

PAPER-4: Mathematics & Statistics [Section: A (Mathematics)] Page no: 1-27

MAY 2001 Foundation Level (Maths)

Answer any five questions.

- 1.a.(i) Convert the number $99\frac{1}{8}$ to binary equivalent. 2
- (ii) Convert the number 498 to equivalent hexadecimal and Octal numbers. 2
- (iii) If $y = a \cos(\log x) + b \sin(\log x)$, then prove that: 5
- $$\frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = 0$$
- 2.a. Using elementary row operations in matrices, solve the following system of equations: 5
- $$x + y + z = 9, 2x + 5y + 7z = 52, 2x + y - z = 0$$
- b. Find: $\lim_{x \rightarrow 0} \frac{\sin(1+x) - \sin(1-x)}{x}$ 5
- 3.a. A contractor undertakes to supply one match stick on the first day, 2 on the second day, 4 on the third, 8 on the fourth and so on for a month of 30 days for one lakhs of Rupees. If a match box of 60 sticks costs Rs 0.06, find to the nearest rupee gain or loss of the supplier. 5
- b. Show that: $\cos A \cos 2A \cos 4A \cos 8A = \frac{1}{16} \cdot \frac{\sin 16A}{\sin A}$ 5
4. a. The result of 21 matches (Win, Loss or Draw) are to be predicted. How many different forecasts can contain exactly 18 correct results? 5
- b. Evaluate: $\int_0^{\pi/4} \frac{\sec x \, dx}{1 + 2\sin^2 x}$ 5
5. Indicate the correct answer of the following proper explanation:
- a. If $\frac{a^n + b^n}{a^{n-1} + b^{n-1}}$ is the Geometric mean between two positive numbers a and b ($a \neq b$), then the value of n is (i) 0; (ii) 1; (iii) $\frac{1}{2}$; (iv) None of these 3
- b. In how many ways 5 boys and 3 girls can stand in a row, so that no two girls are together? (i) 11,100; (ii) 12,200; (iii) 13,300; (iv) 14,400 3
- c. The value of the integral $\int_{-1}^{+1} x|x| \, dx$ is (i) 2; (ii) 1; (iii) 0; (iv) -1 4
6. a. What is an orthogonal matrix? Verify that the matrix: 3
- b. if $\tan \theta + \sin \theta = m$ and $\tan \theta - \sin \theta = n$, show that: 2
- $$(m^2 - n^2)^2 = 16mn$$
- c. The marginal cost of a commodity is given by rs $(27 - 32x - 9x^2)$, where x is the output. Find the total cost and then the average cost function, given that the initial cost is Rs 50. 5

Dec 2001 Foundation level (Mathematics)

1. a.(i) Evaluate: $111_2 + 101_2 + 011_2$ 3+2=5
- (ii) Convert the Hexadecimal number $4F9A_{16}$ into decimal form.



- b. Find the value of $\cos 35^\circ + \cos 85^\circ + \cos 155^\circ$
- 2.a. If $A = \begin{pmatrix} 1 & 3 \\ 3 & 4 \end{pmatrix}$ and $A^2 - kA - 5I_2 = 0$, find the value of k. 5+5
- b. If $\frac{\log a}{y-z} = \frac{\log b}{z-x} = \frac{\log c}{x-y}$ and $D = a^{y^2+yz+z^2} b^{z^2+zx+x^2} c^{x^2+xy+y^2}$ Show that $D=1$
3. a. if $\frac{1}{9!} + \frac{1}{10!} = \frac{x}{11!}$, find this value of x 5+5
- b. There are 25 colleges and 100 Schools in a certain city. Each School and College has 5 peons, 2 clerks and 1 cashier. Each college in addition has 1 accountant and 1 head clerk. The monthly salary bill of each of them is as follows.
- Peon-Rs 300; clerk- Rs 500; cashier- Rs 600; Accountant- Rs 700 and Head clerk-Rs 800
- Using matrix notation, find the total monthly salary bill of all the schools and colleges taken together.
4. Give the correct answer of the following with reason: 3+3+4
- a. $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x^2}$
- i. 0 ii. 1/4 iii. 1/2 iv. 1
- b. if $x^y = e^{x-y}$, then $\frac{dy}{dx} =$
- i. $\frac{y}{1 + \log x}$ ii. $\frac{x-y}{(1 + \log x)^2}$ iii. $\frac{x-y}{1 + \log x}$ iv. $\frac{\log x}{(1 + \log x)^2}$
- c. If $f(x) = \cos(\log x)$, then $f(x) f(y) - \frac{1}{2} \left\{ f\left(\frac{x}{y}\right) + f(xy) \right\}$ equals
- i. -2 ii. 1/2 iii. 2 iv. 0
5. a. Find the total numbers greater than 2000 that can be formed with digits 1,2,3,4,5. No digits being repeated in any number. 5+5
- b. An ABC Ltd. Co, suffers a loss of Rs 121.50, if one of its special product does not sell. Marginal Revenue is approximated by $MR = 30 - 6x$ and Marginal Cost by $MC = -24 + 3x$. Determine the break even points.
6. a. Find the producer's surplus defined by the demand curve $D(x) = 20 - 5x$ and supply curve $S(x) = 4x + 8$. 5
- b. A flag- staff 5m high stands on a building 25m high. To an observer at a height of 30m, the flag staff and the building subtend equal angles. Find the distance of the observer from the top of the flag staff. 5
7. a. Find the value of $\int \frac{e^x(1+x)}{\cos^2(xe^x)} dx$ 5
- b. Draw the graphs of the following inequalities and indicate the common region:
- $x - 2y \leq 4$,
- $x - y \geq -3$,
- $2x + 3y \leq 5$ 5

JUNE 2002 Foundation level (Mathematics & Statistics)

Answer any five questions.

1. a. (i) Convert the hexadecimal number $ABCDE_{16}$ to its Decimal equivalent.
- (ii) Evaluate: $111101_2 - 10111_2$

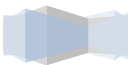


- b. Using trigonometric values of 60° or 120° , find the value of $\cos 20^\circ \cos 40^\circ \cos 80^\circ$
2. a. If $A = \begin{pmatrix} 1 & 2 \\ 3 & 1 \end{pmatrix}$ show that $A^2 - 2A - 5I = 0$, Where 0 is the 2×2 null matrix.
- b. Evaluate: $\lim_{x \rightarrow 0} \frac{1 - \cos 3x}{3x^2}$
3. a. Find the sum to n term of the series:
 $7 + 77 + 777 + 7777 + \dots$
- b. Differentiate $\sin^2 x$ from the first principle.
4. a. Find the value of n if ${}^n C_2 = {}^{n+2} C_3$
- b. Evaluate: $\int \frac{dx}{x^2 - a^2}$
5. a. Solve the following system of equations by augmenting the matrix and using the method of reduction
 $x + y + z = 6, x + 2y + 3z = 14, -x + y - z = -2$
- b. Show that: $\int_0^{\log 3} \frac{e^x dx}{1 + e^x} = \log 2$
6. a. The total profit y in rupees of a company from the manufacture and sale of x bottles is given by
 $Y = \frac{-x^2}{400} + 2x - 80$
- (i) How many bottles must the company sell to achieve maximum profit?
 (ii) What is the profit per bottle when this maximum is achieved?
- b) An account fetches interest at the rate of 15% per annum compounded continuously. An individual deposits Rs 1,500 each year in the account. How much will be in the account after 15 years? Given $e^{2.25} = 9.487$.
7. a. The price per unit at which a company can sell all that it produces is given by the function $p(x) = 300 - 4x$. The cost function is $C(x) = 500 + 28x$, where x is the number of units produced. Find x so that the profit is maximum.
- b. Draw the graph of the following linear inequalities:
 $x + y \leq 4, x - y \leq 4, x \geq -2$. Also indicate the common region.

Dec 2002 Foundation Level (Mathematics & Statistics)

Answer any FIVE questions. All questions carry equal marks. Working notes should form part of answers.

1. a) What are the symbols used in the hexadecimal system? Convert the hexadecimal number $(7EA5D)_{16}$ to decimal equivalent. 2+3
- b) How many numbers between 4000 and 5000 can be formed with the digits 2,3,4,5,7? How many of these numbers are divisible by 5? 5
- 2.a) Find the sum of the squares of the first n natural numbers. 5
- b) Find the adjoint and inverse of the following matrix, if possible. 5
- $$A = \begin{pmatrix} 1 & -3 & 2 \\ 2 & 5 & -1 \\ -3 & 1 & 4 \end{pmatrix}$$
- 3.a) Draw the graph of the following inequalities. What is the result? 5
 $2x + 3y \geq 14, x + 4y \geq 12, x \geq 0, y \geq 0$



- b) $\int x \sin^2 x dx$ 5
- 4.a) Differentiate $\sin 2x$ with respect to x from first principle. 5
- b) Find the deviation of x^e 5
- 5.a) Find the maximum and minimum value of the function: $F(x) = x + \frac{25}{x}$ 5
- b) The pricing policy of a company follows the demand equation $p = D(x)$. $D(x)$ being the price per unit when x units is demanded. After studying the market trends the company determines the price function that is given by. $D(x) = 1000 - 2x$
- If the product is to be marketed the company will incur a fixed cost of Rs. 30,000 and will have to pay Rs300 for each unit that is produced and placed in the store. At what a sales level can the company expect to recover its costs?
- 6.a) Examine the continuity or discontinuity of the function defined by: 5
- $2x^2 +$ for $x \leq 2$
- $F(x) =$ at $x = 2$
- $4x + 1$ for $x > 2$
- b) In a geometric progression the sum of the three numbers is 21 and their product is 64, find them.5
- 7.a) A person has 12 acquaintances of which 8 are relatives. In how many ways can he invite seven guests so that five of them may be relatives. 5
- b) Prove that: $\cos 20^\circ \cos 40^\circ \cos 80^\circ = 1/8$ 5

JUNE 2003 (Maths)

Answer any five questions. All questions carry equal marks.

- 1.a. Define a base in a number system. What are the symbols used in hexadecimal system. Simplify the following after converting them into decimal equivalent. 1+1+3
- $43686_{16} \div 103_8 + 1B_{16} \times 22_8 - 1010_2$
- b. i. If $\cos A + \sin A = \sqrt{2} \cos A$, prove that 2.5+2.5
- $\cos A - \sin A = \sqrt{2} \sin A$
- ii. Prove that: $\frac{1}{\sin 10^\circ} - \frac{\sqrt{3}}{\sin 10^\circ} = 4$
2. a. Find the inverse of the matrix: 5
- b. i. Evaluate: $\lim_{x \rightarrow \alpha} \frac{2x+1}{x^2+1}$
- ii. Define continuity of a function. Examine the continuity of a function defined as follows:
- $x^2 + 2$ for $x \leq 5$
- $f(x) =$ at $x = 5$
- $3x + 12$ for $x > 5$ 1+2
- 3.a. Find the sum of the squares of the first n - natural numbers. 5
- b. Find from first principle the derivative of $\sqrt{2x + 3}$

- 4.a. From 6 men and 4 ladies a committee of 5 is to be formed. In how many ways can this be done so as to include at least one lady. 5
- b. Evaluate: $\int \sqrt{x^2 + a^2} dx$ 5
- 5.a. Using elementary row operation, solve the following system of equations: 5
- $$2x - y + z = -1$$
- $$x - 2y + 3z = 4$$
- $$4x + y + 2z = 4$$
- b. The marginal revenue (in thousands of rupees) function for a particular commodity is $4 + e^{-0.03x}$, where x denotes the number of units sold. Determine the total revenue from the sale of 100 units. It is given that $e^{-3} = 0.05$ (approx) 5
6. a. A manufacturer determines that his total cost function is $C = \frac{q^2}{3} + 2q + 300$, where q is the number of units produced. At what level of output will average cost per unit be a minimum?
- b. A cell manufacturing company introduces production bonus to the employees that increased the cost of the cell. The daily cost of production C for x number of cells is given by: $C(x) = Rs. (2.05x + 550)$
- If each cell is sold for Rs 3, determine the minimum number that must be produced and sold daily to ensure no loss.
 - If the selling price is increased by 30 paise per piece, what would be the break even point?
 - If it is known at least 500 cells can be sold daily, what price should the company charge per piece of cell to guarantee no loss?
7. a. Find the derivative of e^x 5
- b. Draw the graph of the following inequalities and indicate the common region also. 5
- $$4x + 5y \leq 20$$
- $$2 \leq x \leq 4 \text{ and } y \geq 1$$

December 2003 (Mathematics)

Answer any FIVE questions. All questions carry equal marks.

1+2+2

- 1.a. i. What is a base in a number system?
- Convert the number $(FADE)_{16}$ into decimal form.
 - Convert the binary fraction 0.11101_2 to decimal fraction.
- b. Prove that the number of permutations of n different objects taken r at a time is given
- $${}^n P_r = \frac{n!}{n-r!}$$
- 2.a. A committee of 7 members is to be chosen from six Chartered Accountants, 4 Economics and 5 Cost Accountants. In how many ways can this be done if in the committee, there must be at least one member from each group and at least Chartered Accountants? 5
- b.i. Prove that A.M. > G.M. between two unequal positive numbers. 2.5
- Insert 3 geometric means between $\frac{1}{9}$ and 9. 2.5

3.a. Find the inverse of a matrix: $A = \begin{pmatrix} 1 & 1 & 3 \\ 1 & 2 & -1 \\ 1 & 1 & 1 \end{pmatrix}$

5

b. The daily cost of production C for x units of manufactured product is given by $C(x) = \text{Rs } 3.5x + \text{Rs } 12000$

i) If each unit is sold for Rs 6, determine the minimum number of units that should be produced and sold to ensure no loss.

ii). If the selling price is increased by half a rupee per unit, what would be the breakeven point?

iii) If 6000 units are sold daily what piece per units should be charges to guarantee no loss? 5

4. a. Prove that: $\sin 10^\circ \sin 30^\circ \sin 50^\circ \sin 70^\circ + \frac{1}{16}$

b.i. Find the points of discontinuity of the function 2

$$f(x) = \frac{x^2 + 2x + 5}{x^2 - 3x + 2}$$

ii. Find $\frac{dy}{dx}$ if $y = (\sin x)^x$ 3

5. a. The sum of two positive numbers is 16. Find the numbers if the product of the squares is to be a maximum. 5

b. Using elementary row operations, solve the following system of equations: 5

$$2x - y + 3z = 9, x + 3y - z = 4 \text{ and } 3x + 2y + z = 10$$

6. a. Integrate $= \frac{2x+5}{x^2+x+3} dx$ 5

b. A machine is purchased on installment basis such that Rs. 1,800 is to be paid each year for 5 years. If interest is charged at the rate 11% per annum compounded continuously, what would be the cash down price or present of the machine? (Given that $e^{0.55} = 1.733$) 5

7.a. Give the correct answer with reasons for the following: 1.5+1.5+2

i. Which of the following is an orthogonal matrix?

ii. If $\tan \theta = -\frac{4}{3}$, then $\sin \theta$ is

(a) $-\frac{4}{5}$ but not $\frac{4}{5}$

(b) $-\frac{4}{5}$ or $\frac{4}{5}$

(c) $\frac{4}{5}$ but not $-\frac{4}{5}$

(d) None of these

iii. Given $f(m+n) = f(m) \cdot f(n)$, where m and n are natural numbers. Also, it is given that $f(1) = 2$. Then the natural number a for which $f(a+1) + f(a+2) + \dots + f(a+n) = 16(2^n - 1)$ is (a)4, (b)3, (c) 16 and (d) none of these.

b. Draw the graph of the following linear inequalities and indicate the common region also. 5

$$4x + 5y \leq 20, 2 \leq x \leq 4 \text{ and } y \geq 1$$

JUNE 2004 (Maths)

Answer any FIVE questions. All questions carry equal marks.

1. a) Define a base in a number system. What are the symbols used in hexadecimal system. Convert the decimal number $53\frac{1}{8}$ into binary number. 1+2=3

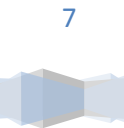


- b) How many words can be formed from the letters of the word "DAUGHTER" so that: 3+2=5
- i) The vowels always come together
 - ii) The vowels are never together
2. a) Sum the series $\frac{1}{n} + \frac{n+1}{n} + \frac{2n+1}{n} + \dots + \frac{n^2-n+1}{n}$ 5
- b) Solve the following system of equations. 5
- $$x+y+z=1$$
- $$ax+by+cz+K$$
- $$a^2x+b^2y+c^2z=K^2$$
- 3.a) A buys a house for Rs 15,88,600 for which he pays Rs 4,00,000 cash down and the balance in 10 annual equal installments paid at the end of each year. If the rate of interest is 5% p.a. Compounded annually, how much money has he to pay every year? 5
- b) If $x=a(\theta - \sin \theta), y=a(\theta + \cos \theta)$, find $\frac{d^2y}{d\theta^2}$ at $\theta + \frac{\pi}{2}$ 5
- 4.a) Evaluate: $\int [\log(\log x) + \frac{1}{(\log x)^2}] dx$ 5
- b) Draw the graph of the following inequalities and indicate the common region also. 5
- $$y \leq 2x+4, y \geq -x-2, y \leq 4-4x$$
- 5.a) Find the value of $\operatorname{csc}^{-1} \operatorname{csc}^{-1} x$.
- b) Evaluate $\lim_{x \rightarrow a} \frac{\sin x - \sin a}{\sqrt{x} - \sqrt{a}}$ 5
- 6.a) Find from first principle the derivative of $\sec x$. 5
- b) A company sells its product at the rate of Rs 6 per unit. The variable cost are estimated to run 25% of the total revenue received. If the fixed cost for the product are Rs 4,500, find: 5
- i) the total revenue function
 - ii) the total cost function
 - iii) the profit function
 - iv) the break even point
- 7.a) Give the $x=200-10p$ and $AC=10+\frac{x}{25}$, where x represents the units of output, p , the price and AC , the average cost. Find the profit maximizing output level. 5
- b) If $y=\alpha+\beta$, prove that:
- $$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1 + 2\cos\alpha \cdot \cos\beta \cdot \cos\gamma$$

Dec 2004 Foundation Level (Maths)

Answer any FIVE questions. All questions carry equal marks.

- 1.a) What is a base in a number system? What are the symbols used in binary form? Convert the following numbers.



(i) 1011.110_2 to decimal form and

(ii) 11111101_2 to octal form

1+2+2=5

b) A car costs Rs 1,84,500. The depreciated value of the car is a linear function of time. If the total cost life of the car is 16 years and its scrap value after 16 years is Rs 1,940, determine the linear relationship between the depreciated value and time and also determine the annual depreciation.

3.5+1.5=5

2. a) A cottage toy industry has 29 workers. The cost of producing a unit of toy is Rs 2.07. Other fixed cost including production bonus is Rs 30 per worker.

2.5+2.5=5

(i) If each toy is sold for Rs 6 determine the number of toys that must be produced and sold daily to ensure no loss.

(ii) If to promote sale, price is reduced by 50 paise per toy, what would be break even point and if at this Rate 500 toys are sold daily. What would be the profit?

b) What is trigonometry? What are trigonometrically ratios? Show that:

1+4=5

$$\cos 40^\circ \cos 100^\circ \cos 160^\circ = \frac{1}{8}$$

3.a) A man is employed to count Rs 10,710. He counts at the rate of Rs 180 per minute of half an hour. After this he counts at the rate of Rs 3 less every minute than the preceding minute. Find the time taken by him to count the entire amount.

5

b) Define continuity of a function. Find the values of a and b if the function defined below is continuous in the interval $[-1, 3]$.

1+4=5

$$f(x) = \begin{cases} 1-x & , \text{for } -1 \leq x \leq 1 \\ a+bx & , \text{for } 1 < x \leq 2 \\ x-4 & , \text{for } 2 < x \leq 3 \end{cases}$$

4.a) Show that:

5

$$A = 2 \begin{pmatrix} 2 & 2 \\ 1 & 2 \\ 2 & 1 \end{pmatrix}$$

Satisfies the equation $A^2 - 4A - 5I = 0$, where I and 0 are identity and zero matrixes of order 3×3 respectively.

b) For the equation $ax^2 + 2hxy + by^2 = 1$, verify that $\frac{dy}{dx} \cdot \frac{dx}{dy} = 1$

5

5.a) How many permutations can be made with the letters of the word MISSISSIPPI taken all together? In how many of these will the vowels occupying the even places?

2.5+2.5=5

b) Evaluate: $\int \frac{x}{(x-1)(2x+1)} dx$

5

6.a) Solve by matrix inversion method the following system of equations:

5

$$2x + y - z = 3, \quad x + y + z = 1, \quad \text{and} \quad x - 2y - 3z = 4$$

b) The cost of manufacturing a particular type of cricket ball is given by:

3+2=5

$C(x) = x^2 - 1200x + 3600040$, where x denotes the number of balls produced. How many balls should the company manufacturer at which cost is minimum and what would be the cost per ball at this level of production?

- 7.a) A car manufacturing company manufactures cars of two types A and B. Model A requires 150 man hours for assembling, 50 man hours for painting and 10 man hours for checking and testing. Model B requires 60 man hours for assembling, 40 man hours for painting and 20 man hours for checking and testing. There are available 30 thousand man hours for assembling, 13 thousand man hours for painting and 5 thousand man hour for checking and testing. Express this using linear inequality. Draw graphs of the inequalities and then mark the feasible region. 5
- b) A piece of equipment has a useful life of 10 years. It can be rented at Rs 16,000 per year (in equal weekly installments) or purchased by an outright cash payment of Rs 92,000. The salvage value after 10 years is zero. Is the present value of the rental payments at an 8% interest rate greater or less than the outright cash purchase? 5

JUNE 2005 (Maths)

Answer any FIVE questions. All questions carry marks.

1. a. i) Convert the binary number $(110010)_2$ into decimal number system. (2+3=5)
 ii) Find the hexadecimal equivalent of the octal number 5674_8 .
- b. In how many ways can the letters of the word STRANGE be arranged so that
 i) The vowels are never separated,
 ii) The vowel never come together, and
 iii) The vowel occupy only odd places. (1+2+2=5)
2. a) A person agrees to pay off a debt of Rs. 36,000 by 40 annual installment, which form A.P., when 30 installments are paid he dies leaving one third of the debt unpaid. Find the value of the first installment. 5
- b) Solve the equation using elementary row operations. 5
- $$x - y + z = 3$$
- $$2x + 3y - z = 13$$
- $$3x + 6y - 4z = 20$$
3. a) What do you mean by a matrix? When does the multiplication of two matrices exist? Show that
 $A = \frac{1}{3} \begin{pmatrix} -1 & 2 & 2 \\ 2 & -1 & 2 \\ 2 & 2 & -1 \end{pmatrix}$ is an orthogonal matrix. (0.5+0.5+4=5)
- b) A company sells x tins of talcum powder each day at Rs.10 per tin. The cost of manufacturing is Rs 6 per tin and the distributor charge Rs. 1 per tin. Besides these the daily overhead cost comes to Rs 600. Determine the profit function. What is the profit if 500 tins are manufactured and sold a day? How do you interpret the situation if the company manufactures and sells 100 tins in a day? What is the breakeven point? 5
4. a) If $A+B+C=\pi$, show that 5
- $$\cos^2 A + \cos^2 B + \cos^2 C = 1 - 2\cos A \cos B \cos C$$
- b) If $y = e^{ax} \sin bx$, prove that 5
- $$\frac{d^2 y}{dx^2} - 2a \frac{dy}{dx} + (a^2 + b^2)y = 0$$

5. a. i) Let $f(x) = \frac{x^2}{a} - a$, for $x \leq a$ (2+3=5)

$$= a - \frac{x^2}{x} \text{ for } x > a \text{ Show that } f(x) \text{ is continuous at } x=a$$

ii) Evaluate $\int \frac{x^{e-1} + e^{x-1}}{x^e + e^x} dx$

b) The marginal cost of a new product and the marginal revenue function are given respectively by

$$C'(x) = 300 + x \text{ and } R'(x) = 400 + \frac{x}{5}$$

Where x is the number of units produced. What is the maximum profit if the fixed cost of the plant is known to be Rs 1,250? 5

6.a) Draw the diagram of the solution set of the linear constraints: 5

$$3x + 3y \leq 36, 5x + 2y \leq 20, 2x + 6y \leq 60, x \geq 0, y \geq 0.$$

b) A piece of equipment has a useful life of 10 years. It can be rented at Rs 16,000 per year (in equal weekly installments) or purchased by an outright cash payment of Rs 92,000. The salvage value after 10 years is zero. Is the present value of the rental payments at an 8% interest rate greater or less than the outright cash payment purchase. ($e^{-0.8} = 0.4493$) 5

7.a) A sugar refinery has total cost Rs $(\frac{x^2}{10} + 5x + 40)$ when x quintals of sugar are produced per week. The fixed market price is Rs. p per quintal. What is the lower price to cover total cost? 5

b) A person invests Rs 50,000 each year in a bank where the rate of return is 10% per annum on the investment. What is the total value of the investment. What is the total value of the investment after 11 years? 5

December 2005 (Maths)

Answer any Five questions. All questions carry equal marks. Working notes should form part of the answer.

1.a) What is a base? Simplify into decimal form $5686_{16} \div 62_8 + 26_{16} \times 77_8$ 5

b) A company sells its product at Rs 4 per unit. Fixed costs for the Company are Rs 2,800 and variable costs are estimated to run 30% of the total revenue. Determine (i) the total revenue function (ii) total cost function (iii) the breakeven point (iv) the quantity that the company must sell to cover its fixed cost. 5

2.a) If the function $f(x) = \begin{cases} 3ax + b & \text{if } x > 1 \\ 11 & \text{if } x = 1 \\ 5ax - 2b & \text{if } x < 1 \end{cases}$

Is continuous at $x=1$, find the values of a and b . 5

b) The sum of three numbers is 20. If we multiply the first number by 2 and add the second number to the result, and subtract the third number, we get 23. By adding second and the third numbers to three times the first number, we get 46. Find the numbers by using Cramer's rule. 5

3.a) Prove that $\cos 20^\circ \cdot \cos 40^\circ \cdot \cos 80^\circ = 1/8$

b) A company borrows a loan of Rs 400,950 on the condition to repay it with compound interest at 6% p.a by annual installments of Rs 150,000 each. In how many years will the debt be paid off? 5

- 4.a) Find the number of combinations that can be made by taking 4 letters of the word COMBINATION.5
- b) Graphically solve the system of linear constraints: 5
- $$x - y \leq 2, x + y \leq 4, x \geq 0, y \geq 0$$
- 5.a) Find $\frac{dy}{dx}$ if $y = u^2 + u + 2, u = v^2 + 5, v = 6x + 7$ 5
- b) A radio manufacturer produces x sets per week at a total cost of Rs. $\frac{x^2}{5} + 3x - 100$. He is a monopolistic and the demand for his product is $x = 105 - 3p$ where p is the price in rupees per set. Show that the maximum net revenue is obtained when 30 sets are produced per week. What is the monopoly price? 5
- 6.a) Evaluate $\int \frac{x^2}{(x-1)(x-2)} dx$ 5
- b) Marginal revenue function of a firm is $\frac{ab}{(x-b)^2} - c$. Prove that the demand law $P = \frac{a}{b-x} - c$ 5
7. a) Determine the inverse of the matrix. 5
- $$A = \begin{bmatrix} 1 & 2 & 0 \\ 1 & 0 & -1 \\ -1 & 3 & 2 \end{bmatrix}$$
- b) An object is dropped from a cliff, which is 1,296 feet above the ground. The height of the object is described as a function of time. The function is $h = -16t^2 + 1296$
- i) How far will the object drop in 2 sec?
- ii) What is the instantaneous velocity of the object at $t = 2$?
- iii) What is the velocity of the object at the instant it hits the ground? 5

Dec 2006 (Maths)

Question No 1 is compulsory. Attempt four questions from the rest.

1) Show that the matrix $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$

Satisfy the equation $A^3 - 6A^2 + 9A - 4I = 0$, and hence deduce A^{-1}

2.a.i) Convert 53.8125 into binary from 2

ii) Divide 10100_2 by 101_2

iii) Evaluate $111011_2 + 101_2 - 111_2$ 2

b) 9 courses are offered to the students

i) In how many ways can 6 courses out of 9 be selected?

ii) If two courses are compulsory, In how many ways can 6 courses be selected? (2+3=5)

3. a. i) A machine costing Rs 10,000 has a probable life of 10 years. The estimated scrap value at the end of 10 years is Rs 1000. Using the straight line method of depreciation, find the annual depreciation and construct the depreciation functions. 3

ii) How many real solution are there of the equation $|x|^2 - 3|x| + 2 = 0$? 2



- b. How the sum of the squares of the first n natural numbers. 5
4. a) If $\tan \theta = \frac{b}{a}$, prove that $a \cos^2 \theta + b \sin^2 \theta = a$ 5
- b) Define the continuity of a function at a point $x=a$. Determine the value of the constant p so that the given function is continuous at the point mentioned. (2+3=5)
- $$f(x) = \begin{cases} 2px+3 & \text{at } x=1 \\ 1-px^2 & \text{if } x>1 \end{cases}$$
5. a) The total cost function is defined as: $C=q^2/3+2q+300$,
Where q is the number of units produced. At what level output will average cost per unit be a minimum? 5
- b) Integrate: $\int \frac{3x+2}{(x^2+1)(x-2)}$ 5
- 6.a) A machine is purchased on installment basis such that Rs 1,800 is to be paid each year for five years. If interest is charged @11% per annum compounded continuously, what would be the cash down price or present value of the machine? Give that $e^{0.55} = 1.700$ 5
- b) Draw the graph of the following linear inequalities: $x+2y \leq 12, 3x+y \leq 12, x+y \leq 5, x \geq 0, y \geq 0$. Also indicate the common region 5

JUNE 2007 (Maths)

Question No1 is compulsory. Attempt any four from the rest

1. When will an inverse of matrix exists?

The following matrix equation $\begin{bmatrix} 1 & 2 & 1 \\ 2 & 3 & 2 \\ 3 & 2 & 2 \end{bmatrix} \begin{matrix} x \\ y \\ z \end{matrix} = \begin{matrix} 8 \\ 14 \\ 13 \end{matrix}$

Is in the form of $AX=B$ where the symbols have usual meanings.

i) Find the inverse of $A = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 3 & 2 \\ 3 & 2 & 2 \end{bmatrix}$ 5

ii) Using inverse matrix method, solve the above equation. 4

2.a.i) Show that: $(4A8)_{16} = (10010101000)_2$ (2+3=5)

ii) Express the following into decimal form.

b. A box contains 7 red, 6 whites and 4 blue balls. How many selections of three balls can be made so that i) All three are red ii) None is red (2+3=5)

3.a) A man borrowed Rs 11,400 and agrees to repay the total sum without interest in 12 installments, each installment being less than preceding by Rs 100. What should be the first installment? 5

b) If $\tan \theta + \tan \phi = a$ and $\cot \theta + \cot \phi = b$, prove that $\cot(\theta + \phi) = \frac{1}{a} - \frac{1}{b}$

4.a) What condition must be satisfied by a function to be continuous at a point?

A function $f(x)$ is defined as follows:

$$f(x) = \begin{cases} 3ax+4 & \text{for } x \geq 2 \end{cases}$$



22 for $x=2$

18-bx for $x<2$

If $f(x)$ is continuous at $x=2$, find the value of a and b.

5

b) Graph the following system of inequalities:

5

$$2x+3y \geq 12, y \leq x \text{ and } x \leq 6$$

Shade the common region.

5. a) If $y=xe^{-x}$, prove that $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} = y=0$

b) The average cost function in producing the quantity Q is $AC=Q+\frac{8}{Q}+\frac{2000}{Q^2}$; Find at what level of the quantity produced will make the total cost minimum. Also, find the minimum cost.

5

6.a) Evaluate:

(2+3=5)

i) $\int \frac{e^{2x} - e^{-2x}}{e^x + e^{-x}} dx$

ii) $\int_0^{8/25} \frac{dx}{\sqrt{1-2x}}$

b) The annual rate of repairing cost is given by $\frac{dc}{dt} = 10t+100$ where t is the age of the machine in years and $\frac{dc}{dt}$ is in Rs per year. Find the total repair cost after 5 years.

5

December 07 (Maths)

Question No 1 is compulsory. Attempt any FOUR question from the rest.

1.a) What do you mean by Singular and Non singular matrices?

1

b) If $A = \begin{pmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 2 & 3 & 4 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & -2 \\ -1 & 0 \\ 1 & -1 \end{pmatrix}$

Does BA exist?

4

c) Find the adjoint and the inverse of the matrix

$$A = \begin{pmatrix} 2 & 0 & 1 \\ 2 & 1 & 3 \\ 1 & -1 & 0 \end{pmatrix}$$

5

2.a) What is a base in number system? Simplify the following into decimal equivalent. (1+4=5)

$$4386_{16} \div 103_8 + 1B_{16} \times 22_8 - 1010_2$$

b) How many numbers between 4000 and 5000 can be formed with the digits 2,3,4,5,6,7? How many numbers are divided by 5?

5

3.a) A printer machine costing Rs 10,000 has probable life of 10 years. The estimated scrap value at the end of 10 years is Rs 1,000. Using the straight line method of depreciation, find the annual depreciation and construct the depreciation function.

5

b) Prove that:

i) $\sin 20^\circ \sin 40^\circ \sin 80^\circ = \frac{\sqrt{3}}{8}$ 3

ii) $\tan^{-1} x + \tan^{-1} y = \tan^{-1} \frac{x+y}{1-xy}$ 2

4.a) The daily cost of production 'C' for x units of a manufactured product is given by $C(x) = \text{Rs.}(3.5x+12,000)$ 5

i) If each unit is sold for Rs 6, determine the minimum number of units that should be produced and sold to ensure no loss.

ii) If the selling price is increased by half a rupee per unit, what would be the break even point?

iii) If 5000 units are sold daily, what price per unit should be charged to guarantee no loss?

b) A function is defined as

$$f(x) = 2x^2 + 1 \text{ for } x < 2$$

$$= 5 \text{ for } x = 2$$

$$= 4x + 1 \text{ for } x > 2$$

Is the function continuous at $x=2$? If not, state how you can make it continuous.

5. a) If $xy = e^{x-y}$, prove that $\frac{dy}{dx} = \frac{\log x}{(1+\log x)^2}$

b) The cost of fuel in running an engine is proportional to the square of the speed in kms, per hour, and is Rs 48 per hour when the speed is 16kms. Other costs amount to Rs 300 per hour. Find the most economical speed. 5

6.a) Evaluate:

i) $\int (e^x - e^{-x})^2 dx$

ii) $\int_0^1 \frac{3dx}{\sqrt{3x+1}}$

b) Draw the graph of the following linear inequalities:

$$x+2y \leq 8, 3x+y \leq 12, x+y \leq 5 \text{ and } x \geq 0, y \geq 0. \text{ Also indicate the common region.} \quad 5$$

JUNE 2008 (Maths)

Question no 1 is compulsory. Attempt any FOUR questions from the rest

1.a) Construct the matrix $A = [a_{ij}]$ if A is 2×2 and $a_{ij} = 4i + 2j$ 5

b) If $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$. Show that $A^2 - 4A - 5I = 0$, where I is an identity matrix of order 3. 5

2.a. i) Convert $(AFB2)_{16}$ into binary number. 3

ii) Evaluate $01101_2 + 10111_2 - 10011_2$ 2

b) How many 4 digits numbers can be formed with the digits 1,2,3,4,5,6 when a digit may be repeated any number of times in any arrangement? 5



3.a) The original cost of a machine is Rs 25,000. It depreciates at the rate of 5% per annum simple depreciation. Find its yearly simple depreciation and the value of the machine at the end of 4th year. 5

b. i) Prove that $\tan 20^\circ + 4\sin 20^\circ = \sqrt{3}$ 2.5

ii) Prove that: $\tan 75^\circ = \frac{\sqrt{3}+1}{\sqrt{3}-1}$

4.a) A function f(x) is defined as:

$$f(x) = x^2 - 1, 1 \leq x < 2$$

$$= 4x - 5, 2 \leq x < 3$$

$$= x + 2, 3 \leq x < 4$$

Discuss the continuity and discontinuity of f(x) at x=2 and x=3 (2.5+2.5=5)

b) Draw the graph of the following linear inequalities: $x - y \leq 2, x + y \leq 4, x \geq 0, y \geq 0$.

Shade the feasible region.

5.a) Find $\frac{dy}{dx}$, where $x - y = \sin xy$

b) A company estimated that the cost of producing x units of a product can be modeled by $c = 800 + 0.04x + 0.0002x^2$. At what level of output will average cost per unit be a minimum?

6.a) Evaluate the following integral:

i) $\int \frac{(x+1)}{x(x-1)(x+2)} dx$

ii) $\int_{-1}^3 (3x^2 - x + 6) dx$

b) If the marginal cost function is $\frac{dc}{dq} = 2q + 75$

where 'c' is the total cost of producing q units of product per week, find the total cost function, it is given that $c(0) = 2000$

Dec 2008 (Maths)

Question No 1 is compulsory. Attempt any four questions from the rest.

1.a) Find the inverse of the following Matrix. 5

$$A = \begin{bmatrix} 0 & 3 & 1 \\ 1 & 1 & 0 \\ 2 & 3 & 3 \end{bmatrix}$$

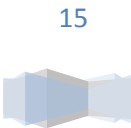
2.a.i) Convert $(B3D.E)_{16}$ into the decimal form. 2

ii) Convert $(24713)_8$ into binary number. 3

b.i) In how many ways can the letter of the word 'STATISTICS' be arranged? 2

ii) From 6 boys and 4 girls 5 are to be selected as council member. In how many ways can this be done if there must be exactly 2 girls? 3

3.a) The first letter of an arithmetic progression is 11, second term is 15 and last term is 139. How many terms are there? 5



b) In a geometric progression the first term is 7, the last term is 448 and the sum is 889, find the common ratio. 5

4.a) Draw the graph of following inequalities and shade the feasible region

$$3x+4y \leq 120$$

$$2x+y \leq 40$$

$$x \leq 30$$

where $x, y \geq 0$ are non negatively constraint. 5

b.i) Prove that:

$$\frac{\cos 15^\circ + \sin 15^\circ}{\cos 15^\circ - \sin 15^\circ} = \sqrt{3}$$

ii. Find value of $\tan 75^\circ$ and hence prove that; $\tan 75^\circ + \cot 75^\circ$ Is equal to 4.

5.a) A company finds that the variable cost per unit output is 10 and fixed cost is Rs 30,000. If each output sold for Rs 25. Find:

i) Total cost function

ii) Total revenue cost

iii) Profit function

iv) Break even point

v) Number of output when the profit of the company is Rs 54,000.

b) If $f(x) = (x^2 - 1)$ find:

i) $f(a)$

ii) $f(a+b)$

iii) $f(x+h)$

iv) $f(x+h) - f(x)$

v) $\frac{f(x+h) - f(x)}{h}$

6. a.i) The average cost of machine x units of an item in rupee is

$$AC = x + 5 + \frac{36}{x}$$

Find marginal cost of 100 units of output

ii) Find the differential coefficient of $e^{ax} - e^{-bx}$

b) Evaluate:

i) $\int \frac{x+2}{x-2} dx$

ii) $\int_1^0 \frac{3dx}{\sqrt{3x+1}}$

JUNE 2009 Foundation Examination(Maths)

Question No. 1 is compulsory. Attempt any FOUR questions from the rest.

1. a) How do you know that the given two matrices are comfortable for addition and multiplication?



b) If $A = \begin{bmatrix} 1 & 3 & -1 \\ 2 & 2 & -1 \\ 3 & 0 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} -2 & 3 & -1 \\ -1 & 2 & -1 \\ -6 & 9 & -4 \end{bmatrix}$ then find AB 3

c) Find the inverse of the matrix 5

$$B = \begin{bmatrix} 1 & -3 & 2 \\ 2 & 5 & -1 \\ -3 & 1 & 4 \end{bmatrix} \quad \text{3+2=5}$$

2.a) i) Show that: $(4A8)_{16} = (10010101000)_2$

ii) Express the following into decimal form:

$$(10110)_2 + (18)_{16} \times (31)_8$$

b) A math exam paper contains two groups. Each has six questions. First question of each group is compulsory. Candidates are required to solve five questions from each group. In how many ways this can be done. 5

3. a) A man is employed to count Rs 10,710. He counts at the rate of Rs 180 per minute for half an hour. After this he counts at the rate of Rs 3 less every minute than the preceding minute. Find the time taken by him to count the entire amount. 5

b) Draw the graph of the following inequalities and shade for the feasible region.

$$X + y \leq 4, 2x - y \leq 2, x \geq 0, y \geq 0 \quad \text{5}$$

4. a) A function $f(x)$ is defined as: $f(x) = \begin{cases} 3 + 2x & \text{for } \frac{-3}{2} \leq x < 0 \\ 3 - 2x & \text{for } 0 \leq x < \frac{3}{2} \\ -3 - 2x & \text{for } x \geq \frac{3}{2} \end{cases}$ 5

b) The cost and demand function of a commodity are given by $C = Q^2 + 8Q + 2$ and $P = 20 - Q$ respectively.

i) Find average cost function. 1

ii) For what level of output average cost will be minimum? 3

5. a) Find the value of $\cos 20^\circ \cos 40^\circ \cos 80^\circ$ 5

b) A manufacturer determine that his total cost function is $C = \frac{q^2}{3} + 2q + 300$, where q is the number of units produced. At what level of output will average cost per unit be minimum? 5

6. a) Prove that: $\int_0^{\log 3} \frac{e^x dx}{1+e^x} = \log 2$ 5

b) Find from first principle the derivative of $\sec x$ 5

DEC 2009 Foundation level (Mathematics & Statistics)

Question No 1 is compulsory. Attempt any FOUR questions from the rest.

1.a)(i) If $A = \begin{bmatrix} 1 & 2 \\ 3 & 1 \end{bmatrix}$, then prove that $A^2 - 2A - 5I = 0$, where I and O are the identify and null matrix of same Size. 2 17

(ii) By using matrix reduction method, solve the equations.

$$2x + 3y = 9,$$

$$5x - 8y = 7$$

3

- b) Show that $\begin{bmatrix} yz & zx & xy \\ x & y & z \\ x^2 & y^2 & z^2 \end{bmatrix} = (y-z)(z-x)(x-y)(yz+zx+xy)$ 5
- 2.a) i) Show that $(2DAD)_{16} = (26655)_8$ 2
- ii) Express the following into decimal form $(352)_{16} + (10110)_2$ 3
- b) i) How many 6-digit telephone numbers can be constructed with the digits 0,1,2,3,4,5,6,7,8,9 if each number starts with 98 and no digits appear more than once? 3
- ii) In how many ways can a committee of 15 members formed out of 8 engineers, 5 doctors and 4 lawyers so that all lawyers always have representation? 2
- 3.a) Find the value of the machine after a period of 10 years if at the time of purchase it was worth Rs. 12,500. The machine is depreciated at the rate of 15% for the first four years and at 20% for the rest of the period. The reducing balance method of charging depreciation was followed for the entire period. 5
- b) The total cost function $C=4q-q^2+2q^3$
- i) At what level of output, the average cost will be minimum? 3
- ii) Show that at the level of minimum average cost, average cost is marginal cost. 2
- 4.a) Draw the graph of the following inequalities and shade the feasible region: 5
- $X+y \leq 4, 3x+y \geq 3, 0 \leq x \leq 3, 0 \leq y \leq 2$
- b) Find the derivative of the function $f(x)=\sin^{-1}x$ with respect to x from the first principle. 5
- 6.a) i) Find: $\frac{dy}{dx}$, when $y=x^{ex}$ 2
- ii) Evaluate: $\int \frac{1}{x \log x \log(\log x)} dx$ 3
- b) A manufacturer of certain item find that it has a marginal revenue function $MR = \frac{100}{1+0.002x}$ dollars of a production level x items per week. Find the increase in the total revenue resulting from an increase in sales $x=30$ to $x=40$ items per week. 5

JUNE 2010 Foundation level (Maths)

Question No.1 is compulsory. Attempt any FOUR questions from the rest.

1.a) (i)

	Peon	Clerk	Head Clerk	Care taker
	(P)	(C)	(HC)	(CT)
School	3	2	1	1
College	5	3	1	0

	Peon	Clerk	Head Clerk	Care taker
	(P)	(C)	(HC)	(CT)
School	3	2	1	1
College	5	3	1	0

Salary (in Rs)

$$A = \begin{bmatrix} 3,100 \\ 3,700 \\ 4,000 \\ 3,500 \end{bmatrix}$$

Find total monthly salary bill of the school and college.

3



- ii) Find x and y if $\begin{bmatrix} 4 & 7 \\ x & 7 \end{bmatrix} + \begin{bmatrix} y+2 & 1 \\ 5 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 8 \\ 6 & 7 \end{bmatrix}$ 1
- iii) Define inverse of a square matrix. 1
Verify that $CA=6I$. Using this result solve the system of linear equations. 5
 $x-y=3$; $2x+3y+4z=17$; $y+2z=7$
- 2.a) i) Convert 111010101_2 into octal and hexadecimal equivalent. 3
ii) Evaluate $10101_2 \times 11_2$ 2
- b) i) In how many ways can the letters of the word LAUGHTER be arranged so that the vowels may never be separated? 3
ii) A committee of 5 members is to be chosen from 9 ladies and 8 men. In how many ways can this be done if the committee commands a lady majority? 2
- 3.a) Find the sum of all numbers between 100 & 1000 which are divisible by 11. 5
b) Find the common region of the following linear inequalities: 5
 $3x + 2y \geq 6$; $5x + 6y \leq 30$; $3y - 2x \leq 6$; $y \geq 1$; $x \geq 0$
- 4.a) The cost for manufacturing a particular should type of jeans for the beauty company is given by $C=x^2-140x+4990$, where x denotes the number of jeans produced and C the cost in Rupees, per jeans. How many jeans the company should produce at which the cost is minimum?
What will be the cost per jeans at this level of production? 5
- b) If $(m^2 + n^2) \sin \theta = 2mn$, show that $(m^2+n^2) \cos \theta = \sin \theta = m^2-n^2$ 5
5. a) Find the derivative of the function $f(x)=\sin mx$ with respect to x from the first principle. 5
b) Find the elasticity of demand at the equilibrium price for the demand function $p=\sqrt{100 - q^2}$ and the supply function $q=2p- 10$, where p is price per unit and q is quantity. 5
6. a) Integrate $\int \frac{3x+2}{\sqrt{2x^2+5x+4}} dx$
b) The demand function $P_d=19- x$ and the supply function $p_s=2x + 1$ where x is the number of units. Find the consumer's surplus at the equilibrium market price. 5

Dec 2010 Foundation level (Maths)

Question No. 1 is compulsory. Attempt any FOUR questions from the rest.

1. a) What is skew symmetric matrix? Give one example of order 3×3 .
2. 2

b) Solve: $\begin{bmatrix} 3x-8 & 3 & 3 \\ 3 & 3x-8 & 3 \\ 3 & 3 & 3x-8 \end{bmatrix} = 0$ 3

c) Solve by matrix inverse method: $x + y + z = 3$
 $x + 2y + 3z = 4$ 5
 $x + 4y + 9z = 6$

2. a)(i) Convert $(E1BD2)_{16}$ into octal equivalent. 3
(ii) Convert 0.4375 into binary equivalent. 2

b) Define the term permutations and combinations.

Out of 6 members belonging to party 'A' and 4 to party 'B' in how many ways a committee of 5 can be selected so that committee may contains the member of A are in majority? $1+4=5$

- 3.a) A person borrows Rs 19,682 and pays it back 9 installments, each installment being treble of preceding one. Find first and last installment. Ignore interest 5
- b) Maximize and minimize $F=8x-5y+40$ subject to $x+2y \leq 10$, $x-y \geq 1$, $x \geq 0$, $y \geq 0$ 5
- 4.a) A manufacturer finds that the production cost associated with Rs 20 per item and fixed cost are Rs 60,000 per month. If the item is sold at Rs 32 per unit find: 1+2+2=5
- i) the break even point
- ii) the number of items that must be produced and sold each month so as to make a profit of Rs 18,000.
- iii) the loss to be borne if only 48,00 items are produced and sold each month.
- b) i) Prove the identity $\cos 4\theta + 4\cos 2\theta = 8\cos^4\theta - 3$ 3
- ii) Hence solve $\cos 4\theta + 4\cos 2\theta = 2$ for $0 \leq \theta \leq 360^\circ$ 3
5. a) Find the derivatives of $\frac{4}{\sqrt{(2-3e^{-2x^2})}}$ 5
- b) The cost and demand function of a commodity are given by $C=200,000+200q+.001q^2$ and $q=250,000-500p$ respectively, where q equals number of units demanded and p equals price in dollars. How many units q should be produced in order to maximize the profit? 5
6. a) Find the integrate of $\int_0^2 \frac{3x^2}{(2+x^3)} dx$ 5
- b) If the marginal revenue function for output x is $\frac{6}{(x+2)^2} + 5$, find the total revenue function and the demand function. 3+2=5

June 2009 (Maths)*Attempt all questions.*

1. a) A man retires at the age of 60 years and gets a pension of Rs. 1200 a year payable in half yearly installment for the rest of his life. Taking his expectation of life to be 13 years further, that the interest is at 4% p.a. payable half yearly, what single sum is equivalent to this pension? 5
- b) Convert the following hexadecimal number into binary number system
- $$(15A2B)_{16} = (\dots \dots \dots \dots)_2 \quad 5$$
- 2.a) What is combination? How does it differ from permutation? Out of ten packets of instant noodles, three packets have a coupon of special prize inside, but it is not known which have prize. In how many of these selections will include at least one prize? 5
- b) Every year, a person buys saving certificates issued by Nepal Rastra Bank. His purchases in each succeeding year increases by Rs. 100. After 10 years, he finds that the total value of the certificate held by him (excluding interest) is Rs. 5000. Find the value of the certificate purchased by him:
- i) in first year and
- ii) in the 8th year.
3. a) A manufacturer of a certain brand of watch finds that the production cost to each watch is Rs 200 and the fixed cost is Rs. 100,000. If each watch can be sold for Rs. 300, determine: (1+1+1+2=5)

- i) the cost function
- ii) the revenue function
- iii) the demand function
- iv) the breakeven point

b) For the following matrices K, VC and W where,

$$K = \begin{matrix} & R_1 & R_2 & R_3 & R_4 \\ \begin{matrix} S_1 \\ S_2 \\ S_3 \end{matrix} & \begin{bmatrix} 6 & 8 & 3 & 4 \\ 5 & 7 & 4 & 5 \\ 8 & 3 & 5 & 1 \end{bmatrix} \end{matrix}; V = \begin{bmatrix} 18 \\ 20 \\ 24 \\ 35 \end{bmatrix}$$

Matrix K shows the stock of four types of record players R_1, R_2, R_3 and R_4 in three shops S_1, S_2 and S_3 . Matrix V shows the values of the record players in ('00) rupees. matrix W gives the week's sales. Find:
i) The stock at the end of the week. ii) The order matrix to bring the stock of each of the cheaper pair of players to 8 and the deater pair to 5. 2+3=5

4.a) One kind of cake requires 150 gm flour and 50gm fat and another kind requires 75 gm flour 75 gm fat. We want to make as many cakes as possible when 1500 gm flour and 600 gm fat are available. Formulate the problem and shade the feasible area. (2+3=5)

b) If $\tan A = \frac{1-\cos B}{\sin B}$, prove that $B = 2A$. Use this result to prove that:

$$\tan(7\frac{1}{2})^\circ = \sqrt{6} - \sqrt{3} + \sqrt{2} - 2 \quad (2+3=5)$$

5. a) A firm has a demand function $p=108 - 5Q$ and the cost function $C = -12 + Q^2$, where p is the price per unit, Q is the quantity produced and C is the total cost. Find the price at which the profit is maximum. Find the maximum profit. 5

b) The marginal revenue function is given by :

MR = $3-2x-x^2$, x being the output. Find the total revenue and the demand function. 5

December 2009, Math & Stat

1. a) A company purchased machinery for Rs. 1,20,000 and set aside Rs. 6,000 at the end of each year to accumulate to replace the machinery. After what time would the sum of Rs. 1,20,000 be replaced, reckoning interest at 3.5% p.a. compounded? 5
 - b) i) Write down symbols used in decimal, hexadecimal and binary system? 2.
 - ii) Convert $(236.2)_8$ into decimal form. 2.5
2. a) A candidate is required to answer 6 out of 10 questions which are divided into 2 groups each containing 5 questions he is not permitted to attempt more than 4 from any group. In how many different ways can he make up his choice? 5
 - b) What do to mean by arithmetic progression? Write two differences between arithmetic and geometric progressions. Mr. Shyam borrows Rs. 8190 without paying interest, f he pays the loan in 12 monthly installments, each installment being twice the preceding one. Find the first and last installment. (1+1+3=5)
- 3.a) A company sells three different items A, B and C from its three different shops X, Y, Z. The quantity sold from the shops and the profits earned daily are given below:

Shops	Sales Units			Profit (in Rs.100)
	A	B	C	
X	2	3	4	20
Y	3	4	5	26
Z	3	5	6	31

Find the profit from each unit of the different items.

5

- b) i) A function $f: A \rightarrow B$ is defined from Set A to Set B, what is the relation between range of f and Set B.
2.5
- ii) A company observes that the fixed cost of the new product is Rs. 4,80,000 and variable cost per unit is Rs. 1,500. The revenue function for the sale of x units is given by $400x + 700x^2$. Find cost function, profit function and breakeven point.
2.5
- 4.a) A factory turns out two articles A and B each of which is processed by two machines X and Y. A requires 2 hours of X and 4 hours of Y, B requires 4 hours of X and 2 hours of Y. If x is the number of A and y is the number of B produced daily, write down two inequalities in x and y , noting that neither x nor y can work more than 24 hours a day. Graph the inequalities and shade the feasible area. 5
- b) If $\tan A = \frac{2mn}{m^2 - n^2}$ find, $\tan \frac{A}{2}$
- 5.a) The production function $Q = 8 + 16F - F^2$ where Q is the total output and F is units of input. Find the number of units of input required for maximum output and the output at that point. 5
- b) If the marginal revenue function is given as $MR = 9 - 4Q^2$ find the maximum revenue and also the total and average revenue functions. 5

JUNE 2010 (Maths)

Attempt all questions

1. (a) A wagon is purchased on installment basis Rs 5,000 is to be paid on the shaping of the contract and four yearly installment of Rs 3,000 each payable at the end of the first, second, third and fourth year. If interest is charged at 5% p.a. what should be the cash down price? 5
- (b) i. Convert $(156.34375)_{10}$ into octal number system. 2.5
- ii. Simplify: $\frac{9(4^x)^2}{16^{x+1} \cdot 2^{x+18}}$ 2.5
2. (a) Define permutations and combinations. In how many ways can 8 persons be seated at a round table? In how many ways will two particular persons sit together? $(1+2+2=5)$
- (b) Ramesh agrees to work in a restaurant for a week under the condition that his employer pays him Rs 100 for the first day and doubles his salary on each succeeding day. How much does he earn during the week? Also find his earning on the last day? 5
3. (a) For what condition the inverse of a square matrix exists? A, B and C has Rs 480, Rs 760 and Rs 710 respectively. They used the amounts to purchase three types of goods with prices x, y and z . A purchases 2 goods of price x , 5 of price y and 3 of price z , B purchases 4 goods of price x , 5 of price y

and 6 of price z, C purchases 1 good of price x, 4 of price y and 10 of price z. Find x,y,z by using inverse method. 5

(b) Define the logarithmic function.

Prove that $(yz)^{\log y - \log z} (zx)^{\log z - \log x} (xy)^{\log x - \log z} = 1$ 5

4. (a) A goldsmith produces two articles, gold rings and chains. He works 15 hours a day, each day manufactures at most 25 articles. It takes an hour to make ring and half an hour to make a chain. He makes profit of Rs 275 on a ring and Rs 180 on a chain. Find how many of each he should produce daily to maximize the profit. 5

(b) Solve: $\frac{3\sin^{-1} 2x}{1+x^2} - \frac{4\cos^{-1} 1-x^2}{1+x^2} + \frac{2\tan^{-1} \frac{2x}{1-x^2}}{3} = \frac{\pi}{3}$

5.(a) The cost function is $C=2x^3-24x+15$ where x is quantity of output. Examine whether the cost increasing or decreasing when output $x=3$ and $x=\frac{3}{2}$, Find the stationary point. 5

(b) A Company suffers a loss of Rs 2,100 if one of its special products does not sell. If the marginal revenue is approximated by $MR=0.2-0.3x$ and marginal cost by $MC=-0.1+0.2x$, find (3+2=5)

i. Find the i total profit function

ii. Average cost functions, if the cost of producing one unit product is Rs 50..

December 2010 (Maths)

Attempt all questions

1. a) A firm anticipate a capital expenditure of Rs 500,000 for new equipment in 10 years. How much money should be deposited at the end of each year in sinking fund earning 8 percent per annum compounded annually to provide for the purchase? 5

b) i) Convert $(453)_{10}$ into Octal number system. 2.5

ii) If $a=10^x$, $b=10^y$ and $a^y b^x=100$, Then prove that $xy=1$ 2.5

2. a) If seven persons are invited for a party, in how many ways can they and the host be seated at a circular table? In how many of these will three particular persons always together? In how many of these will all three particulars persons be never together? (1+2+2=5)

b) What do you mean by sequence and series? There are 10 varieties of birds in a zoo. The number of each variety is being doubled of the number of pervious variety. If the number of first variety is 2. Find the numbers in the last variety and also total number of all varieties of birds in the zoo. (1+2+2=5)

3.a) What do you mean by onto function? If $x=\log_{2a} a, y=\log_{3a} 2a, z=\log_{4a} 3a$ Prove that $xyz+1=2yz$ (1+4=5)

b) What do you mean by concurrent lines. Show that the straight lines $y=m_1x+c_1$, $y=m_2x+c_2$, $y=m_3x+c_3$ are concurrent if $m_1(c_2-c_3)+m_2(c_3-c_1)+m_3(c_1-c_2)=0$ (1+4=5)

4.a) Solve the following $\cos^{-1}x+\cos^{-1}2x=\frac{3\pi}{4}$ 5

b) A scooter company manufactures two types of scooters A and B. Model A requires 15 man hours for assembling, 5 man hours for painting and finishing and 1 man hour for checking and testing. Model B

requires 6 men hours for assembling, 4 men hours for painting and finishing and 2 men hours for checking and testing. In a week, there are 300 men hours available in the assembling shop 120 men hours available in painting and finishing shop and 50 men hours in checking and testing division. Express the case using linear inequalities and draw the graph of common region. 5

- 5.a) If the marginal revenue function is $MR=500-200Q+30Q^2$ where Q is the output, find the total revenue and demand function. Also, find the total revenue when the output is 10. (2+2+1=5)
- b) The demand function for a commodity is given by $p=\frac{200}{3x}+\frac{3x}{5}$. If the cost of production per unit of the commodity is Rs 3 and there is no fixed cost. Find (1+2+2=5)
- i. marginal cost
 - ii. slope of the revenue function
 - iii. value of x at which marginal cost is equal to marginal revenue.

JUNE 2011 (Maths)

Attempt all questions

- 1.a) A man obtains a loan of Rs 200,000 and agrees to repay it in 10 equal installments at 8.5% compound interest. The first payment is to be made at the end of the first year. Find the amount of cash installment. 5
- b) What are the advantages of using hexadecimal system? Convert 482594.34375_{10} into hexadecimal system. (1+4=5)
- 2.a) From 6 gentlemen and 4 ladies a committee of 5 is to be formed. In how many ways can this be done so as to include at least one lady? 5
- b) Define the term Geometric progression.
- Find the sum of the series $27+9+3+\dots+\frac{1}{81}$ (1+4=5)
- 3.a) A stationery shop sells English, Mathematics and Nepali books on Sunday, Monday and Tuesday as follows:

	Sun	Mon	Tue
<i>English</i>	20	15	25
<i>Mathematics</i>	25	10	20
<i>Nepali</i>	15	25	30

- i) Find the total sales of each book in all three days. 1
 - ii) Find the revenue of all books on each day when cost of English, Mathematics and Nepali are Rs 10,15 and 20 respectively. 2
 - iii) Find the total revenue of all books on three days 2
- b) A group of engineers is interested in forming a company to produce smoke detectors. They have developed a design and estimate that variable cost per unit including material, labour and marketing cost is \$22.50. Find cost associate with the formation, operation, management of the company, purchase of equipment and machinery is total \$250,000. They estimate that the selling price will be \$30 per detector.

- i) Determine the number of smoke detectors which must be sold in order to reach the break even. 3
- ii) Preliminary marketing data indicate that the firm can expect to sell approximately 30,000 smoke detectors over the life of the project if the detectors are sold for \$30 per unit. Determine expected profits at this level of output. 2
- 4.a) Upon completing the construction of his houses, Mr Jha discovers that 96 square feet of plywood scrap and 80 square feet of white pine scrap are in usable from for the construction of tables and bookcase. It takes 16 sq.ft of plywood and 8 sq.ft of white pine to make a table and 12 sq.ft. of plywood and 16 sq.ft. of pine wood are requires to construct a bookcase. Express the case using linear inequalities and draw the graph of common region. 5
- b) i) Prove that: $\frac{\sin\theta + \sin 3\theta + \sin 5\theta + \sin 7\theta}{\cos\theta + \cos 3\theta + \cos 5\theta + \cos 7\theta} = \tan 4\theta$ 3
- ii) Find the exact value of $\tan 75^\circ$ without using calculator. 2
- 5.a) A manufacturing has determined a cost function which expresses the annual cost of purchasing owing and maintaining its raw material inventory as a function of the size of each order. The cost function is $C = \frac{512,000}{q} + 80q + 750,000$ where q equals the size of each order (in tons) and C equals the annual inventory cost. i) Determine the order size q which minimizes annual inventory cost 4
- ii) What is the minimum inventory cost expected to equal? 1
- b) Evaluate: $\int_1^e x^2 (\log_e x) dx$ 5

December 2011, Maths/ CAP-I

Attempt all questions.

- 1.a) A man buys a house for which he agrees to pay \$500,000 now and \$5,000 at the end of each months for 8 years. If money is worth 12% per annum compounded monthly. What is the cash price of the house? 5
- b) What do you understand by the base of number system? Find the square root of $\sqrt{17D2_{16}}$ is decimal form. Simplify $DA_{16} + 44_8$ in decimal form. $1+2+2=5$
- 2.a) Define the term “ permutation”. How many 10 digits pre paid mobile member numbers can be constructed with the digits 0,1,2,3,4,5,6,7,8,9. If each number starts with 9841 and no digit appears more than once? $1+4=5$
- b) A student has read a 426 page book. He finds that he reads faster as he gets into the subject. He reads 19 pages on the first day, and his rate of reading then goes up by 3 pages each day. How long does he take to finish the book? 5
- 3.a) A manufacture sells a product at Rs 8 per unit, selling all that is produced. Fixed cost is Rs 5,000 and variable cost per unit is Rs $\frac{22}{9}$.
- i) Find the total output and the revenue at the break even point. 3
- ii) Find the profit when 1,800 units are produced. 2
- b) Define “exponential function”.
- If $\frac{\log x}{y-z} = \frac{\log y}{z-x} = \frac{\log z}{x-y}$, then
- Prove that $x^y y^z z^x = 1$ $1+4=5$

