**    Verify which of the arguments are logically correct.    **(04)**

**Q.3**    A Graph G is defined by the vertex set $V(G) = \{a, b, c, d, e\}$ and the edge set $E(G) = \{(ab, 4), (ac, 3), (bd, 1), (bc, 1), (ce, 1), (de, 1), (df, 2), (ef, 2)\}$. The number following each edge is the weight of the edge.

    **a)**    Draw the graph.    **(02)**

    **b)**    Apply Kruskal's Algorithm to G. List the edges of the forest that is grown, in the order that they are added.    **(06)**

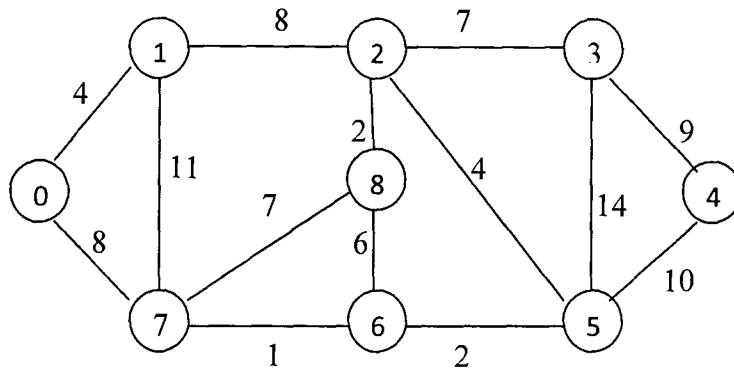    **c)**    What is the weight of a minimum spanning tree in G?    **(02)**

**P. T. O.**

**Q. 4** **a)** Suppose data items A, B, C, D, E, F, G occur with the following probability **(08)** distribution:

| Data Item: | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| Probability: | 10 | 30 | 5 | 15 | 20 | 15 | 5 |

Find a Huffman code for the data items.

**b)** State the Handshaking Lemma (Theorem). **(02)**

**Q. 5** Calculate the total cost using Prim's algorithm: **(10)**



**Q. 6** Find all solutions to the following systems of linear equations:

$$x_1 - 2x_2 + 2x_3 = 5$$
$$x_1 - x_2 = -1$$
$$-x_1 + x_2 + x_3 = 5$$

**Q7.** **a)** What is Rank of a matrix? How can you determine if a system of equations **(04)** is consistent or not from its rank?

**b)** Compute the absolute value and the conjugate of : **(06)**

**i)** $z = (1+i)^6$

**ii)** $w = i^{17}$

**Q.8** **a)** Find the gradient and divergence of the vector field: **(05)**

$$u = (-y, x, 0), u_x = -y, u_y = x$$

**b)** Use De Moivre's Theorem to compute $(1+i)^{12}$ **(05)**

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