

2024

MATHEMATICS — HONOURS

Paper : SEC-B-1, SEC-B-2.1 and SEC-B-2.2

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

SEC-B-1

(Mathematical Logic)

Full Marks : 80

(Notations and symbols have their usual meanings.)

1. Choose the correct option and justify your answer :

(1+1)×10

(a) Which one of the following propositions is a tautology?

(i) $(p \vee q) \rightarrow q$

(ii) $p \vee (q \rightarrow p)$

(iii) $p \vee (p \rightarrow q)$

(iv) Both (ii) and (iii).

(b) Disjunctive normal form of the formula $p \leftrightarrow q$ is

(i) $(p \wedge q) \vee (p \wedge \sim q)$

(ii) $(p \wedge q) \vee (\sim p \wedge \sim q)$

(iii) $(p \wedge \sim q) \vee (\sim p \wedge q)$

(iv) $(\sim p \wedge q) \vee (\sim p \wedge \sim q)$.

(c) Let $A(x)$ be a predicate on a non-empty set X . Then $\sim \forall x A(x)$ is equivalent to

(i) $\forall x \sim A(x)$

(ii) $\exists x \sim A(x)$

(iii) $\exists x A(x)$

(iv) $\sim \exists x \sim A(x)$.

(d) A counter example to the universally quantified statement $\forall x \forall y (x^2 \neq y^2)$, where the domain for all variables is the set of integers is

(i) $x = 8, y = 4$

(ii) $x = 3, y = 4$

(iii) $x = 8, y = 9$

(iv) $x = 4, y = -4$.

(e) Which one of the following is NOT equivalent to $p \leftrightarrow q$?

(i) $(\neg p \vee q) \wedge (p \vee \neg q)$

(ii) $(\neg p \vee q) \vee (p \rightarrow q)$

(iii) $(\neg p \vee q) \vee (p \wedge \neg q)$

(iv) $(\neg p \vee \neg q) \vee (p \wedge q)$.

Please Turn Over

(f) The Deduction theorem in Propositional Calculus is

(i) If $\Gamma \cup \{p\} \vdash q$ then $\Gamma \vdash p \rightarrow q$ (ii) If $\Gamma \cup \{p\} \vdash q$ then $\Gamma \vdash q \rightarrow p$

(iii) If $\Gamma \cup \{p\} \vdash q$ then $\Gamma \cup \{q\} \vdash p$ (iv) If $\Gamma \cup \{p\} \vdash q$ then $\Gamma \vdash p \vee q$.

(g) The truth values of the statements p, q, r are T, F, T respectively, then which of the following is True?

(i) $p \wedge q \wedge r$

(ii) $p \wedge \sim q \wedge \sim r$

(iii) $q \rightarrow (p \wedge c)$

(iv) $p \rightarrow (q \wedge r)$.

(h) Which one of the following is an adequate system of connectives?

(i) $\{\vee, \rightarrow\}$

(ii) $\{\wedge, \rightarrow\}$

(iii) $\{\sim, \wedge\}$

(iv) $\{\sim, \leftrightarrow\}$.

(i) The inverse of the statement formula $(p \rightarrow \sim q)$ is

(i) $q \rightarrow \sim p$

(ii) $\sim p \rightarrow \sim q$

(iii) $\sim p \rightarrow q$

(iv) $p \rightarrow q$.

(j) The truth values of $(\forall x \in \mathbb{Z})(\exists y \in \mathbb{Z})(x + y = 0)$ and $(\exists x \in \mathbb{Z})(\forall y \in \mathbb{Z})(x + y = 0)$ are respectively

(i) T, T

(ii) T, F

(iii) F, T

(iv) F, F .

Unit - I

2. Answer *any two* questions :

(a) (i) State the negation, converse, inverse, contrapositive of the conditional statement "If it is raining, then there is a less traffic in the road".

(ii) Translate only the contrapositive of the above statement into a well formed propositional formula. 4+1

(b) (i) Suppose p and q are two well formed formulae of Propositional Logic. When does p logically imply q ? 1+4

(ii) Examine whether $\sim p \rightarrow (q \rightarrow r)$ and $q \rightarrow (p \vee r)$ are logically equivalent or not. 1+4

(c) (i) Construct the truth table of the following proposition :

$$\neg(p \vee (q \wedge r)) \leftrightarrow ((p \vee q) \wedge (p \rightarrow r))$$

(ii) Determine the negation of the statement : $\neg p \vee \neg q$. 4+1

- (d) (i) Suppose $\sim((p \rightarrow q) \leftrightarrow (q \rightarrow p))$ is false. Is $p \leftrightarrow q$ True? Explain.
 (ii) Restore parenthesis to the following abbreviated propositional forms.
 (A) $\sim \sim p \vee \sim q \wedge \sim r$
 (B) $\sim p \vee q \wedge \sim \sim p \wedge q \vee r$.

3+2

Unit - II

3. Answer *any six* questions :

- (a) Define an adequate system of connectives. Examine whether $\{\wedge, \rightarrow\}$ is an adequate system of connectives? Justify your answer. 1+1+3
 (b) When is a statement formula said to be in Conjunctive Normal Form (CNF)? Find the CNF of the formula $(q \vee (p \wedge r)) \wedge \sim((p \vee r) \wedge q)$. 1+4
 (c) (i) Write down the axioms and rule of inference of Propositional Calculus.
 (ii) Show that absolute inconsistent always implies negative inconsistent in Propositional Calculus. 3+2
 (d) Find a derivation of the theorem in Propositional Calculus $\vdash (\sim p \rightarrow p) \rightarrow p$, where p is a well formed formula of Propositional Logic. 5
 (e) Write notes on (i) Proof, (ii) Theorem, (iii) Logical consequences for the Propositional Calculus. 2+2+1
 (f) Using Deduction theorem in Propositional Calculus, prove that if $\vdash p \rightarrow q$ and $\vdash q \rightarrow r$ then $\vdash p \rightarrow r$, where p, q, r are well formed formulae of Propositional Logic. 1+4
 (g) Design a switching circuit corresponding to the given statement formula :
 $(p \wedge q \wedge \neg r) \vee (\neg p \wedge q \wedge r) \vee (p \vee \neg q \wedge r) \vee (p \wedge q \wedge r)$.
 Also find the simplest equivalent circuit. 3+2
 (h) Express the following argument symbolically and check whether this is a valid argument using truth table.
 "If I study, then I will pass examination.
 If I do not go to picnic, then I will study.
 But I failed examination.
 Therefore, I went to picnic." 5
 (i) Prove that the well formed formula $(p \rightarrow (q \rightarrow r)) \rightarrow ((p \rightarrow q) \rightarrow (p \rightarrow r))$ is a theorem in Propositional Logic. 5
 (j) State and prove Completeness theorem in Propositional Logic. 5

4. Answer *any four* questions :

(a) Consider the predicate symbols

$P(x)$: x is a student

$Q(x)$: x is clever

$R(x)$: x is successful.

Express the following into first-order language

(i) Some students are clever.

(ii) Some students are not successful.

2+3

(b) Over the Universe of animals, let $A(x)$: x is a whale, $B(x)$: x is a fish, $C(x)$: x lives in water.

Translate the following in your own words :

(i) $\exists x(\sim C(x))$

(ii) $\exists x(B(x) \wedge \sim A(x))$

(iii) $\forall x((A(x) \wedge C(x)) \rightarrow B(x)).$

1+2+2

(c) (i) Find the truth value of $\forall x P(x)$, where $P(x)$ is the statement " $x^2 < 50$ " and the domain set $\{1, 2, 3, 4, 5\}$.

(ii) Let $P(x, y)$ state that " $x^2 > y + 2$ " where the domain is the set $S = \{1, 2, 3\}$. Find the truth value of the quantifier $\exists x \forall y P(x, y)$.

2+3

(d) Convert the following first-order formula into Prenex Normal Form :

$$\forall x(\exists y(P(x, y) \rightarrow \forall z Q(y, z))).$$

Explain each step in your conversion process.

5

(e) (i) Define free and bound variable in a well-formed formula (*wff*).

(ii) Find the free and bound variable in the following *wff* :

$$\forall z(P(z) \rightarrow \exists y(\exists x Q(x, y, z) \vee R(x, y, z))).$$

2+3

(f) Determine whether the following *wff* is logically valid or not :

$$\forall x(P(x) \vee Q(x)) \rightarrow \forall x P(x) \vee \exists x Q(x).$$

5

(g) Define first-order theory with equality. Using this develop (i) Ring theory, (ii) Field theory.

1+2+2

SEC-B-2.1**(Scientific Computing with SageMath)****Full Marks : 80***Notations and symbols have their usual meaning.**Throughout the question paper, sage code means code in SageMath.*

1. Choose the correct alternative with proper justification wherever it is applicable : 2×10
- (a) Which command in SageMath is used to compute the square root of 16?
- (i) `sqrt(16)` (ii) `squareroot(16)`
 (iii) `root(16)` (iv) `square_root(16)`
- (b) How would you compute the natural logarithm of 20 in SageMath?
- (i) `log(20)` (ii) `ln(20)`
 (iii) `log(20, e)` (iv) `natural_log(20)`
- (c) Which of the following Sage command will correctly compute the definite integral of $f(x) = x^2$ from 0 to 3?
- (i) `integrate(x^2, (0, 3))` (ii) `integral(x^2, (x, 0, 3))`
 (iii) `definite_integral(x^2, (x, 0, 3))` (iv) `int(x^2, (x, 0, 3))`
- (d) How do you create a 3×3 identity matrix in SageMath?
- (i) `identity_matrix(3)` (ii) `eye(3)`
 (iii) `id_matrix(3)` (iv) `identity(3)`
- (e) What will be the output of the following sage code?
- ```
f(x) = 3*x + 5
g(x) = x^3 + 1
h(x) = f(g(x))
print(h(1))
```
- (i) 11 (ii) 9  
 (iii) 153 (iv) 8
- (f) The output of the sage code `4*(10//4) + 10% 4 == 9, 3*3<3` is
- (i) (True, False) (ii) (True, True)  
 (iii) (False, True) (iv) (False, False)

**Please Turn Over**

(g) What will be the output of the following code?

```
points = [(1,2), (3,4), (5,6), (7,8)]
```

```
print (points[1])
```

(i) 1

(ii) (3,4)

(iii) (1,2)

(iv) (7,8)

(h) What will be the output of the sage command  $21//7\%2/3//2+5^3$  ?

(i) 125.17

(ii) 751/6

(iii) 125

(iv) 125.16666666666667

(i) What will be the output of the sage code `print(mod(17,5))`?

(i) 2

(ii) 3

(iii) 4

(iv) 1

(j) Which will be the output of the following sage code?

```
sum = 0
for i in range(10,1,-2):
 sum = sum+10%i
print(sum)
```

(i) 13

(ii) 12

(iii) 6

(iv) 8.

### Section-I

Answer *any one* question.

2. (a) Write sage commands to compute  $\frac{[2 + \sqrt[5]{33}]^7}{0.05^3} + 312$ .

(b) Write the sage code to find the number of digits in the number  $22^{22}$ .

(c) Write the sage code to find the number of zeroes in 2024!

(d) Write sage commands to find the factors and divisors of the number  $2^{32} - 1$ .

$2+2+2+(2+2)$

3. (a) Use sage code to determine whether  $2^{2015} - 1$  is prime or not.

(b) Write the sage commands to calculate the expression  $500 \frac{[1 - (1 + 0.05)^{-30}]}{0.05}$ .

(c) Write a sage code to round off the value of  $\pi$  after three decimal spaces.

(d) Write sage code to find the value of  $\sin 45^\circ$  in decimal.

(e) Use sage code to print the decimal representation of the golden ratio up to 10 digits.

2+2+2+2+2

### Section-II

Answer *any one* question.

4. (a) Write sage code to plot the graph of the curve  $f(x) = \sin x + \cos 2x$ ,  $x \in [0, 2\pi]$ , its tangent at  $x = \frac{\pi}{2}$  and a big dot of size 40 at that point.

(b) Write sage code to plot the following function in parametric form :

$$\begin{cases} x = \sin 3t \\ y = \cos(t + \sin 3t) \end{cases}, t \in [0, 2\pi].$$

(2+2+2)+4

5. (a) Write sage code to plot the graph of the following function :

$$f(x) = \begin{cases} e^{2x+3}, & -1 \leq x < 0 \\ \log_e(x+1), & 0 \leq x \leq 2 \end{cases}$$

(b) Plot the function  $f_n(x) = \sin^n(x)$  using sage in the interval  $[0, \pi]$  for  $n = 1, 2, 3$  in single graph with same axes. Use different colors and different line styles for different lines.

(c) Write sage code to plot the polar curve  $r = 2(1 + \cos \theta)$ ,  $0 \leq \theta \leq 2\pi$ .

4+3+3

### Section-III

Answer *any one* question.

6. (a) Write sage codes to find the first three derivatives of  $f(x) = e^x \cos x$  and to plot them together along with the graph of  $f(x)$ . Use different colours for different curves.

(b) Print the value of the integral  $\int_0^\infty \frac{\sin^3(x) \cos^2(x)}{x^2} dx$  using SageMath.

(c) Evaluate the integral  $\int_0^\pi \frac{\cosh(x)}{x^2 + 4} dx$  using SageMath.

(2+2+2)+2+2

7. (a) Define a function  $f(x) = \sin(x^2) + \ln(x)$  in SageMath. Write the SageMath code to find first derivative of  $f(x)$  at  $x = 2$ , using definition of derivative.

(b) Write sage codes to evaluate :

(i)  $\int \cosh^2 x \, dx$

(ii)  $\int_0^{\infty} \frac{\tan x}{x} \, dx$

(iii)  $\int_{-1}^1 x^2 \sin x \, dx.$

4+(2+2+2)

#### Section-IV

Answer *any one* question.

8. Let  $A = \begin{pmatrix} 9 & 8 & 7 \\ 6 & 5 & 4 \\ 3 & 2 & 1 \end{pmatrix}, B = \begin{pmatrix} 1 & 3 & 5 \\ 5 & 7 & 6 \\ 5 & 4 & 5 \end{pmatrix}$ . Write sage codes to do the following :

- (a) Display  $A$  and  $B$ .  
 (b) Find  $AB^T$ .  
 (c) Find  $\det B$  and  $B^{-1}$ .  
 (d) What will be the output of the following sage codes?

(i)  $A[1, 1]$

(ii)  $B[2, 1]$ .

- (e) Write a sage code to solve the following system of equations :

$$5x - 2y + z = 11$$

$$3x + 8y - z = 17$$

$$2x + 5y - 9z = 7$$

2+1+(1+1)+(1+1)+3

9. (a) Write sage code to display a  $4 \times 4$  matrix  $A$ , where Rows are provided below :  
 $[8, 4, 2, 1], [4, 7, 3, 2], [2, 3, 6, 3], [1, 2, 3, 9]$ .  
 (b) Write sage codes to find the sum of all elements of  $A$ .  
 (c) Write sage codes to find  $A - A'$  and  $A^{-1}$ .

- (d) Write sage command to determine the eigenvalues of  $A$ .  
 (e) Write a sage code to solve the following system of equations :

$$x + y + 2z = 3$$

$$x - 2y + 5z = 17$$

$$x + 4y = 15$$

$$2+1+(1+1)+2+3$$

### Section-V

Answer *any one* question.

10. (a) Write sage commands to solve the following initial value problem :  $\frac{dy}{dx} = 1 + x^2 y$ ,  $y(0) = 1$ .

- (b) Write sage commands to solve the following boundary value problem and plot the solution in  $[0, e]$

$$\frac{d^2 y}{dx^2} + 3 \frac{dy}{dx} + y = x^2, y(0) = 1, y(e) = \pi.$$

- (c) Write the sage code to solve the equation :  $x^3 + 2x - 6 = 0$ .

$$3+(3+2)+2$$

11. (a) Consider the following boundary value problem :

$$y'' + 4y = \sinh(x),$$

$$y(0) = 0, y(\pi) = 0$$

Write sage code to solve this boundary value problem and plot the solution  $y(x)$  from  $x = 0$  to  $\pi$ .

- (b) Consider the following initial value problem :

$$\frac{dy}{dx} = \frac{(2x+3)}{(x^2+1)} - 2y \ln(x), y(1) = 0.$$

Use SageMath to solve this initial value problem.

- (c) Write sage code to solve the following nonlinear equation :

$$2x^2 + 3 \sinh(x) - 2 \log(x) = 5.$$

$$(3+2)+3+2$$

### Section-VI

Answer *any one* question.

12. (a) Write a sage program to find  $\sum_{n=1}^{100} n(n+2)$ .

- (b) Without using inbuilt function, write sage code that computes the product of all prime numbers less than 100.

Please Turn Over

(c) Write a program in sage to evaluate the function at  $x = 0.5$ .

$$f(x) = \begin{cases} \sqrt{x^2 + |x|}, & -1 \leq x < 0 \\ \sin(3x + 5), & 0 \leq x \leq 1 \\ 2 \cosh x, & 1 < x \leq 2 \end{cases}$$

3+3+4

13. (a) Write a program in sage to find the sum of the following series for any finite  $n$  :

$$2.3 + 4.5 + 6.7 + \cdots + 2n.(2n + 1).$$

(b) Without using inbuilt function, write a program in sage to find the GCD of two given numbers.

(c) Without using inbuilt function, write a program to find all the composite numbers between 10 and 50.

3+3+4

**SEC-B-2.2**  
**(Scientific Computing with R)**

**Full Marks : 80**

Notations and symbols have their usual meanings.

1. Choose the correct option and justify your answer :

2×10

(a) What is the meaning of “←” ?

- |               |                 |
|---------------|-----------------|
| (i) Functions | (ii) Assignment |
| (iii) Loops   | (iv) Addition.  |

(b) What is the output of `trunc(-9.8)` in R?

- |          |          |
|----------|----------|
| (i) -9   | (ii) -10 |
| (iii) 10 | (iv) 9.  |

(c) What should we type to find the value of  $\int_0^2 (x^5 + 3x^2) dx$  in R?

- |                                                                   |                                                                        |
|-------------------------------------------------------------------|------------------------------------------------------------------------|
| (i) <code>f ← function (x) x^5 + 3*x^2 integrate (f, 0, 2)</code> | (ii) <code>f ← function (x) (x^5 + 3*x^2) integrate (f, 0 to 2)</code> |
| (iii) <code>f ← x^3 + 3*x^2 integrate (f, 0, 2)</code>            | (iv) <code>f ← x^3 + 3*x^2 integrate (f, 0, 2).</code>                 |

(d) How would you subset the second row of matrix `V ← matrix (3 : 11, nrow = 3, ncol = 3)?`

- |                               |                               |
|-------------------------------|-------------------------------|
| (i) <code>V [nrow = 2]</code> | (ii) <code>V [ 2 ]</code>     |
| (iii) <code>V [, 2]</code>    | (iv) <code>V [ 2 , ]</code> . |

(e) Which of the following is the correct output of `x [y [6]]` and `y [x [3]]` respectively of the following vectors :

`x = C (1, 4, 9, 3, 15, 22);`

`y = C (23, 32, 54, 12, 8, 4)`

- |                |                |
|----------------|----------------|
| (i) 22 and 9   | (ii) NA and 9  |
| (iii) 3 and NA | (iv) 9 and 22. |

(f) What will be the output of the following R code?

`> x ← 1 : 4`

`> y ← 6 : 9`

`> z ← x + y`

`> z.`

**Please Turn Over**

- (i) 79 11 13  
(iii) 97 11 13
- (ii) 79 11 13 14  
(iv) NULL.
- (g) Which function change the line width in plot ( ) function?  
(i) lty ( )  
(iii) lwd ( )
- (ii) pch ( )  
(iv) type ( ).
- (h) Which one of the following is the correct command to obtain the multiplication of two square matrices  $x$  and  $y$  of the same order?  
(i)  $x * y$   
(iii)  $x \% * \% y$
- (ii)  $x \% * y$   
(iv)  $x \% \% * \% \% y$ .
- (i) Which function draws an axis on the current plot?  
(i) axis ( )  
(iii) mar ( )
- (ii) par ( )  
(iv) abline ( ).
- (j) What is the in-built derivative function in R?  
(i) D ( )  
(iii) Diff ( )
- (ii) DD ( )  
(iv) diff ( ).

### Section - I

Answer *any one* question.

2. (a) Find the outputs of the following R commands :

- (i) C (1, FALSE)  
(ii) C ("a", 1)  
(iii) C (list (1), "a").
- (b)  $x = 6 : 4$ ;  $x = x^3 + 2$ ;  $x$
- (c)  $A = \text{matrix} (C (1, 2, 3, 4), nrow = 2)$ ;  
 $B = \text{matrix} (C (4, 3, 2, 1), nrow = 2)$ ;  
 $X = A \% * \% B$ ;  
 $X$

3+3+4

3. (a) What are the outputs of following codes?

- (i)  $x \leftarrow \text{seq} (2, 10, \text{by} = 4) == C (2, 7, 10)$ ;  $x$   
(ii)  $y \leftarrow (2 : 10)$ ;  $y \leftarrow y [2 * 2.5]$ ;  $y$   
(iii)  $z \leftarrow 0 : 5$ ;  $\text{vector} (z)$ ;  $z [5]$ .

(13)

(b) What are the outputs of the following codes?

$i = 5; j = 6;$

$k = i + j; \text{ print } (k)$

$j = j + 2; k = k + j; \text{ print } (k)$

$k = k * k; \text{ print } (k).$

(c) What are the outputs of the following codes?

(i)  $x \leftarrow \text{diag}(3, nrow = 2, ncol = 2); x$

(ii)  $y \leftarrow \text{diag}(3); y.$

3+3+(2+2)

### Section - II

Answer *any one* question.

4. (a) Write a R code to plot graph of the function  $g(x) = 2 \log_e x - e^{x^3} + \sin^{-1}x$  in the range (1, 6) with green colour and with proper x-label and y-label.

(b) Write a R code for plotting the graph of polar curve  $r = 1 + 3\sin\theta, 0 \leq \theta \leq 2\pi$  with blue colour.

5. Write R code to plot the graphs of the following functions in one plot :

$f(x), f'(x)$  and  $f''(x)$ , where  $f(x) = x^2 + 2$  defined in  $(-2, 2)$ .

4+3+3

### Section - III

Answer *any one* question.

6. (a) Develop a R program to calculate higher order derivatives of order  $n$  of any given expression.

(b) Find the second order derivatives of the following functions :

(i)  $3x^4 - 2x^3 + 4$

(ii)  $5 e^{x \sin x}.$

6+(2+2)

7. (a) Write R commands to find the values of the following integrals :

$$(i) \int_{-\infty}^{\infty} e^{x^2} dx \quad (ii) \int_{-\pi}^{\pi} \sin(5x) dx \quad (iii) \int_{-\pi/4}^{\pi/4} e^x \tan(x) dx.$$

(b) Find a minimizer of the function  $f(x) = (x - 3)^4 + 7(x - 2)^2 + x.$

(2+2+2)+4

### Section - IV

Answer *any one* question.

8. (a) Write a R program to find the sum of the series :  $1^2 + 2^2 + 3^2 + \dots + N^2$ .  
(b) Write a function in R to calculate weighted mean of  $k$  given numbers  $n_1, n_2, \dots, n_k$  with the weights  $w_1, w_2, \dots, w_k$  5+5
9. (a) Write a R program to find gcd of two given numbers.  
(b) Write a R program to find the real roots of the equation  $ax^2 + bx + c = 0$ , where  $a, b$  and  $c$  are real constants. 5+5

### Section - V

Answer *any one* question.

10. (a) Consider the following R code :

$E \leftarrow \text{matrix}(C(5, 2, 3, 6, 2, 7), \text{nrow} = 2)$ . The output is obtained as  $\begin{pmatrix} 5 & 2 & 3 \\ 6 & 2 & 7 \end{pmatrix}$ .

Is the statement correct? If yes, justify, if not correct the code to get this output.

- (b) Define a  $3 \times 3$  matrix and find out its transpose without using the function  $t()$ .  
(c) Suppose,  $x \leftarrow C(2, 3, 5)$  and  $y \leftarrow C(0, 3, 6)$ . Write down the output of  $x*y$  and explain. (1+2)+4+3
11. (a) Solve the following system of equations by writing a R program :  
$$\begin{aligned} 2x + y + z &= 1 \\ x + y - 8z &= 3 \\ 3x - 4y + 5z &= -6 \end{aligned}$$
  
(b) Write a R program to find the roots of the polynomial equation  $4x^4 + 3x^3 + x + 5 = 0$  and plot them on the graph along with the graph of the curve with blue colour. 5+5

### Section - VI

Answer *any one* question.

12. (a) Write a R code to solve the following differential equation with the boundary conditions :

$$x_0 = 0, y(x_0) = 0, x_1 = \frac{\pi}{4}, y(x_1) = 3$$

$$\frac{d^2y}{dx^2} - y = 0$$

( 15 )

*B(4th Sm.)-Mathematics-H/SEC-B-1,  
SEC-B-2.1 & SEC-B-2.2/CBCS*

- (b) Write a R program to find the prime numbers between any two given natural numbers. 5+5
13. (a) Write a R program to convert a decimal number into binary number using recursive function.
- (b) Write a program in R to find the greatest of three given integers  $A$ ,  $B$ ,  $C$ . 5+5
-