1. (a) Outline **two** methods through which statistical data can be collected from primary sources. (2 marks)

(b) Define in words each of the following matrices:

(i) vector matrix; (1 mark)

(ii) triangular matrix; (1 mark)

(iii) identity matrix. (1 mark)

(c) Explain the circumstance under which *conditional probability* is appropriate, giving an example. (3 marks)

(d) In a certain college, accounting is one of the courses offered. Among the accounting students, 60% are male. Among the male students, 75% passed in the national exams while among the female students, 50% passed.

(i) Present this information using a probability tree diagram; (3 marks)

(ii) Determine the probability that an accounting student selected at random passed the national exam; (3 marks)

(iii) An accounting student who passed the exam is selected at random, determine the probability that he is male; (3 marks)

(iv) An accounting student who failed the exam is selected at random, determine the probability that she is female. (3 marks)

2. (a) Define the term *parity bit* as used in character coding systems. (2 marks)

(b) Explain in words each of the following errors as used in numerical analysis:

(i) absolute error; (2 marks)

(ii) relative error; (2 marks)

(iii) percentage error. (2 marks)

(c) A surveyor measured the length of a plot as 76 metres while the actual length was 80 metres. Determine the value of each of the errors in 2(b) above. (3 marks)

(d) Given the equation $f(x) = x^3 + 3x^2 - 5x - 2$, use the Newton-Raphson iterative method to determine the root of the equation to 6 decimal places. Take the initial root as $x_0 = 1.5$. (9 marks)

3. (a) Given two matrices A and B, state the condition(s) which **must** be satisfied for each of the following operations to be performed on the matrices:

(i) A + B; (2 marks)

(ii) A X B. (2 marks)

(b) Differentiate between linear *interpolation* and *linear extrapolation* as used in mathematical estimation, giving an example in each case. (5 marks)

(c) Define the term *logic gate* as used in digital systems. (2 marks)

(d) Describe in words each of the following logic gates, complementing with a circuit diagram:

(i) OR gate; (3 marks)

(ii) AND gate; (3 marks)

(iii) NOT gate. (3 marks)

4. (a) Explain the **three** statistical measures of central tendency. (6 marks)

(b) Explain each of the following character coding systems as used in computer data representation:

(i) ASCII; (2 marks)

(ii) EBCDIC. (2 marks)

(c) A committee of 5 members is to be formed from a group of 8 non-governmental organisations (NGOs) from a certain county. Each NGO is represented by the chairman and the director. Determine the possible number of ways of selecting the committee members if:

(i) each category (chairmen and directors) must be represented by at least one member; (5 marks)

(ii) two members from the same NGO must not both serve in the same committee. (5 marks)

5. (a) Differentiate between the *actual value* and the *positional value* of a digit as used in number systems. (4 marks)

(b) Star Communications Limited has a workforce of 500 employees. Table 1 shows the frequency distribution of the ages of the employees. Use it to answer the questions that follow.

Age (years)	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64
No. of employees	28	45	62	74	92	80	55	40	24

Table 1

Estimate by calculation each of the following measures about the age distribution of the employees:

(i) the median; (3 marks)

(ii) the inter-quartile range; (4 marks)

(iii) the cut-off age for retrenchment if the oldest 15% of the employees are to be retrenched; (3 marks)

(iv) the standard deviation. (6 marks)

6. (a) State the general binomial theorem where **n** is a positive integer. (2 marks)

(b) Using the binomial expansion, expand the expression $(3x + 2y)^5$ in ascending powers of x. (6 marks)

(c) Outline **two** advantages of the median over the mean. (4 marks)

(d) Convert each of the following number systems to their respective equivalents:

(i) 62534_8 to binary; (2 marks)

(ii) 367524_8 to hexadecimal; (2 marks)

(iii) 685984_{10} to octal; (2 marks)

(iv) 1011010011_2 to decimal. (2 marks)

7. (a) A dairy firm has analysed its data for demand and supply and realised that the demand curve is given by the equation $2y = 18 - x$, while that of supply curve is given by $8y = 16 + 3x$. y the price is represented by y in hundred shillings, while quantity is represented by x in thousand litres. Determine the equilibrium price and corresponding quantity for the firm.

(6 marks)

(b) Given a matrix $A = \begin{bmatrix} 2 & 4 & 1 \\ 3 & 1 & 4 \\ 5 & 6 & 0 \end{bmatrix}$, determine the following:

(i) the determinant of A;

(4 marks)

(ii) the inverse matrix of A using the co-factors;

(10 marks)

8. (a) Differentiate between the terms *permutation* and *combination* as used in Mathematics. (4 marks)

(b) A mobile phone operator uses 10 digits to assign phone numbers to its subscribers. However, the first digit must be a 0 (zero) while the second digit must be a 7 (seven), the fifth digit must not be a 0 (zero). Determine the maximum number of subscribers which this coding system can accommodate. (4 marks)

(c) A manufacturing company has a workforce in three departments: production, administration and marketing. 930 employees are in the production department, 144 in the marketing department, and 126 in the administration department. Among the employees, 600 men and 300 women are on permanent terms, while the remainder comprising an equal number of men and women are on casual terms. In the production department, 540 male employees are on permanent terms and 60 female employees are on casual terms. The marketing department employs 60 females on permanent terms and 12 males on casual terms. The administration department employs 18 females on permanent terms and 30 females are on casual terms.

Present this information in tabular form. (6 marks)

(d) Perform the following binary arithmetic operations:

(i) $10101_2 + 1101_2$; (2 marks)

(ii) $10101_2 - 1011_2$; (2 marks)

(iii) $10101_2 \times 1101_2$. (2 marks)