# VIKRAMA SIMHAPURI UNIVERSITY::NELLORE

**Common Framework of CBCS for Colleges in Andhra Pradesh**

(A.P. State of Council of Higher Education)

# B.A./ B.Sc. Mathematics Core Syllabus under CBCS

(*with effect from the Academic Year 2020-21*)

# Course Structure

## Structure of Mathematics Core Syllabus under CBCS

| Course | Subject | Hrs. | Credits | IA | ES | Total |
|---|---|---|---|---|---|---|
| SEMESTER – I PAPER - I | Differential Equations & Differential Equations Problem Solving Sessions | 6 | 5 | 25 | 75 | 100 |
| SEMESTER – II PAPER - II | Three dimensional analytical Solid geometry & Three dimensional analytical Solid Geometry Problem Solving Sessions | 6 | 5 | 25 | 75 | 100 |
| SEMESTER – III PAPER - III | Abstract Algebra & Abstract Algebra Problem Solving Sessions | 6 | 5 | 25 | 75 | 100 |
| SEMESTER – IV PAPER - IV | Real Analysis & Real Analysis Problem Solving Sessions | 6 | 5 | 25 | 75 | 100 |
| SEMESTER – IV PAPER - V | Linear Algebra & Linear Algebra Problem Solving Sessions | 6 | 5 | 25 | 75 | 100 |

**SEMESTER-I, PAPER-I**

**CBCS/ SEMESTER SYSTEM**

**B.A./B.Sc. MATHEMATICS (w.e.f. 2020-21 Admitted Batch)**

**DIFFERENTIAL EQUATIONS**

**SYLLABUS (75 Hours)**

**Course Outcomes:**

After successful completion of this course, the student will be able to;

1. Solve linear differential equations
2. Convert non exact homogeneous equations to exact differential equations by using integrating factors.
3. Know the methods of finding solutions of differential equations of the first order but not of the first degree.
4. Solve higher-order linear differential equations, both homogeneous and non homogeneous, with constant coefficients.
5. Understand the concept and apply appropriate methods for solving differential equations.

**Course Syllabus:**

**UNIT – I (12 Hours)**

**Differential Equations of first order and first degree:**

Linear Differential Equations; Differential equations reducible to linear form; Exact differential equations; Integrating factors.

**UNIT – II (12 Hours)**

**Orthogonal Trajectories:**(Cartesian and polar forms)

**Differential Equations of first order but not of the first degree:**

Equations solvable for *p*, Clairaut's Equation.

**UNIT – III (12 Hours)**

**Higher order linear differential equations-I:**

Solution of homogeneous linear differential equations of order n with constant coefficients; Solution of the non-homogeneous linear differential equations with constant coefficients by means of polynomial operators. General Solution of f(D)y=0.

General Solution of $f(D)y = Q$ when Q is function of $x$,

$\frac{1}{f(D)}$ is expressed as partial fractions.

P.I. of f(D)y = Q when Q= $be^{ax}$

P.I. of f(D)y = Q when Q is bsinax or b cos ax.

## UNIT – IV (12 Hours)

**Higher order linear differential equations-II:**

Solution of the non-homogeneous linear differential equations with constant coefficients.

P.I. of f(D)y = Q when Q= $bx^k$

P.I. of f(D)y = Q when Q= $e^{ax}V$ , where V is a function of x.

P.I. of f(D)y = Q when Q= xV , where V is a function of x.

P.I. of f(D)y = Q when Q= $x^mV$ , where V is a function of x.

## UNIT –V (12 Hours)

**Higher order linear differential equations-III :**

Method of variation of parameters(with out non constant coefficients), The Cauchy-Euler Equation, Legendre's linear equations.

**Co-Curricular Activities(15 Hours)**

Seminar/ Quiz/ Assignments/ Applications of Differential Equations to Real life Problem /Problem Solving.

**Text Book :**

Differential Equations and Their Applications by Zafar Ahsan, published by Prentice-Hall of India Pvt. Ltd, New Delhi-Second edition.

**Reference Books :**

1. A text book of Mathematics for B.A/B.Sc, Vol 1, by N. Krishna Murthy & others, published by S.Chand & Company, New Delhi.
2. Ordinary and Partial Differential Equations by Dr. M.D,Raisinghania, published by S. Chand & Company, New Delhi.
3. Differential Equations with applications and programs – S. Balachandra Rao & HR Anuradha- Universities Press.
4. Differential Equations -Srinivas Vangala & Madhu Rajesh, published by Spectrum University Press.

## BLUE PRINT OF QUESTION PAPER

**(INSTRUCTIONS TO PAPER SETTER)**

## B.A./B.Sc. MATHEMATICS SEMESTER-I,PAPER-I

## DIFFERENTIAL EQUATIONS

*NOTE: - Paper Setter Must select TWO Short Questions and TWO Easy Questions from Each Unit as Follows*

| UNIT | TOPICS | 5 MARKS QUESTIONS | 10 MARKS QUESTIONS |
|---|---|---|---|
| UNIT - I | Linear Equations | 1(Problem) | - |
| | Bernoulli's Equations | - | 1(Problem) |
| | Integrating Factor | 1(Problem) | - |
| | Exact Equations | - | 1(Problem) |
| UNIT - II | Orthogonal Trajectories | 1(Problem) | 1(Problem) |
| | Solvable for p<br>Clairaut's equation | 1(Problem) | 1(Problem) |
| UNIT - III | General Solution of f(D)y=0 | 1(Problem) | - |
| | f(D)y = Q when Q= $be^{ax}$ | 1(Problem) | 1(Problem) |
| | f(D)y = Q when Q is b sin ax or b cos ax | - | 1(Problem) |
| UNIT - IV | f(D)y = Q when Q= $bx^k$ | 1(Problem) | - |
| | f(D)y = Q when Q= $e^{ax}$ V | 1(Problem) | 1(Problem) |
| | f(D)y = Q when Q= xV | - | 1(Problem) |
| UNIT - V | Variation of Parameters (without non constant coefficient equations) | - | 1(Problem) |
| | Cauchy-Euler Equations | 2(Problems) | - |
| | Leg ender's Equations | - | 1(Problem) |

**B.A./B.Sc. FIRST YEAR MATHEMATICS**
**SEMESTER-I,PAPER-I**
**MODEL QUESTION PAPER-1**
**DIFFERENTIAL EQUATIONS**

*TIME : 3 Hours* *Max.Marks : 75*

## PART – A

***I. Answer any FIVE Questions :*** ***5 X 5 = 25M***

**1.** Solve $\frac{dy}{dx} + 2xy = e^{-x^2}$ .

**2.** Find Integrating factor of $\left(xy^3 + y\right)dx + 2\left(x^2y^2 + x + y^4\right)dy = 0$.

**3.** Find the Orthogonal trajectories of the family of curves $x^{2/3} + y^{2/3} = a^{2/3}$ where'a' is a parameter.

**4.** Solve $p^2 - 5p + 6 = 0$

**5.** Solve $\left(D^4 + 8D^2 + 16\right)y = 0$.

**6.** Solve $\left(D^2 - 5D + 6\right)y = e^{4x}$.

**7.** Solve $\left(D^2 + 4\right)y = x\sin x$.

**8.** Solve $\left(D^2 - 4D + 4\right)y = x^3$.

**9.** Solve $\left(x^2D^2 - xD + 1\right)y = \log x$.

**10.** Find the complementary function $y_c$ of $\left(x^2D^2 - 3xD + 5\right)y = x^2\sin\left(\log x\right)$.

## PART - B

***Answer any FIVE of the following Questions.*** ***5 × 10 =50 Marks***

**11.** Solve $\frac{dy}{dx}\left(x^2y^3 + x^4\right) = 1$.

**12.** Solve $x^2ydx - \left(x^3 + y^3\right)dy = 0$.

**13.** Find the orthogonal Trajectories of the families of Curves $r = \frac{2a}{1+\cos\theta}$ when "a" is Parameter.

***14.*** Solve $(py + x)(px - y) = 2p$

**15.** Solve $\left(D^3 + 1\right)y = \left(e^x + 1\right)^2$.

**16.** Solve $\left(D^2 - 3D + 2\right)y = \cos 3x.\cos 2x$.

**17.** Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 13y = 8e^{3x}\sin 2x$.

**18.** Solve $\left(D^2 + 1\right)y = x^2e^{2x} + x\cos x$.

**19.** Solve by the method of variation of parameters $\left(D^2+1\right)y=\cos ec x$.

**20.** Solve $\left[(1+x)^2 D^2+(1+x)D+1\right]y = 4\cos\log(1+x)$.

**SEMSTER-II, PAPER-II**

**CBCS/ SEMESTER SYSTEM (w.e.f. 2020-21 Admitted Batch)**

**B.A./B.Sc. MATHEMATICS**

# THREE DIMENSIONAL ANALYTICAL SOLID GEOMETRY

## Syllabus (75 Hours)

**Course Outcomes:**

After successful completion of this course, the student will be able to;

1.Get the knowledge of planes.

2.Basic idea of lines, sphere and cones.

**3.**Understand the properties of planes, lines, spheres and cones.

4.Express the problems geometrically and then to get the solution.

**Course Syllabus:**

### UNIT – I (12 Hours)

**The Plane:**

Equation of plane in terms of its intercepts on the axis, Equations of the plane through the given points, Length of the perpendicular from a given point to a given plane, System of planes, Bisectors of angles between two planes, Combined equation of two planes.

### UNIT – II (12 hrs)

**The Line:**

Equation of a line; Angle between a line and a plane; The condition that a given line may lie in a given plane; The condition that two given lines are coplanar; Number of arbitrary constants in the equations of straight line; Sets of conditions which determine a line; The shortest distance between two lines; The length and equations of the line of shortest distance between two straight lines.

### UNIT – III (12 hrs)

**The Sphere-I:**

Definition and equation of the sphere; Equation of the sphere through four given points; Plane sections of a sphere; Intersection of two spheres; Equation of a circle; Sphere through a given circle; Intersection of a sphere and a line, Power of a point.

### UNIT – IV (12 hrs)

**The Sphere-II:**

Tangent plane; Plane of contact, Angle of intersection of two spheres; Conditions for two spheres to be orthogonal; Radical plane; Coaxial system of spheres; Simplified from of the equation of two spheres.

## **UNIT – V (12 hrs)**

**The Cone:**

Definitions of a cone; vertex; guiding curve; generators; Equation of the cone with a given vertex and guiding curve; equations of cones with vertex at origin are homogenous; Condition that the general equation of the second degree should represent a cone, Enveloping cone of a sphere; Vertex of a cone; right circular cone: equation of the right circular cone with a given vertex, axis and semi vertical angle.

**Co-Curricular Activities(15 Hours)**

Seminar/ Quiz/ Assignments/Three dimensional analytical Solid geometry and its applications/ Problem Solving.

**Note:** Concentrate Problematic Parts in all above Units

**Text Book :**

Analytical Solid Geometry by Shanti Narayan and P.K. Mittal, published by S. Chand & Company Ltd. 7th Edition.

**Reference Books :**


1. A text book of Mathematics for BA/B.Sc Vol 1, by V Krishna Murthy & Others, published by S. Chand & Company, New Delhi.
2. A text Book of Analytical Geometry of Three Dimensions, by P.K. Jain and Khaleel Ahmed, published by Wiley Eastern Ltd., 1999.
3. Co-ordinate Geometry of two and three dimensions by P. Balasubrahmanyam, K.Y. Subrahmanyam, G.R. Venkataraman published by Tata-MC Gran-Hill Publishers Company Ltd., New Delhi.
4. Solid Geometry by B.Rama Bhupal Reddy, published by Spectrum University Press.

## BLUE PRINT OF QUESTION PAPER

**(INSTRUCTIONS TO PAPER SETTER)**

## B.A./B.Sc. MATHEMATICS SEMESTER-II,PAPER-II

## SOLID GEOMETRY

***NOTE: - Paper Setter Must select TWO Short Questions and TWO Easy Questions from Each Unit as Follows***

| UNIT | TOPICS | 5 MARKS QUESTIONS | 10 MARKS QUESTIONS |
|---|---|---|---|
| **UNIT - I** | Planes Introductions | 2 (Problems) | - |
| | System of Planes & Bisecting Planes | - | 1(Problem) |
| | Pair of Planes | - | 1(Problem) |
| **UNIT - II** | Straight Lines First Part | 2 (Problems) | - |
| | Image & coplanar Lines | - | 1(Problem) |
| | Shortest Distance | - | 1(Problem) |
| **UNIT - III** | Sphere Introduction | 1(Problem) | - |
| | Plane Section of a Sphere | 1(Problem) | 1(Problem) |
| | Great Circle & Small Circle | - | 1(Problem) |
| **UNIT - IV** | Tangent Plane | 1(Problem) | - |
| | Angle of Intersection of Two Spheres & Orthogonal Spheres | 1(Problem) | 1(Problem) |
| | Limiting Points | - | 1(Problem) |
| **UNIT - V** | Equation of a Cone<br>Enveloping Cone | 2(Problems) | - |
| | Vertex of a Cone<br>Right Circular Cone | - | 2(Problems) |

**B.A./B.Sc. FIRST YEAR MATHEMATICS**

**SEMESTER-II,PAPER-II**

**MODEL QUESTION PAPER**

**SOLID GEOMETRY**

*Time: 3 Hours* *Max. Marks : 75*

## PART-A

***I. Answer any FIVE of the following Questions : 5 X 5= 25 Marks***

**1.** Find the Equation of the plane through the point (-1,3,2) and perpendicular to the planes $x+2y+2z=5$ and $3x+3y+2z=8$.

**2.** Find the angles between the planes $x+2y+3z=5,\ 3x+3y+z=9$.

**3.** Show that the line $\frac{x+1}{-1}=\frac{y+2}{3}=\frac{z+5}{5}$ lies in the plane x+2y-z=0.

**4.** Find the point of intersection with the plane $3x+4y+5z=5$ and the line $\frac{x+1}{1}=\frac{y+3}{3}=\frac{z-2}{2}$.

**5.** Find the centre and radius of the sphere $2x^2+2y^2+2z^2-2x+4y+2z+1=0$.

**6.** Find the equation of the sphere through the circle $x^2+y^2+z^2=9$, $2x+3y+4z=5$ and the point (1,2,3)

**7.** Find the equation of the tangent plane to the sphere $3x^2+3y^2+3z^2-2x-3y-4z=22=0$ at the point (1,2,3)

**8.** Show that the spheres are orthogonal $x^2+y^2+z^2+6y+2z+8=0;$ $x^2+y^2+z^2+6x+8y+4z+20=0$.

**9.** Find the enveloping cone of the sphere $x^2+y^2+z^2+2x-2y-2=0$ with its vertex at $(1,1,1)$

**10.** Find the equation of the cone with vertex (1,1,0) and guiding curve $y=0, x^2+z^2=4$.

## ***PART - B***

***Answer any FIVE of the following Questions.*** ***$5 \times 10 = 50$ Marks***

## ***SECTION – A***

**11.** Find the equation of the plane passing through the intersection of the planes $x+2y+3z=4, 2x+y-z+5=0$ and perpendicular to the plane $6z+5x+3y+8=0$.

**12.** Prove that Equation $2x^2-6y^2-12z^2+18yz+2zx+xy=0$ represents a pair of planes and find the angle between them.

**13.** Find the image of the point (2,-1,3) in the plane $3x-2y+z=9$.

**14.** Find the length and equation to the line of shortest distance between the lines $\frac{x-2}{3}=\frac{y-3}{4}=\frac{z-1}{2}, \quad \frac{x-4}{4}=\frac{y-5}{5}=\frac{z-2}{3}$.

**15.** Find the equation of the sphere through the circle $x^2+y^2+z^2+2x+3y+6=0$, $x-2y+4z-9=0$ and the centre of the sphere $x^2+y^2+z^2-2x+4y-6z+5=0$.

**16.** Find whether the following circle is a great circle or small circle $x^2+y^2+z^2=4x+6y-8z+4=0, \quad x+y+z=3$.

**17.** Find the equation of the sphere which touches the plane $3x+2y-z+2=0$ at (1,-2,1) and cuts orthogonally the sphere $x^2+y^2+z^2-4x+6y+4=0$.

**18.** Find limiting points of the co axial system of spheres $\left(x^2+y^2+z^2-20x+30y+40z+29\right)+\lambda\left(2x-3y+4z\right)=0$.

**19.** Find the equation of right circular cone whose vertex is $P(2,-3,5)$ axis PQ which makes equal angles with the axis and which passes through A(1, -2, 3).

**20.** Find the vertex of the cone $7x^2+2y^2+2z^2-10zx+10xy+26x-2y+2z-17=0$.

**SEMESTER-III, PAPER-III**

**CBCS/ SEMESTER SYSTEM (w.e.f. 2020-21 Admitted Batch)**

**B.A./B.Sc. MATHEMATICS**

## ABSTRACT ALGEBRA

**SYLLABUS (75 Hours)**

**Course Outcomes:**

After successful completion of this course, the student will be able to;

1. acquire the basic knowledge and structure of groups, subgroups and cyclic groups.
2. get the significance of the notation of a normal subgroups.
3. get the behavior of permutations and operations on them.
4. study the homomorphisms and isomorphisms with applications.
5. understand the ring theory concepts with the help of knowledge in group theory and to prove the theorems.
6. understand the applications of ring theory in various fields.

**Course Syllabus:**

### UNIT – I (12 Hours)

**GROUPS :**

Binary Operation – Algebraic structure – semi group-monoid – Group definition and elementary properties Finite and Infinite groups – examples – order of a group, Composition tables with examples.

### UNIT – II (12 Hours)

**SUBGROUPS:**

Complex Definition – Multiplication of two complexes Inverse of a complex-Subgroup definition- examples-criterion for a complex to be a subgroups. Criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups.

**Co-sets and Lagrange's Theorem:**

Cosets Definition – properties of Cosets(Statements only)–Index of a subgroups of a finite groups–Lagrange's Theorem.

### UNIT –III (12 Hours)

**NORMAL SUBGROUPS:**

Definition of normal subgroup – proper and improper normal subgroup–Hamilton group – criterion for a subgroup to be a normal subgroup – intersection of two normal subgroups.

**HOMOMORPHISM:**

Definition of homomorphism – Image of homomorphism elementary properties of homomorphism – Isomorphism – automorphism definitions –kernel of a homomorphism – fundamental theorem on Homomorphism.

## UNIT – IV (12 Hours)

### PERMUTATION GROUPS:

Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem.

## UNIT – V (12 Hours)

### RINGS:

Definition of Ring and basic properties, Boolean Rings, divisors of zero and cancellation laws Rings, Integral Domains, Division Ring and Fields, Definitions and examples only in Sub Rings, Ideals.

**Co-Curricular Activities(15 Hours)**

Seminar/ Quiz/ Assignments/ Group theory and its applications / Problem Solving.

**Text Book :**

A text book of Mathematics for B.A. / B.Sc. by B.V.S.S. SARMA and others, published by S.Chand & Company, New Delhi.

**Reference Books :**


1. Abstract Algebra by J.B. Fraleigh, Published by Narosa publishing house.
2. Modern Algebra by M.L. Khanna.
3. Rings and Linear Algebra by Pundir & Pundir, published by Pragathi Prakashan.

## BLUE PRINT OF QUESTION PAPER

**(INSTRUCTIONS TO PAPER SETTER)**

## B.A./B.Sc. MATHEMATICS SEMESTER-III,PAPER-III

## ABSTRACT ALGEBRA

***NOTE: - Paper Setter Must select TWO Short Questions and TWO Easy Questions from Each Unit as Follows***

| UNIT | TOPICS | 5 MARKS QUESTIONS | 10 MARKS QUESTIONS |
|---|---|---|---|
| **UNIT - I** | Group Definition and Elementary Properties | 1 (Theorem) | - |
| | Composition Tables | 1(Problem) | - |
| | Problems | - | 2 (Problems) |
| **UNIT - II** | Subgroups | 1 (Theorem) | 2 (Theorems) |
| | Cosets and Lagrange's theorem | 1 (Theorem) | - |
| **UNIT - III** | Normal Subgroups<br>Homomorphism | 1(Theorem)<br>1 (Theorem) | 1(Theorem)<br>1 (Theorem) |
| **UNIT - IV** | Permutation groups<br>& Cayley's Theorem | 2 (Problems) | 2 (Problems) |
| **UNIT - V** | Rings | 1(Problem)<br>1 (Theorem) | 2 (Theorems) |

**B.A./B.Sc. SECOND YEAR MATHEMATICS**

**SEMESTER-III,PAPER-III MODEL QUESTION PAPER**

**ABSTRACT ALGEBRA**

*Time: 3 Hours* *Max. Marks : 75*

## ***PART - A***

***I. Answer any FIVE of the following Questions : 5 X 5= 25 Marks***

**1.** Prove that in a group G Inverse of any Element is unique.

**2.** $G = \{1,2,3,4,5,6\}$ Prepare composition table and prove that G is a finite abelian group of order 6 with respect to $X_7$.

**3.** If H is any subgroups of G then prove that $H^{-1} = H$ .

**4.** State and prove Lagrange's theorem.

**5.** Prove that intersection of any two normal subgroup is again a normal subgroup.

**6.** Prove that the homomorphic image of a group is a group.

**7.** If $A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{pmatrix}, B = \begin{pmatrix} 1 & 2 & 3 \\ & & \end{pmatrix}$ find AB and BA.

**8.** Find the inverse of the permutation: $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 4 & 5 & 6 & 1 & 2 \end{pmatrix}$

**9.** Define Types of rings and give one example for each.

**10.** If R is a Boolean ring then prove that $a + a = 0 \forall a \in R$.

## ***PART - B***

***Answer any FIVE of the following Questions. 5 × 10 =50 Marks***

## ***SECTION - A***

**11.** Define abelian group. Prove that the set of $n^{th}$ roots of unity under multiplication form a finite abelian group.

**12.** Show that the set of all positive rational numbers form on abelian group under the composition '0' defined by $aob = \frac{ab}{2}$.

**13.** Prove that a non-empty finite subset of a group which is closed under multiplication is a subgroup of G.

**14.** Prove that the union of two subgroups of a group is a subgroup if f one is contained in the other.

**15.** A subgroup H of G is normal if and only if $xHx^{-1}=H$.

**16.** State and prove fundamental theorem on Homomorphism of Groups.

**17.** Examine the following permutation are even (or) odd

(i) $f = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 3 & 2 & 4 & 5 & 6 & 7 & 1 \end{pmatrix}$ (ii) $g = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 7 & 3 & 1 & 8 & 5 & 6 & 2 & 4 \end{pmatrix}$

**18.** Find the regular permutation group isomorphic to the multiplicative group $G = \{1, -1, i, -i\}$ where $i^2 = -1$.

**19.** Prove that a finite integral domain is a field.

**20.** State and Prove Cancellation laws on Rings.

**SEMESTER –IV – PAPER - IV**

**CBCS/ SEMESTER SYSTEM (w.e.f. 2020-21 Admitted Batch)**

**B.A./B.Sc. MATHEMATICS**

## REAL ANALYSIS

## SYLLABUS (75 Hours)

**Course Outcomes:**

After successful completion of this course, the student will be able to

1. get clear idea about the real numbers and real valued functions.
2. obtain the skills of analyzing the concepts and applying appropriate methods for testing convergence of a sequence/ series.
3. test the continuity and differentiability and Riemann integration of a function.
4. know the geometrical interpretation of mean value theorems.

**Course Syllabus:**

### UNIT – I (12 Hours)

**REAL NUMBERS:**

The algebraic and order properties of R, Absolute value and Real line, Completeness property of R, Applications of supremum property; intervals. (No question is to be set from this portion).

**Real Sequences:**

Sequences and their limits, Range and Boundedness of Sequences, Limit of a sequence and Convergent sequence. The Cauchy's criterion, properly divergent sequences, Monotone sequences, Necessary and Sufficient condition for Convergence of Monotone Sequence. (No question is to be set from this portion).

**INFINTE SERIES:**

**Series :**Introduction to series, convergence of series. Cauchy's general principle of convergence for series tests for convergence of series, Series of Non-Negative Terms.

1. P-test
2. Cauchy's $n^{th}$ root test or Root Test.
3. D'-Alemberts' Test or Ratio Test.

## UNIT – II (12 Hours)

### CONTINUITY:

**Limits :** Real valued Functions, Boundedness of a function, Limits of functions. Some extensions of the limit concept, Infinite Limits. Limits at infinity. (No question is to be set from this portion).

**Continuous functions :** Continuous functions, Combinations of continuous functions, Continuous Functions on intervals.

## UNIT – III (12 Hours)

### DIFFERENTIATION AND MEAN VALUE THEORMS :

The derivability of a function, on an interval, at a point, Derivability and continuity of a function, Graphical meaning of the Derivative, Problems on Differentiation.

## UNIT – IV (12 Hours)

### MEAN VALUE THEOREMS:

Mean value Theorems; Rolle's Theorem, Lagrange's Theorem, Cauchy's Mean value Theorem and their applications.

## UNIT – V (12 Hours)

### RIEMANN INTEGRATION:

Riemann Integral, Riemann integral functions, Darboux theorem(statement only), Necessary and sufficient condition for R – integrability, Properties of integrable functions, Fundamental theorem of integral calculus, First-Mean Value theorem.

### Co-Curricular Activities(15 Hours)

Seminar/ Quiz/ Assignments/ Real Analysis and its applications / Problem Solving.

### Text Book:

Introduction to Real Analysis by Robert G.Bartle and Donlad R. Sherbert, published by JohnWiley.

### Reference Books:

1. A Text Book of B.Sc Mathematics by B.V.S.S. Sarma and others, published by S. Chand & Company Pvt. Ltd., New Delhi.
2. Elements of Real Analysis as per UGC Syllabus by Shanthi Narayan and Dr. M.D. Raisinghania, published by S. Chand & Company Pvt. Ltd., New Delhi.

## BLUE PRINT OF QUESTION PAPER

**(INSTRUCTIONS TO PAPER SETTER)**

## B.A./B.Sc. MATHEMATICS SEMESTER-IV,PAPER-IV

## REAL ANALYSIS

*NOTE: - Paper Setter Must select TWO Short Questions and TWO Easy Questions from Each Unit as Follows*

| PAPER | TOPICS | 5 MARKS QUESTIONS | 10 MARKS QUESTIONS |
|---|---|---|---|
| **UNIT – I** | Series | 2 (Problems) | 2 (Theorem) |
| **UNIT – II** | Continuity | 2 (Problems) | 1(Problem)<br>1 (Theorem) |
| **UNIT – III** | Differentiation | 2 (Problems) | 2 (Problems) |
| **UNIT – IV** | Mean Value Theorems | 1 (Problem)<br>1 (Theorem) | 1 (Problem)<br>1 (Theorem) |
| **UNIT – V** | Riemann Integration | 1 (Problem)<br>1 (Theorem) | 2 (Theorems) |

**B.A./B.Sc. SECOND YEAR MATHEMATICS**

**SEMESTER-IV,PAPER-IV**

**MODEL QUESTION PAPER**

**REAL ANALYSIS**

*Time: 3 Hours* *Max. Marks : 75*

## PART - A

***I. Answer any FIVE of the following Questions : 5 X 5= 25 Marks***

**1.** Test for convergence $\sum \frac{1}{n^2+1}$.

**2.** State Cauchy's root test and test for convergence $\sum \left(1+\frac{1}{n}\right)^{-n^2}$.

**3.** Discuss various types of discontinuity.

**4.** Examine for continuity of a function $f(n) = |x| + (x-1)$ at x=0.

**5.** If $f(x) = \frac{x}{1+e^{\frac{1}{x}}}$ if $x \neq 0$ and $f(x) = 0$ if x=0 show that f is not derivable at x = 0.

**6.** Prove that $f(x) = x^2 \sin\left(\frac{1}{x}\right), x \neq 0$ and $f(0) = 0$ is derivable at the origin.

**7.** State cauchy's Mean value theorem.

**8.** Find 'C' of the Lagrange's mean value theorem for $f(x) = (x-1)(x-2)(x-3)$ on $[0,4]$.

**9.** If $f(x) = x^2$ on $[0,1]$ and $P = \left\{0, \frac{1}{4}, \frac{2}{4}, \frac{3}{4}, 1\right\}$ compute $L(P, f)$ and $U(P, f)$.

**10.** Prove that a constant function is Riemann integrable on $[a,b]$.

## PART - B

***Answer any FIVE of the following Questions.*** **5 × 10 =50 Marks**

**11.** State and Prove Root Test.

**12.** State and prove Ratio Test.

**13.** Discuss the continuity of $f(x) = \dfrac{x\left(e^{\frac{1}{x}} - e^{-\frac{1}{x}}\right)}{e^{\frac{1}{x}} + e^{-\frac{1}{x}}}$ for $x \neq 0$ and $f(0) = 0$ at x = 0.

**14.** If f is continuous on $[a,b]$ and $f(a), f(b)$ having opposite sign then prove that there exit $C \in (a,b) \ni f(c) = 0$.

**15.** Show that $f(x) = x\sin\left(\frac{1}{x}\right), x \neq 0, f(x) = 0$ when x=0 is continuous but not derivable at x=0.

**16.** Show that $f(x) = \dfrac{x\left(e^{\frac{1}{x}} - 1\right)}{e^{\frac{1}{x}} + 1}$ if $x \neq 0$ and $f(0) = 0$ is continuous at x=0 but not derivable at x=0.

**17.** State and prove Rolle's theorem.

**18.** Using Lagrange's theorem show that $x > \log(1+n) > \dfrac{x}{1+x}$ if $f(x) = \log(1+x)$.

**19.** If $f:[a,b] \to R$ is monotonic on $[a,b]$ then f is integrable on $[a,b]$.

**20.** If $f \in R[a,b]$ and m, M are the infimum and supremum of f on $[a,b]$, then $m(b-a) \leq \int_a^b f(x)\,dx \leq M(b-a)$.

**SEMESTER – IV, PAPER - V**

**CBCS/ SEMESTER SYSTEM (w.e.f. 2020-21 Admitted Batch)**

**B.A./B.Sc. MATHEMATICS**

**LINEAR ALGEBRA**

**SYLLABUS (75 Hours)**

**Course Outcomes:**

After successful completion of this course, the student will be able to;

1. understand the concepts of vector spaces, subspaces, basis, dimension and their properties
2. understand the concepts of linear transformations and their properties
3. apply Cayley- Hamilton theorem to problems for finding the inverse of a matrix and higher powers of matrices without using routine methods
4. learn the properties of inner product spaces and determine orthogonality in inner product spaces.

**Course Syllabus:**

**UNIT – I (12 Hours)**

**Vector Spaces-I:**

Vector Spaces, General properties of vector spaces, n-dimensional Vectors, addition and scalar multiplication of Vectors, internal and external composition, Null space, Vector subspaces, Algebra of subspaces, Linear Sum of two subspaces, linear combination of Vectors, Linear span Linear independence and Linear dependence of Vectors.

**UNIT –II (12 Hours)**

**Vector Spaces-II:**

Basis of Vector space, Finite dimensional Vector spaces, basis extension, co-ordinates, Dimension of a Vector space.

**UNIT –III (12 Hours)**

**Linear Transformations:**

Linear transformations, linear operators, Properties of L.T, sum and product of LTs, Algebra of Linear Operators, Range and null space of linear transformation, Rank and Nullity of linear transformations – Rank – Nullity Theorem.

## UNIT –IV (12 Hours)

**Matrix:**

Matrices, Elementary Properties of Matrices, Rank of Matrix, Linear Equations, Characteristic equations, Characteristic Values & Vectors of square matrix, Cayley – Hamilton Theorem(only problems).

## UNIT –V (12 Hours)

**Inner product space:**

Inner product spaces, Euclidean and unitary spaces, Norm or length of a Vector, Schwartz inequality, Triangle Inequality, Parallelogram law.

**Co-Curricular Activities(15 Hours)**

Seminar/ Quiz/ Assignments/ Linear algebra and its applications / Problem Solving.

***Reference Books :***


1. Linear Algebra by J.N. Sharma and A.R. Vasista, published by Krishna Prakashan Mandir, Meerut-250002.
2. Linear Algebra by Kenneth Hoffman and Ray Kunze, published by Pearson Education (low priced edition), New Delhi.
3. Linear Algebra by Stephen H. Friedberg et al published by Prentice Hall of India Pvt. Ltd. $4^{th}$ Edition 2007.

**BLUE PRINT OF QUESTION PAPER**

**(INSTRUCTIONS TO PAPER SETTER)**

**B.A./B.Sc. MATHEMATICS SEMESTER-IV, PAPER-V**

## LINEAR ALGEBRA

***NOTE: - Paper Setter Must select TWO Short Questions and TWO Easy Questions from Each Unit as Follows***

| PAPER | TOPICS | 5 MARKS QUESTIONS | 10 MARKS QUESTIONS |
|---|---|---|---|
| **UNIT – I** | Subspace | 1 (Theorem) | 1 (Theorem) |
| | Linear Combination, Linear dependent and Independent | 1 (Problem) | 1 (Theorem) |
| **UNIT – II** | Basis and f.d.v.s | 1 (Problem)<br>1 (Theorem) | 1 (Problem)<br>1 (Theorem) |
| **UNIT – III** | Linear Transformation | 2 (Problems) | - |
| | Range, Null Space, Rank | - | 1 (Theorem)<br>1 (Problem) |
| **UNIT – IV** | Rank of a Matrix<br>Method of consistency | 2 (Problems) | - |
| | Eigen Values and Vectors<br>Cayley-Hamilton theorem(only problems) | - | 1 (Problem)<br>1 (Problem) |
| **UNIT – V** | Inner Product Space | 1 (Problem)<br>1 (Theorem) | 2 (Theorems) |

**B.A./B.Sc. THIRD YEAR MATHEMATICS SYLLABUS**

**SEMESTER-IV,PAPER-V**

**MODEL QUESTION PAPER**

**<u>LINEAR ALGEBRA</u>**

***Time: 3 Hours*** ***Max. Marks : 75***

## ***<u>PART - A</u>***

***I. Answer any <u>FIVE</u> of the following Questions :*** ***5 X 5= 25 Marks***

**1.** Prove that intersection of two subspaces is again a subspace.

**2.** Show that the system of vector $(1,3,2),(1,-7,-8),(2,1,-1)$ of $V_3(R)$ is Linearly dependent.

**3.** State and prove "Invariance theorem".

**4.** Show that the vectors $(1,1,2),(1,2,5),(5,3,4)$ of $R^3(R)$ do not form a basis set of $R^3(R)$.

**5.** Show that the mapping $T:V_3(R)\rightarrow V_2(R)$ is defined by $T:(x,y,z)=(x-y,x-z)$ is a Linear Transformation.

***6.*** $T:V_3(R)\rightarrow V_2(R)$ and $H:V_3(R)\rightarrow V_2(R)$ be two Linear Transformations $T(x,y,z)=(x-y,y+z)$ and $H(x,y,z)=(2x,y-3)$ Find (i) H+T (ii) aH.

**7.** Obtain the rank of the matrix $A=\begin{bmatrix}-1 & 2 & 0\\ 3 & 7 & 1\\ 5 & 9 & 3\end{bmatrix}$.

**8.** Show that the equations $x+y+z-3=0,\ 3x-5y+2z-8=0,\ 5x-3y+4z-14=0$ are consistent.

**9.** State and prove Triangle Inequality.

**10.** If $\alpha,\beta$ are two vectors in Euclidean space $V(R)$ such that $\|\alpha\|=\|\beta\|$ prove that $(\alpha+\beta,\alpha-\beta)=0$.

## *PART - B*

***Answer any FIVE of the following Questions.*** ***$5 \times 10 = 50$ Marks***

**11.** If $V(F)$ be a vector space. $\omega \subseteq V$. Prove that the necessary and sufficient conditions for $\omega$ to be a subspace of $V$ are

(i) $\alpha \in \omega, \beta \in \omega \Rightarrow \alpha - \beta \in \omega$

(ii) $a \in F, \alpha \in \omega \Rightarrow a\alpha \in \omega$.

**12.** If show that are the sub sets of a vector space $v(F)$ then prove that $L(S \cup T) = L(S) + L(T)$.

**13.** State and prove Basis Existence theorem.

**14.** Find the co-coordinators of (2,3,4,-1) with respect to the basis of $V_4(R)$ B={(1,1,1,2),(1,-1,0,0),(0,0,1,1),(0,1,0,0)}

**15.** Find $T(x,y,z)$ where $T: R^3 \to R$ is defined by $T(1,1,1) = 3$, $T(0,1,-2) = 1$, $T(0,0,1) = -2$.

**16.** Define Null space. Prove that Null space $N(T)$ is subspace of $U(F)$ where $T: U \to V$ is a Linear Transformation.

**17.** If $A = \begin{bmatrix} 2 & 1 & 2 \\ 5 & 3 & 3 \\ -1 & 0 & -2 \end{bmatrix}$ verify cayley – Hamilton theorem. Hence find $A^{-1}$.

**18.** Find the characteristic roots and vectors to the matrix $A = \begin{bmatrix} 2 & 1 & 0 \\ 0 & 2 & 1 \\ 0 & 0 & 2 \end{bmatrix}$.

**19.** State and prove parallelogram Law.

**20.** If $\alpha, \beta$ and two vectors in an I.P.S. then prove that $\alpha, \beta$ are Linear Independent iff $|(\alpha, \beta)| = \|\alpha\| \|\beta\|$ .