



Batch 2024-2028
SRI Y.N.COLLEGE (AUTONOMOUS): NARSAPUR
I B.Sc., Hon's CBCS w.e.f A.Y. 2023-2024
For I B.Sc., Maths, Physics, Chemistry, Computer Science and Electronics Major Programs
Course-1: Essentials and Applications of Mathematical, Physical and Chemical Sciences
SEMESTER-I

Hours: 5hrs/week

Credits: 4

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of the essential concepts and applications of mathematical, physical, and chemical sciences. The course aims to develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

Learning outcomes:

1. Apply critical thinking skills to solve complex problems involving complex numbers, trigonometric ratios, vectors, and statistical measures.
2. To explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to connect their knowledge of physics to everyday situations
3. To explain the basic principles and concepts underlying a broad range of fundamental areas of chemistry and to connect their knowledge of chemistry to daily life.
4. Understand the interplay and connections between mathematics, physics, and chemistry in various applications. Recognize how mathematical models and physical and chemical
5. Principles can be used to explain and predict phenomena in different contexts.
6. To explore the history and evolution of the Internet and to gain an understanding of network security concepts, including threats, vulnerabilities, and countermeasures.

UNIT I: ESSENTIALS OF MATHEMATICS:

Complex Numbers: Introduction of the new symbol i – General form of a complex number – Modulus- Amplitude form and conversions

Trigonometric Ratios: Trigonometric Ratios and their relations – Problems on calculation of angles

Vectors: Definition of vector addition – Cartesian form – Scalar and vector product and problems

Statistical Measures: Mean, Median, Mode of a data and problems

UNIT II: ESSENTIALS OF PHYSICS:

Definition and Scope of Physics- Measurements and Units - Motion of objects: Newtonian Mechanics and relativistic mechanics perspective - Laws of Thermodynamics and Significance - Acoustic waves and electromagnetic waves- Electric and Magnetic fields and their interactions - Behaviour of atomic and nuclear particles- Wave-particle duality, the uncertainty principle - Theories and understanding of universe

UNIT III: ESSENTIALS OF CHEMISTRY:

Definition and Scope of Chemistry - Importance of Chemistry in daily life - Branches of chemistry - Significance – PERIODIC TABLE:- Significance, Electronic Configuration, Periodic properties like atomic size and Ionization potential and their trend. Types of chemical changes - Classification of macromolecules. BIOMOLECULES:- Classification & Functions of Carbohydrates, Proteins, Fats & Vitamins.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY:

Applications of Mathematics in Physics & Chemistry: Calculus, Differential Equations & Complex Analysis

Application of Physics in Industry and Technology: Electronics and Semiconductor Industry, Robotics and Automation, Automotive and Aerospace Industries, Quality Control and Instrumentation, Environmental Monitoring and Sustainable Technologies.

Applications of Chemistry in Industry and Technology:

Chemical Manufacturing, Pharmaceuticals and Drug Discovery, Materials Science, Food and Beverage Industry

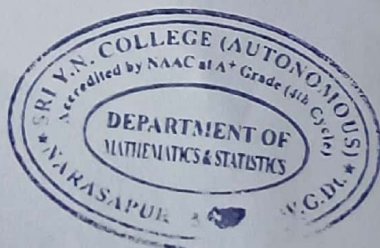
UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

Milestones of Computer Evolution - Computer – Block Diagram, Generations of Computers; Internet Basics, history, Internet Service Providers, Types of Networks, IP, Domain Name Services, applications;

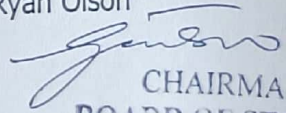
Ethical and social implications: Network and security concepts- Information Assurance Fundamentals, Cryptography - Symmetric and Asymmetric, Malware, Firewalls, Fraud Techniques- Privacy and Data Protection;

Recommended books:

1. Functions of one complex variable by John. B. Conway, Springer- Verlag.
2. Elementary Trigonometry by H. S. Hall and S. R. Knight
3. Vector Algebra by A. R. Vasishtha, Krishna Prakashan Media (P) Ltd.
4. Basic Statistics by B. L. Agarwal, New age international Publishers
5. University Physics with Modern Physics by Hugh D. Young and Roger A. Freedman
6. Fundamentals of Physics by David Halliday, Robert Resnick, and Jearl Walker
7. "Physics for Scientists and Engineers with Modern Physics" by Raymond A. Serway and John W. Jewett Jr.
8. Physics for Technology and Engineering" by John Bird
9. Chemistry in daily life by Kirpal Singh
10. Chemistry of bio molecules by S. P. Bhutan
11. Fundamentals of Computers by V. Raja Raman
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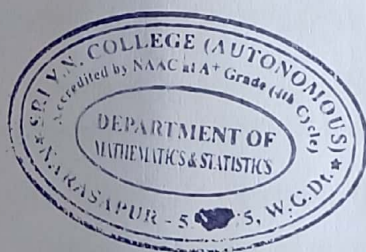
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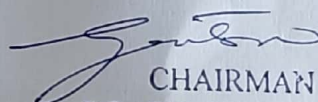
GUIDELINES TO THE PAPER SETTER

BLUE PRINT

Unit No.	Section-A MCQ's	Section-B Fill in the Blanks	Section-C Matching Questions
I	8	2	2
II	8	2	2
III	8	2	2
IV	8	2	2
V	8	2	2
Total	40	10	10



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Batch 2024-2028
SRI Y.N.COLLEGE (AUTONOMOUS): NARSAPUR
I B.Sc., Hon's in Geography under CBCS w.e.f A.Y. 2023-2024
For I B.Sc., Hon's in Geography Major Program
Course-1: Essentials and Applications of Mathematical, Physical and Chemical Sciences
SEMESTER-I

Hours: 5hrs/week

Credits: 4

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of the essential concepts and applications of mathematical, physical, and chemical sciences. The course aims to develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

Learning outcomes:

1. Apply critical thinking skills to solve complex problems involving complex numbers, trigonometric ratios, vectors, and statistical measures.
2. To explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to connect their knowledge of physics to everyday situations
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6. To explore the history and evolution of the Internet and to gain an understanding of network security concepts, including threats, vulnerabilities, and countermeasures.

UNIT I: ESSENTIALS OF MATHEMATICS:

9hrs

Complex Numbers: Introduction of the new symbol i – General form of a complex number – Modulus- Amplitude form and conversions

Trigonometric Ratios: Trigonometric Ratios and their relations – Problems on calculation of angles
Vectors: Definition of vector addition – Cartesian form – Scalar and vector product and problems
Statistical Measures: Mean, Median, Mode of a data and problems

UNIT II: ESSENTIALS OF PHYSICS:

9hrs

Definition and Scope of Physics- Measurements and Units - Motion of objects: Newtonian Mechanics and relativistic mechanics perspective - Laws of Thermodynamics and Significance - Acoustic waves and electromagnetic waves- Electric and Magnetic fields and their interactions - Behaviour of atomic and nuclear particles- Wave-particle duality, the uncertainty principle - Theories and understanding of universe

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UNIT IV: ESSENTIALS OF GEOGRAPHY

9hrs

Geography – definition, Nature and Scope of Physical geography;

Geography – Interaction with other Sciences;

Interior of the earth

Environment and Natural Resources;

Introduction to Remote Sensing – Definition, History and advantages

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

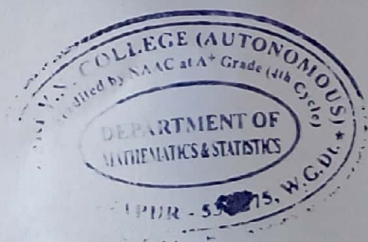
9 hrs

Milestones of Computer Evolution - Computer – Block Diagram, Generations of Computers; Internet Basics, history, Internet Service Providers, Types of Networks, IP, Domain Name Services, applications;

Ethical and social implications: Network and security concepts- Information Assurance Fundamentals, Cryptography - Symmetric and Asymmetric, Malware, Firewalls, Fraud Techniques- Privacy and Data Protection;

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8. Physics for Technology and Engineering" by John Bird
9. Chemistry in daily life by Kirpal Singh
10. Chemistry of bio molecules by S. P. Bhutan
11. Strahler, AH, and Strahler An (1971) Physical Geography, Wiley Eastren, New Delhi
12. John R Jenson 2009, Remote Sensing of the Environment, Pearson Education, New Delhi
13. Fundamentals of Computers by V. Raja Raman
14. Cyber Security Essentials by James Graham, Richard Howard, Ryan Olson



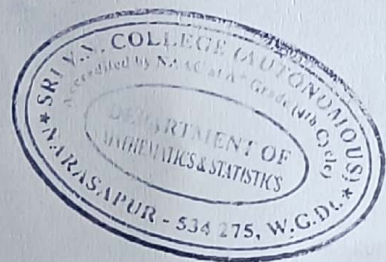
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Unit No.	Section-A Multiple Choice Questions	Section-B Fill in the Blanks	Section-C Matching Questions
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II	5	1	1
III	5	1	1
IV	20	6	6
V	5	1	1
Total	40	10	10



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Course Objective:

The objective of this course is to provide students with an in-depth understanding of the recent advances and cutting-edge research in mathematical, physical, and chemical sciences. The course aims to broaden students' knowledge beyond the foundational concepts and expose them to the latest developments in these disciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

Learning outcomes:

Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used to model and solve real-world problems.

To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations.

Understand the different sources of renewable energy and their generation processes and advances in nanomaterials and their properties, with a focus on quantum dots. To study the emerging field of quantum communication and its potential applications. To gain an understanding of the principles of biophysics in studying biological systems. Explore the properties and applications of shape memory materials.

Understand the principles and techniques used in computer-aided drug design and drug delivery systems, to understand the fabrication techniques and working principles of nanosensors. Explore the effects of chemical pollutants on ecosystems and human health.

Understand the interplay and connections between mathematics, physics, and chemistry in various advanced applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.

Understand and convert between different number systems, such as binary, octal, decimal, and hexadecimal. Differentiate between analog and digital signals and understand their characteristics. Gain knowledge of different types of transmission media, such as wired (e.g., copper cables, fiber optics) and wireless (e.g., radio waves, microwave, satellite)..

UNIT I: ADVANCES IN BASICS MATHEMATICS:

Straight Lines: Different forms – Reduction of general equation into various forms – Point of intersection of two straight lines

Limits and Differentiation: Standard limits – Derivative of a function – Problems on product rule and quotient rule

Integration: Integration as a reverse process of differentiation – Basic methods of integration

Matrices: Types of matrices – Scalar multiple of a matrix – Multiplication of matrices – Transpose of a matrix and determinants

UNIT II: ADVANCES IN PHYSICS:

Renewable energy: Generation, energy storage, and energy-efficient materials and devices. Recent advances in the field of nanotechnology: Quantum dots, Quantum Communication- recent advances in biophysics- recent advances in medical physics- Shape Memory Materials.

UNIT III: ADVANCES IN CHEMISTRY:

Computer aided drug design and delivery, Nanosensors, Chemical Biology, impact of chemical pollutants on ecosystems and human health, Dye removal - Catalysis method

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

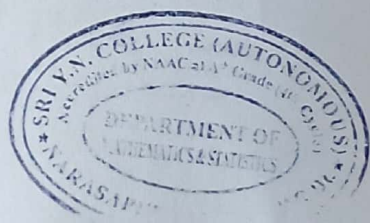
Mathematical Modelling applications in physics and chemistry Application of Renewable energy: Grid Integration and Smart Grids, Application of nanotechnology: Nanomedicine, Application of biophysics: Biophysical Imaging, Biomechanics, Neurophysics, Application of medical physics: Radiation Therapy, Nuclear medicine
Solid waste management, Environmental remediation- Green Technology, Water treatment

UNIT V: Advanced Applications of Computer Science

Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec, Multiplexing, Transmission media, error detection and correction- Parity check and CRC, Networking devices- Repeater, hub, bridge, switch, router, gateway.

Recommended books:

1. Coordinate Geometry by S.L.Lony, Arihant Publications
2. Calculus by Thomas and Finny, Pearson Publications
3. Matrices by A.R.Vasishtha and A.K.Vasishtha, Krishna Prakashan Media(P)Ltd.
4. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
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Physics: An Introduction" by Rodney Cotterill

Medical Physics: Imaging" by James G. Webster

"Shape Memory Alloys: Properties and Applications" by Dimitris C. Lagoudas

10. Nano materials and applications by M.N.Borah

11. Environmental Chemistry by Anil.K.D.E.

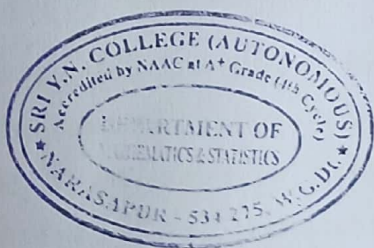
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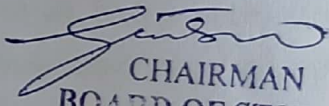
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UNIT III: ADVANCES IN CHEMISTRY:

9hrs

Computer aided drug design and delivery, Nanosensors, Chemical Biology, impact of chemical pollutants on ecosystems and human health, Dye removal - Catalysis method

UNIT IV: ADVANCED APPLICATIONS OF GEOGRAPHY

9hrs

Urban planning and settlements – Rural and urban

Human adaptation to the environment- Eskimos, Bushmen, Goands and Gujjars

Classification of Economic activities – Primary, Secondary, Tertiary and Quaternary

Types of Migrations –

Geographical Information System (GIS) – Definition and advantages

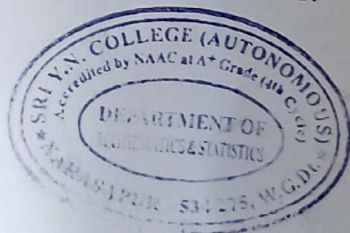
UNIT V: Advanced Applications of Computer Science

9hrs

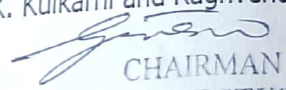
Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec, Multiplexing, Transmission media, error detection and correction- Parity check and CRC, Networking devices- Repeater, hub, bridge, switch, router, gateway.

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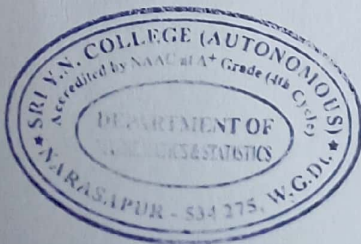

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 12. M.Anjireddy 2009, Text book of R S and Geographical Information Systems, BS Publications, Hyderabad
 13. WheelerJetal, 1995. Economic Geography, JohnWiley- New York
 14. Digital Logic Design by Morris Mano
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GUIDELINES TO THE PAPER SETTER

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Unit No.	Section-A Multiple Choice Questions	Section-B Fill in the Blanks	Section-C Matching Questions
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Total	40	10	10



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SRI Y.N.COLLEGE(Autonomous), Narsapur
Affiliated to Adikavi Nannayya University

I B.Sc Mathematics Major Syllabus for II Semester
Course –3 Differential Equations (for 2024-2028 batch, w. e. f 2023-24)

UNIT - I: Differential equations of first order and first degree (8 Marks-2,4 Marks-2)

Additional Input: (Variables Separable, Homogeneous Differential equations.)

Linear differential equations; Bernoulli's Equations; Exact differential equations; Integrating Factors – (i) Inspection Method (ii) $\frac{1}{Mx+Ny}$ (iii) $\frac{1}{Mx-Ny}$

UNIT – II : Differential Equations of first order but not of the first degree :

(8Marks-2, 4Marks- 1)

Orthogonal Trajectories, Equations solvable for p, Equations solvable for y, Equations solvable for x, Equations that do not contain x (or) y, Equations of the first degree in x and y- Clairaut's Equation.

UNIT-III: Higher order linear differential equations I (8Marks-2, 4Marks-2)

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 $f(D)y=Q$, where Q is a function of x.

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

P.I. of $f(D)y = Q$ when $Q = b \sin ax$ or $b \cos ax$.

UNIT-IV: Higher order linear differential equations II (8Marks-2, 4Marks-1)

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.

UNIT-V: Higher order linear differential equations III (8Marks-2, 4Marks-2)

Method of Variation of Parameters; Linear Differential Equations with Non-Constant Coefficients, The Cauchy-Euler equation, Legendre's linear equations.

Prescribed Text Book: (1) A Text Book of B.Sc Mathematics Volume-I (S.Chand & Company) (V.Venkateswara Rao, N.Krishnamurthy, B.V.S.S.Sarma, S.Anjaneya Sastry)

Reference Books:

- (1) Ordinary and Partial Differential Equations Raisinghania, published by S. Chand & Company, New Delhi.
- (2) Differential Equations with applications and programs – S. Balachandra Rao & HR Anuradha- universities press.
- (3) Differential Equations and Their Applications by Zafar Ahsan, published by Prentice-Hall of India Learning Pvt. Ltd. New Delhi- Second edition.



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SEMESTER-II
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Mathematics Major Course – 3

Differential Equations

Time: 3Hrs.

Max. Marks:60

SECTION – I
Answer any FIVE Questions, each question carries FOUR marks. $5 \times 4M = 20 M$

- | | |
|---|---------------|
| Differential equations of first order and first degree | : 2 questions |
| Differential equations of the first order but not of the first degree | : 1question |
| Higher order Linear differential equations I | : 2questions |
| Higher order Linear differential equations II | : 1 question |
| Higher order Linear differential equations III | : 2 questions |

Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks. $5 \times 8M = 40M$

Note: Under SECTION-II (Q.NO:13) & SECTION-III (Q.NO:14) will be given from UNIT-III.

SECTION – II

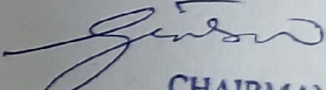
- | | |
|---|---------------|
| Differential equations of the first order and first degree | : 2questions |
| Differential equations of the first order but not of the first degree | : 2 questions |
| Higher order Linear differential equations I | : 1question |

SECTION – III

- | | |
|--|---------------|
| Higher order Linear differential equations I | : 1 question |
| Higher order Linear differential equations II | : 2 questions |
| Higher order Linear differential equations III | : 2 questions |



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Affiliated to Adikavi Nannayya University

Mathematics Major Course - 3
II semester (for 2024-2028 batch, w. e. f 2023-24)
Model Question Paper - Differential Equations

Time: 3Hrs

Max Marks: 60

SECTION - I
Answer any FIVE Questions, each question carries FOUR marks.

5x4M = 20M

1. Solve $\left[y\left(1 + \frac{1}{x}\right) + \cos y\right] dx + [x + \log x - x \sin y] dy = 0$.
2. Solve $(1 - x^2) \frac{dy}{dx} + 2xy = x\sqrt{1 - x^2}$.
3. Solve $x^2(y - px) = p^2y$.
4. Solve $(D^3 + 6D^2 + 12D + 8)y = 0$.
5. Solve $(D^4 - 2D^3 + 2D^2 - 2D + 1)y = 0$.
6. Solve $(D^2 + 4)y = x \sin x$.
7. $(x \sin x + \cos x) \frac{d^2y}{dx^2} - x \cos x \frac{dy}{dx} + y \cos x = 0$.
8. Solve $(x^2 D^2 + 2xD - 12)y = x^3(\log x)$.

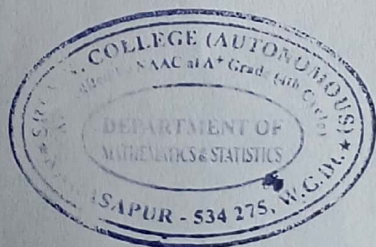
SECTION - II
Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks.

5x8M = 40M

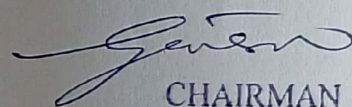
9. Solve $(2x^2y - 3y^2) dx + (2x^3 - 12xy + \log y) dy = 0$.
10. Solve $\frac{dy}{dx} + \frac{y}{x} = y^2 x \sin x, x > 0$.
11. Show that the family of confocal conics $\frac{x^2}{(a^2 + \lambda)} + \frac{y^2}{(b^2 + \lambda)} = 1$ is self orthogonal, where λ is a parameter.
12. Solve $p^2 + 2py \cot x = y^2$.
13. Solve $(D^2 - 3D + 2)y = \cosh x$.

SECTION - III

14. Solve $(D^2 + 9)y = \cos^3 x$.
15. Solve $(D^2 + 3D + 2)y = xe^x \sin x$.
16. Solve $(D^2 - 4D + 1)y = e^{2x} \cos^2 x$.
17. Solve $(x + 2) \frac{d^2y}{dx^2} - (2x + 5) \frac{dy}{dx} + 2y = (x + 1)e^x$, given that $y = e^{2x}$ is a part of C.F.
18. Solve $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} - y = x^2 e^x$ by the method of variation of parameters.



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**UNIT – I: The Plane :** (8Marks-2, 4Marks-1)

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, Bisectors of angles between two planes, Combined equation of two planes, Orthogonal projection on a plane.

UNIT – II : The Line : (8Marks-2, 4Marks- 2)

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; Length of the perpendicular from a given point to a given line.

UNIT – III : Sphere : (8Marks-2, 4Marks-2)

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; Tangent plane; Plane of contact; Polar plane; Pole of a Plane; Conjugate points; Conjugate planes.

UNIT – IV: Sphere: (8Marks-2, 4Marks-1)

Angle of intersection of two spheres; Conditions for two spheres to be orthogonal; Radical plane; Coaxial system of spheres; Simplified form of the equation of two spheres, limiting points.

UNIT – V : Cone: (8Marks-2, 4Marks-2)

Definitions of a cone; vertex; guiding curve; generators; Equation of the cone with a given vertex and guiding curve; Enveloping cone of a sphere; Equations of cones with vertex at origin are homogenous; Condition that the general equation of the second degree should represent a cone; Condition that a cone may have three mutually perpendicular generators.

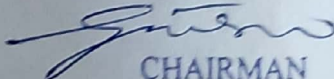
Intersection of a line and a quadric cone; Tangent lines and tangent plane at a point; Condition that a plane may touch a cone; Reciprocal cones; Intersection of two cones with a common vertex; Right circular cone; Equation of the right circular cone with a given vertex; axis and semi-vertical angle.

Prescribed Text Book: (1) A Text Book of B.Sc Mathematics Volume-I (S.Chand & Company) (V.Venkateswara Rao, N.Krishnamurthy, B.V.S.S.Sarma, S.Anjaneya Sastry)

Reference Books :

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

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SEMESTER-II
BLUE PRINT
Mathematics Major Course – 4

Analytical Solid Geometry

Time: 3Hrs.

Max. Marks:60

SECTION – I

Answer any FIVE Questions, each question carries FOUR marks. $5 \times 4M = 20 M$

Unit-I (The Plane)	: 1 question
Unit-II(The Line)	: 2 questions
Unit-III(The Sphere)	: 2 questions
Unit-IV(The Sphere)	:1 questions
Unit-V (The Cones)	: 2 questions

**Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks. $5 \times 8 M = 40 M$**

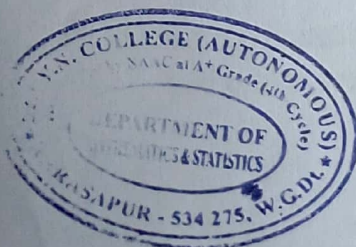
Note: Under SECTION-II (Q.NO:13) & SECTION-III (Q.NO:14) will be given from UNIT-III.

SECTION – II

Unit-I (The Plane)	: 2 questions
Unit-II (The Line)	: 2 questions
Unit-III (The Sphere)	: 1 question

SECTION – III

Unit-III (The Sphere)	: 1 question
Unit-IV (The Sphere)	: 2 questions
Unit-V (The Cones)	: 2 questions



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SRI Y.N.COLLEGE(Autonomous),Narsapur
Affiliated to Adikavi Nannaya University

I B.Sc. Mathematics– Semester – II
Major Course – 4 : Analytical Solid Geometry
Model Question Paper (for 2024-28 batch w. e. f 2023-2024)

Time: 3Hrs

Max Marks: 60

SECTION - I

Answer any FIVE Questions, each question carries FOUR marks. 5x 4M = 20M

1. Prove that the equation of the plane through the points $(1,-2,4)$ and $(3,-4,5)$ and parallel to x -axis is $y + 2z = 6$.
2. Find the equations of the straight line passing through the point $(1,0,-1)$ and intersecting the lines $4x - y - 13 = 0 = 3y - 4z - 1$; $y - 2z + 2 = 0 = x - 5$.
3. Prove that the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$; $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$ are coplanar, also find their point of intersection.
4. Find the equation of the sphere circumscribing the tetrahedron whose faces are $x = 0$, $y = 0$, $z = 0$ and $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$.
5. Find the pole of the plane $x+2y+3z=7$ w.r.t the sphere $x^2 + y^2 + z^2 - 2x - 4y - 6z + 11 = 0$.
6. Find the equation of the sphere through the circle $x^2 + y^2 + z^2 - 2x + 3y - 4z + 6 = 0$, $3x-4y+5z-15=0$ and cutting the sphere $x^2 + y^2 + z^2 + 2x + 4y - 6z + 11 = 0$ orthogonally.
7. Find the equation to the cone whose vertex is $(1,1,0)$ and whose guiding curve is $y = 0$, $x^2 + z^2 = 4$.
8. Show that the reciprocal cone of $ax^2 + by^2 + cz^2 = 0$ is the cone $\frac{x^2}{a} + \frac{y^2}{b} + \frac{z^2}{c} = 0$.

Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks. 5x8M = 40M

SECTION – II

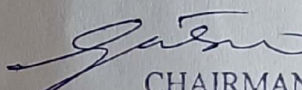
9. Find the equations of the planes bisecting the angles between the planes $3x-6y+2z+5=0$, $4x-12y+3z-3=0$ also point out which the plane bisects the acute angle.
10. A variable plane is at a constant distance p from the origin and meets the axis in A, B, C show that the locus of the centroid of the tetrahedron $OABC$ is $x^{-2} + y^{-2} + z^{-2} = 16p^{-2}$.
11. Find the image of the line $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ in the plane $x+y+z=1$.
12. Find the shortest distance and equations of the line S.D between the lines $3x-9y+5z=0=x+y-z$ and $6x+8y+3z-10=0=x+2y+z-3$.
13. Find the equations of the spheres passing through the circle $x^2 + y^2 = 4, z = 0$ and is intersected by the plane $x + 2y + 2z = 0$ in a circle of radius 3.

SECTION-III

14. Show that the two circles $x^2 + y^2 + z^2 - y + 2z = 0$, $x - y + z = 2$ and $x^2 + y^2 + z^2 + x - 3y + z - 5 = 0$, $2x - y + 4z - 1 = 0$ lie on the same sphere and find its equation.
15. If r_1, r_2 are the radii of two orthogonal spheres, then show that the radius of the circle of their intersection is $\frac{r_1 r_2}{\sqrt{(r_1^2 + r_2^2)}}$.
16. Find the equation of the sphere which touches the plane $3x + 2y - z + 2 = 0$ and $(1, -2, 1)$ and cuts orthogonally the sphere $x^2 + y^2 + z^2 - 4x + 6y + 4 = 0$
17. Show that the equation of quadric cone which contains the three coordinate axes and the lines in which the plane $x - 5y - 3z = 0$ cuts the cone $7x^2 + 5y^2 - 3z^2 = 0$ is $yz + 10zx + 18xy = 0$.
18. Find the equation of the right circular cone whose vertex is the origin, axis as the line $x = t, y = 2t, z = 3t$ and whose semi-vertical angle is 60° .



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SRI Y.N.COLLEGE(Autonomous), Narsapur
Affiliated to Adikavi Nannayya University

I B.Sc Mathematics Minor Syllabus for II Semester
Course –1 Differential Equations (for 2024-2028 batch, w. e. f 2023-24)

UNIT - I: Differential equations of first order and first degree (8 Marks-2, 4 Marks-2)

Additional Input: (Variables Separable, Homogeneous Differential equations.)

Linear differential equations; Bernoulli's Equations; Exact differential equations; Integrating

Factors – (i) Inspection Method (ii) $\frac{1}{Mx+Ny}$ (iii) $\frac{1}{Mx-Ny}$

UNIT – II : Differential Equations of first order but not of the first degree :

(8Marks-2, 4Marks- 1)

Orthogonal Trajectories, Equations solvable for p, Equations solvable for y, Equations solvable for x, Equations that do not contain x (or) y, Equations of the first degree in x and y- Clairaut's Equation.

UNIT-III: Higher order linear differential equations I (8Marks-2, 4Marks-2)

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 $f(D)y=Q$, where Q is a function of x.

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

P.I. of $f(D)y = Q$ when $Q = b \sin ax$ or $b \cos ax$.

UNIT-IV: Higher order linear differential equations II (8Marks-2, 4Marks-1)

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.

UNIT-V: Higher order linear differential equations III (8Marks-2, 4Marks-2)

Method of Variation of Parameters; Linear Differential Equations with Non-Constant Coefficients, The Cauchy-Euler equation, Legendre's linear equations.

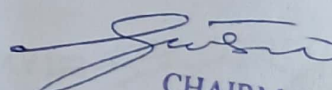
Prescribed Text Book: (1) A Text Book of B.Sc Mathematics Volume-I (S.Chand & Company) (V.Venkateswara Rao, N.Krishnamurthy, B.V.S.S.Sarma, S.Anjaneya Sastry)

Reference Books:

- (1) Ordinary and Partial Differential Equations Raisinghania, published by S. Chand & Company, New Delhi.
- (2) Differential Equations with applications and programs – S. Balachandra Rao & HR Anuradha- universities press.
- (3) Differential Equations and Their Applications by Zafar Ahsan, published by Prentice-Hall of India Learning Pvt. Ltd. New Delhi- Second edition.



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SEMESTER-II
BLUE PRINT
Mathematics Minor Course – I

Differential Equations

Time: 3Hrs.

Max. Marks:60

SECTION – I

Answer any FIVE Questions, each question carries FOUR marks. $5 \times 4M = 20M$

Differential equations of first order and first degree	: 2 questions
Differential equations of the first order but not of the first degree	: 1question
Higher order Linear differential equations I	: 2questions
Higher order Linear differential equations II	: 1 question
Higher order Linear differential equations III	: 2 questions

**Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks.**

$5 \times 8M = 40M$

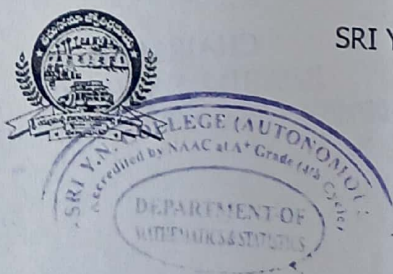
**Note: Under SECTION-II (Q.NO:13) & SECTION-III (Q.NO:14) will be given from
UNIT-III.**

SECTION – II

Differential equations of the first order and first degree	: 2questions
Differential equations of the first order but not of the first degree	: 2 questions
Higher order Linear differential equations I	: 1question

SECTION – III

Higher order Linear differential equations I	: 1 question
Higher order Linear differential equations II	: 2 questions
Higher order Linear differential equations III	: 2 questions



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SRI Y.N.COLLEGE(Autonomous), Narsapur
Affiliated to Adikavi Nannayya University
Mathematics Minor Course- 1
II semester (for 2024-2028 batch, w. e. f 2023-24)
Model Question Paper - Differential Equations

Time: 3Hrs

Max Marks: 60

SECTION - I

Answer any FIVE Questions, each question carries FOUR marks.

5x4M = 20M

1. Solve $\left[y\left(1 + \frac{1}{x}\right) + \cos y\right] dx + [x + \log x - x \sin y] dy = 0$.
2. Solve $(1 - x^2) \frac{dy}{dx} + 2xy = x\sqrt{1 - x^2}$.
3. Solve $x^2(y - px) = p^2y$.
4. Solve $(D^3 + 6D^2 + 12D + 8)y = 0$.
5. Solve $(D^4 - 2D^3 + 2D^2 - 2D + 1)y = 0$.
6. Solve $(D^2 + 4)y = x \sin x$
7. $(x \sin x + \cos x) \frac{d^2y}{dx^2} - x \cos x \frac{dy}{dx} + y \cos x = 0$.
8. Solve $(x^2D^2 + 2xD - 12)y = x^3(\log x)$.

Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks.

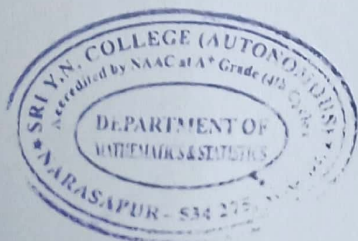
5x8M = 40M

SECTION - II

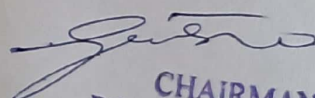
9. Solve $(2x^2y - 3y^2) dx + (2x^3 - 12xy + \log y) dy = 0$.
10. Solve $\frac{dy}{dx} + \frac{y}{x} = y^2 x \sin x, x > 0$.
11. Show that the family of confocal conics $\frac{x^2}{(a^2 + \lambda)} + \frac{y^2}{(b^2 + \lambda)} = 1$ is self orthogonal, where λ is a parameter.
12. Solve $p^2 + 2py \cot x = y^2$.
13. Solve $(D^2 - 3D + 2)y = \cosh x$.

SECTION - III

14. Solve $(D^2 + 9)y = \cos^3 x$.
15. Solve $(D^2 + 3D + 2)y = xe^x \sin x$.
16. Solve $(D^2 - 4D + 1)y = e^{2x} \cos^2 x$.
17. Solve $(x + 2) \frac{d^2y}{dx^2} - (2x + 5) \frac{dy}{dx} + 2y = (x + 1)e^x$, given that $y = e^{2x}$ is a part of C.F.
18. Solve $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} - y = x^2 e^x$ by the method of variation of parameters.



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Affiliated to Adikavi Nannayya University

II B.Sc Mathematics Major Syllabus for III semester

Course 5 – GROUP THEORY (for 2023-2027 batch, w.e.f 2024-25)

Course Outcomes

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

1. acquire the basic knowledge and structure of groups
2. get the significance of the notation of a subgroup and cosets.
3. understand the concept of normal subgroups and properties of normal subgroup
4. study the homomorphisms and isomorphisms with applications.
5. understand the properties of permutation and cyclic groups

UNIT – 1 : Groups(8Marks-2,4 Marks-1)

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 – 2 : Subgroups, Co-Sets and Lagrange's Theorem(8 Marks-2,4 Marks-2)

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. Coset Definition – properties of Cosets-Index of a subgroups of a finite groups-Lagrange's Theorem.

UNIT –3 : Normal Subgroups(8 Marks-2,4 Marks-1)

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 – Sub group of index 2 is a normal sub group – simple group

UNIT – 4: Homomorphism:(8 Marks-2,4 Marks-2)

Quotient group – criteria for the existence of a quotient group.

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

UNIT – 5 : Permutation Group and Cyclic Groups (8 Marks-2,4 Marks-2)

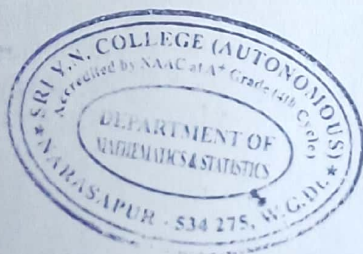
Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem.

Definition of cyclic group – elementary properties – classification of cyclic groups.

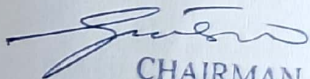
Prescribed Text Book: A Text Book of B.Sc Mathematics Volume-II (S.Chand& Company)(V.Venkateswara Rao, N.Krishnamurthy, B.V.S.S.Sarma, S.Anjaneya Sastry

Reference Books :

1. A. First course in Abstract Algebra, by J.B. Fraleigh Published by Narosa Publishing house.
2. Modern Algebra by M.L. Khanna.



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SEMESTER-III
BLUE PRINT
MATHEMATICS MAJOR

Course-5 : GROUP THEORY

Time: 3Hrs.

Max. Marks:60

SECTION - I

Answer any FIVE Questions, each question carries FOUR marks.

5 x 4M = 20M

Groups	: 1 question
Subgroups, Co-sets & Lagrange's theorem	: 2 question
Normal Sub groups	: 1 question
Homomorphism	: 2 questions
Permutations and Cyclic groups	: 2 questions

**Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks.**

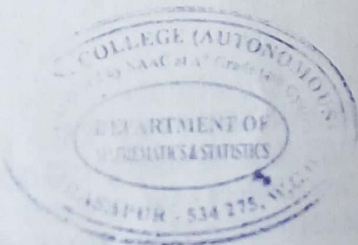
5 x 8M = 40M

SECTION- II

Groups	: 2 questions
Subgroups, Co-sets & Lagrange's theorem	: 2 questions
Normal Subgroups	: 1 question

SECTION-III

Normal Subgroups	: 1 question
Homomorphisms	: 2 questions
Permutations and Cyclic groups	: 2 questions



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Affiliated to Adikavi Nannayya University
II B.Sc Mathematics Major (for 2023 – 2027 batch, w.e.f 2024-25)

Course-5 : GROUP THEORY

Model Question Paper

Time: 3Hrs

Max Marks: 60

Answer any FIVE Questions, each question carries FOUR marks.

SECTION - I

5x4M = 20M

1. Show that the set Q^+ of all positive rational numbers forms an abelian group under the composition " $\circ$ " defined by $a \circ b = \frac{ab}{3} \forall a, b \in Q^+$
2. If H is any subgroup of a group G , then prove that $H^{-1} = H$.
3. Prove that any two left (right) co-sets of a subgroup are either disjoint or identical.
4. Prove that every sub group of an abelian group is normal.
5. Let G be a multiplicative group and $f : G \rightarrow G$ such that for $a \in G$, $f(a) = a^{-1}$, then prove that f is one-one onto and f is homomorphism iff G is commutative.
6. The homomorphic image of a group is a group.
7. Find the order of the cycle $(1 \ 4 \ 5 \ 7)$.
8. Show that the group $(G = \{1, 2, 3, 4, 5, 6\}, \times_7)$ is cyclic. Also write down all its generators.

Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks.

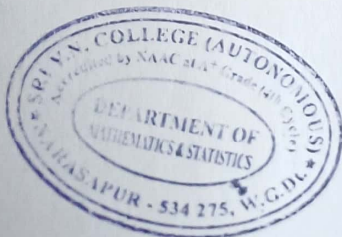
5x8M = 40M

SECTION - II

9. Prove that in a group G , for $a, b, x, y \in G$ the equation $ax=b$ and $ya=b$ have unique solutions.
10. Define Order of an element of a group. In a group G for $a, b \in G$, $O(a)=5$, $b \neq e$ and $aba^{-1} = b^2$, then find $O(b)$.
11. Prove that union of two subgroups is also a subgroup iff one is contained in another.
12. If H is a subgroup of group G , then Prove that there is one to one correspondence between the set of all distinct left cosets of H in G and the set of all distinct right cosets of H in G
13. Prove that a subgroup H of a group G is a normal subgroup of G iff the product of two right cosets of H in G is again a right coset of H in G .

SECTION - III

14. If G is a group and H is a subgroup of index 2 in G , then prove that H is a normal subgroup of G .
15. Let G be a group and G^1 be a non-empty set. If there exists a mapping f of G onto G^1 such that $f(ab) = f(a)f(b)$, for $a, b \in G$, then prove that G^1 is a group.
16. Let f be a homomorphism of a group G onto a group G^1 . Let K be the Kernel of f . Prove that the necessary and sufficient condition for f to be an isomorphism is that $K = \{e\}$, where ' e ' is the identity element in G .
17. If $f = (1 \ 2 \ 3 \ 4 \ 5 \ 8 \ 7 \ 6)$, $g = (4 \ 1 \ 5 \ 6 \ 7 \ 3 \ 2 \ 8)$ are cyclic permutations, then show that $(fg)^{-1} = g^{-1}f^{-1}$.
18. Prove that a group of prime order is cyclic.



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II B.Sc Mathematics Major Syllabus for III semester

Course 6- Numerical Methods (for 2023-2027 batch, w.e.f 2024-25)

Course Outcomes

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

1. difference between the operators Δ, ∇, E and the relation between them
2. know about the Newton – Gregory Forward and backward interpolation
3. know the Central Difference operators δ, μ, σ and relation between them
4. solve Algebraic and Transcendental equations
5. understand the concept of Curve fitting

Unit – 1 The calculus of finite differences (8 Marks -2,4 Marks -2)

The operators Δ, ∇, E - Fundamental theorem of difference calculus- properties of Δ, ∇, E and problems on them to express any value of the function in terms of the leading terms and the leading differences - relations between E and D - relation between D and Δ - problems on one or more missing terms- Factorial notation- problems on separation of symbols- problems on Factorial notation.

Unit – 2 Interpolation with equal and unequal intervals (8 Marks -2,4 Marks -1)

Derivations of Newton – Gregory Forward and backward interpolation and problems on them. Divided differences - Newton divided difference formula - Lagrange's and problems on them.

Unit – 3 Central Difference Interpolation formulae (8 Marks -2,4 Marks -2)

Central Difference operators δ, μ, σ and relation between them - Gauss forward formula for equal intervals - Gauss Backward formula - Stirlings formula - Bessel's formula and problems on the above formulae.

Unit – 4 Solution of Algebraic and Transcendental equation (8 Marks -2,4 Marks -2)

Method for finding initial approximate value of the root - Bisection method - to find the solution of given equations by using (i) Regula Falsi method (ii) Iteration method (iii) Newton – Raphson's method and problems on them.

Unit – 5 Curve Fitting (8 Marks -2,4 Marks -1)

Least-squares curve fitting procedures - fitting a straight line-nonlinear curve fitting-curve fitting by a sum of exponentials.

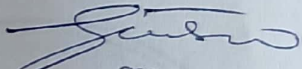
Text Book: Numerical Analysis by G. Shanker Rao, New Age International Publications

Reference Books

1. Applied Numerical Analysis by Curtis F. Gerald and Patrick O. Wheatley, Pearson, (2003) 7th Edition.
2. Introductory Methods of Numerical Analysis by S.S. Sastry, (6th Edition) PHI New Delhi 2012.
3. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S .R. K. Iyengar and R. K. Jain, New Age International Publishers (2012), 6th edition.



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Course 6 : Numerical Methods
Time: 3Hrs

SEMESTER-III
BLUE PRINT
MATHEMATICS MAJOR

Course- 6 : Numerical Methods

Time: 3Hrs.

Max.Marks:60

SECTION - I

Answer any FIVE questions, each question carries FOUR marks.

5 x 4M = 20M

Unit - I	: 2 questions
Unit - II	: 1 question
Unit - III	: 2 questions
Unit - IV	: 2 questions
Unit - V	: 1 question

**Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks.**

5 x 8M = 40M

SECTION - II

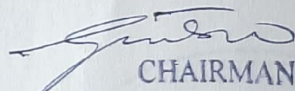
Unit - I	: 2 questions
Unit - II	: 2 questions
Unit - III	: 1 question

SECTION- III

Unit - III	: 1 question
Unit - IV	: 2 questions
Unit - V	: 2 questions



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Affiliated to Adikavi Nannayya University

II B.Sc Mathematics Major - III semester

Course 6 : Numerical Methods (for 2023 – 2027 batch, w.e.f 2024-25)

Time: 3Hrs

Model Question Paper

Max. Marks: 60

SECTION – I

Answer any FIVE questions. Each question carries FOUR marks

5 x 4 = 20M

1. Show that $\Delta^3 f(x) = f(x+3h) - 3f(x+2h) + 3f(x+h) - f(x)$

2. Show that $\delta = E^{-\frac{1}{2}} \Delta = \Delta E^{-\frac{1}{2}}$

3. Construct the divided difference table for the following data

x	1	3	4	6	10
f(x)	0	18	58	190	920

4. Using Gauss's forward formula find the value of $f(32)$ given that $f(25)=0.2707$, $f(30)=0.3027$, $f(35)=0.3386$, $f(40)=0.3794$.

5. Apply Bessel's formula to find the value of $f(9)$ for the following data.

x	4	6	8	10	12	16
y	3.5460	5.0753	6.4632	7.7217	8.8633	9.8986

6. Find the real root of the equation $f(x) = x^3 - x - 1 = 0$.

7. Using Newton Raphson method establish the iterative formula

$$x_{n+1} = \frac{1}{2} \left[x_n + \frac{N}{x_n} \right] \text{ to calculate the Square root on } N.$$

8. Find the least square line $y = a+bx$ for the following data

x_r	-2	-1	0	1	2
y_r	1	2	3	3	4

Answer any FIVE questions, choosing atleast two from each section.

Each question carries EIGHT marks

5 x 8 = 40M

SECTION – II

9. Construct a Forward difference table from the following data and evaluate $\Delta^4 y_1$

x	1	2	3	4	5
y	2	5	10	20	30

10. Find the missing term in the following table

x	0	1	2	3	4
y	1	3	9	?	81

11. Determine the values of $f(22)$ from the following table

x	20	25	30	35	40	45
f(x)	354	332	391	260	231	204



II B.Sc Mathematics Major Syllabus for III semester

Course 7 - LAPLACE TRANSFORMS (for 2023-2027 batch, w.e.f 2024-25)

Course Outcomes

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

1. understand the definition and properties of Laplace transformations
2. get an idea about first and second shifting theorems and change of scale property
3. understand Laplace transforms of standard functions like Bessel, Error function etc
4. know the reverse transformation of Laplace and properties
5. get the knowledge of application of convolution theorem

Unit – 1: LAPLACE TRANSFORMS – I (8 Marks - 2,4 Marks -1)

Definition of Laplace Transform - Linearity Property - Piecewise Continuous Function - Existence of Laplace Transform - Functions of Exponential order and of Class A.

Unit – 2 : LAPLACE TRANSFORMS – II (8 Marks - 2,4 Marks -1)

First Shifting Theorem, Second Shifting Theorem, Change of Scale Property, Laplace transform of the derivative of $f(t)$, Initial value theorem and Final value theorem.

Unit – 3 : LAPLACE TRANSFORM – III (8 Marks - 2,4 Marks -2)

Laplace Transform of Integrals - Multiplication by t , Multiplication by t^n - division by t - Laplace transform of Bessel Function - Laplace Transform of Error Function – Laplace transform of Sine and Cosine integrals.

Unit – 4 : INVERSE LAPLACE TRANSFORMS – I (8 Marks - 2,4 Marks -2)

Definition of Inverse Laplace Transform - Linearity Property - First Shifting Theorem - Second Shifting Theorem - Change of Scale property - use of partial fractions - Examples.

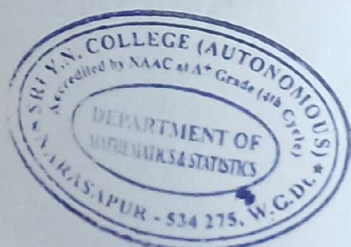
Unit – 5 : INVERSE LAPLACE TRANSFORMS – II (8 Marks - 2,4 Marks -2)

Inverse Laplace transforms of Derivatives - Inverse Laplace Transforms of Integrals - Multiplication by Powers of ' p ' - Division by powers of ' p ' - Convolution Definition - Convolution Theorem - proof and Applications - Heaviside's Expansion theorem and its Applications.

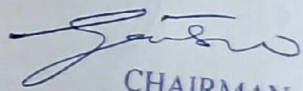
Text Book : Laplace Transforms by A.R.Vasishtha, Dr.R.K.Gupta, Krishna Prakashan Media Pvt. Ltd., Meerut.

Reference Books :

1. Introduction to Applied Mathematics by Gilbert Strang, Cambridge Press
2. Laplace and Fouries transforms by Dr.J.K. Goyal and K.P. Guptha, PragathiPrakashan, Meerut.



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SECTION - I

Answer any FIVE questions, each question carries FOUR marks.

5 x 4M = 20M

Unit - I	: 1 questions
Unit - II	: 1 question
Unit - III	: 2 questions
Unit - IV	: 2 question
Unit - V	: 2 questions

Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks.

5 x 8M = 40M

SECTION - II

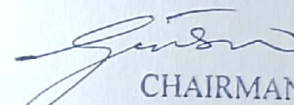
Unit - I	: 2 questions
Unit - II	: 2 questions
Unit - III	: 1 question

SECTION- III

Unit - III	: 1 question
Unit - IV	: 2 questions
Unit - V	: 2 questions



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4M = 20M



SRI Y.N.COLLEGE(Autonomous), Narsapur
Affiliated to Adikavi Nannayya University
II B.Sc Mathematics Major (for 2023 – 2027 batch, w.e.f 2024-25)
Course 7 - LAPLACE TRANSFORMS
Model Question Paper

Time: 3Hrs

Max. Marks: 60

SECTION – I
Answer any FIVE questions. Each question carries FOUR marks 5 x 4M = 20M

- Find $L\{7e^{2t} + 9e^{-2t} + 5\cos t + 7t^3 + 5\sin 3t + 2\}$
- If $L\{F(t)\} = \frac{p^2-p+1}{(2p+1)^2(p-1)}$ then show that $L\{F(2t)\} = \frac{p^2-2p+4}{4(p+1)^2(p-2)}$ by applying change of scale property
- Evaluate $L\{t \cos at\}$
- Find $L\left\{\frac{\sinh at}{t}\right\}$
- Find the inverse Laplace transform of $\frac{p^2}{(p+2)^3}$
- Find the inverse Laplace transform of $\frac{4}{(p+1)(p+2)}$
- Find the inverse Laplace transform of $\log\left(\frac{p+3}{p+2}\right)$
- Find the inverse Laplace transform of $\frac{p}{p^2-a^2}$

Answer any FIVE questions, choosing atleast two from each section.
Each question carries EIGHT marks 5 x 8M = 40M

SECTION – II

- If 'a' is constant ,then prove that $L(\cosh at) = \frac{p}{p^2-a^2}$
- Find the Laplace transform of $F(t)$ defined as $F(t) = \begin{cases} 1, & 0 < t < 2 \\ 2, & 2 < t < 4 \\ 3, & 4 < t < 6 \\ 0, & t > 6 \end{cases}$
- State and prove First Shifting theorem.
- State and prove final value theorem.
- Evaluate $\int_0^\infty \frac{e^{-t}\sin^2 t}{t} dt$

SECTION – III

- Prove that $L[J_0(t)] = \frac{1}{\sqrt{1+p^2}}$
- Find the inverse Laplace transform of $\frac{e^{-\pi p}(p+1)}{p^2+p+1}$
- Find the inverse Laplace transform of $\frac{4p+5}{(p-4)^2(p+3)}$
- Find the inverse Laplace transform of $\left\{\frac{p}{(p^2+a^2)^2}\right\}$, using convolution theorem.
- State and prove Heaviside's expansion formula.



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II B.Sc Mathematics Major Syllabus for III semester
Course 8 - Special Functions (for 2023-2027 batch, w.e.f 2024-25)

Learning Outcomes

After successful completion of the course will be able to

1. Understand the Beta and Gamma functions, their properties and relation between these two functions, understand the orthogonal properties of Chebyshev polynomials and recurrence relations.
2. Find power series solutions of ordinary differential equations.
3. Solve Hermite equation and write the Hermite Polynomial of order (degree) n , also find the generating function for Hermite Polynomials, study the orthogonal properties of Hermite Polynomials and recurrence relations.
4. Solve Legendre equation and write the Legendre equation of first kind, also find the generating function for Legendre Polynomials, understand the orthogonal properties of Legendre Polynomials.
5. Solve Bessel equation and write the Bessel equation of first kind of order n , also find the generating function for Bessel function understand the orthogonal properties of Bessel function.

Unit – 1:

Beta and Gamma functions, Chebyshev polynomials (8 Marks -2, 4 Marks -2)

Euler's Integrals-Beta and Gamma Functions, Elementary properties of Gamma Functions, Transformation of Gamma Functions. Another form of Beta Function, Relation between Beta and Gamma Functions. Chebyshev polynomials, orthogonal properties of Chebyshev polynomials, recurrence relations, generating functions for Chebyshev polynomials.

Unit – 2: Power series and Power series solutions of ordinary differential equations(8 Marks -2, 4 Marks -1)

Introduction, summary of useful results, power series, radius of convergence, theorems on Power series, Introduction of power series solutions of ordinary differential equation, Ordinary and singular points, regular and irregular singular points, power series solution.

Unit – 3: Hermite polynomials (8 Marks -2, 4 Marks -2)

Hermite Differential Equations, Solution of Hermite Equation, Hermite polynomials, generating function for Hermite polynomials. Other forms for Hermite Polynomials, Rodrigues formula for Hermite Polynomials, to find first few Hermite Polynomials. Orthogonal properties of Hermite Polynomials, Recurrence formulae for Hermite Polynomials.

Unit – 4: Legendre polynomials - (8 Marks -2, 4 Marks -1)

Definition, Solution of Legendre's equation, Legendre polynomial of degree n , generating function of Legendre polynomials. Definition of $P_n(x)$ and $Q_n(x)$, General solution of Legendre's Equation (derivations not required) to show that $P_n(x)$, is the coefficient of h^n in the expansion of $(1 - 2xh + h^2)^{-\frac{1}{2}}$. Orthogonal properties of Legendre's polynomials, Recurrence formulas for Legendre's Polynomials.

Unit – 5: Bessel's equation (8 Marks -2, 4 Marks -2)

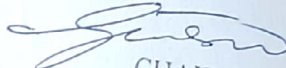
Definition, Solution of Bessel's equation, Bessel's function of the first kind of order n , Bessel's function of the second kind of order n . Integration of Bessel's equation in series form $=0$, Definition of $J_n(x)$, recurrence formulae for $J_n(x)$, Generating function for $J_n(x)$, orthogonality of Bessel functions.

Reference Book:

1. Dr.M.D.Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
2. J.N.Sharma and Dr.R.K.Gupta, Differential equations with special functions, Krishna Prakashan Mandir.
3. Shanti Narayan and Dr.P.K.Mittal, Integral Calculus, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
4. George F.Simmons, Differential Equations with Applications and Historical Notes, Tata McGRAW-Hill Edition, 1994.
5. Shepley L.Ross, Differential equations, Second Edition, John Willy & sons, New York, 1974.



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SEMESTER-III
BLUE PRINT
MATHEMATICS MAJOR

Course – 8 : SPECIAL FUNCTIONS

Time: 3Hrs.

Max. Marks:60

SECTION-I

Answer any FIVE Questions, each question carries FOUR marks. $5 \times 4M = 20M$

Beta and Gamma functions, Chebyshev polynomials : 2 questions

Power series and Power series solutions of
ordinary differential equations : 1 question

Hermite polynomials : 2 questions

Legendre polynomials : 1 question

Bessel's equation : 2 questions

Answer any FIVE questions. Choosing atleast TWO questions from each section. Each question carries EIGHT marks. $5 \times 8M = 40M$

SECTION-II

Beta and Gamma functions, Chebyshev polynomials : 2 questions

Power series and Power series solutions of
ordinary differential equations : 2 questions

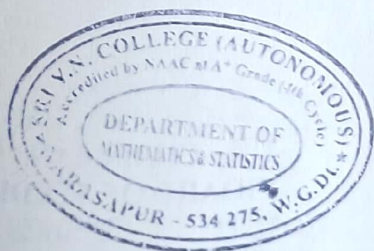
Hermite polynomials : 1 question

SECTION-III

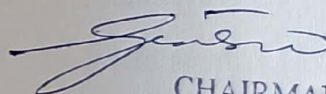
Hermite Polynomials : 1 question

Legendre Polynomials : 2 questions

Bessel's equation : 2 questions



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Affiliated to Adikavi Nannayya University
II B.Sc Mathematics Major - III semester
Course 8 : Special Functions (for 2023 – 2027 batch, w.e.f 2024-25)
Model Question Paper

Time: 3Hrs

SECTION-I

Max Marks : 60

Answer any FIVE Questions, each question carries FOUR marks. 5x4M = 20M

1. Compute $\Gamma\left(-\frac{1}{2}\right)$
2. Evaluate $\int_0^2 \frac{x^2 dx}{\sqrt{(2-x)}}$
3. Find the radius of convergence of the power series $\sum \frac{(n+1)}{(n+2)(n+3)} x^n$.
4. Prove that $H_n^{(1)}(x) = 4n(n-1)H_{n-2}$
5. Prove that if $m < n$, $\frac{d^m}{dx^m} \{H_n(x)\} = \frac{2^m n!}{(n-m)!} H_{n-m}(x)$
6. Prove that $(2n+1)xP_n = (n+1)P_{n+1} + nP_{n-1}$
7. Show that $J_{-\frac{1}{2}}(x) = \sqrt{\left(\frac{2}{\pi x}\right)} \cos x$.
8. Prove that $J_2 = J_0^{11} - x^{-1}J_0^1$

Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks. 5x8M = 40M

SECTION – II

9. Prove that $\beta(l, m) = \frac{\Gamma(l)\Gamma(m)}{\Gamma(l+m)}$.
10. Show that $2^n \Gamma\left(n + \frac{1}{2}\right) = 1.3.5 \dots (2n-1)\sqrt{\pi}$
11. Find the power series solution of the equation $(x^2 - 1)y'' + xy' - xy = 0$ in powers of x (i.e., about $x = 0$).
12. Show that $x = 0$ is a regular point of $(2x + x^3)y'' - y' - 6xy = 0$ and find its solution about $x = 0$.
13. Prove that $\int_{-\infty}^{\infty} e^{-x^2} H_n(x) H_m(x) dx = \begin{cases} 0 & \text{if } m \neq n \\ 2^n \sqrt{\pi} n! & \text{if } m = n \end{cases}$

SECTION-III

14. Show that $\sum_{k=0}^n \frac{H_k(x)H_k(z)}{2^k k!} = \frac{H_{n+1}(y)H_n(x) - H_{n+1}(x)H_n(y)}{2^{n+1}n!(y-x)}$
15. Prove that $P_n(x) = \frac{1}{n!2^n} \frac{d^n}{dx^n} (x^2 - 1)^n$
16. Prove that (i) $\int_{-1}^1 P_m(x)P_n(x)dx = 0$ if $m \neq n$ (ii) $\int_{-1}^1 [P_n(x)]^2 dx = \frac{2}{2n+1}$ if $m = n$
17. Prove that $J_n^1(x) = nJ_n(x) - xJ_{n+1}(x)$.
18. Prove that $\frac{d}{dx} [J_n^2 + J_{n+1}^2] = 2\left(\frac{n}{x} + J_n^2 - \frac{n+1}{x} J_{n+1}^2\right)$



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Affiliated to Adikavi Nannayya University

II B.Sc Mathematics Minor Syllabus for III semester

Course 2 – GROUP THEORY (for 2023-2027 batch, w.e.f 2024-25)

Course Outcomes

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

1. acquire the basic knowledge and structure of groups
2. get the significance of the notation of a subgroup and cosets.
3. understand the concept of normal subgroups and properties of normal subgroup
4. study the homomorphisms and isomorphisms with applications.
5. understand the properties of permutation and cyclic groups

UNIT – 1 : Groups(8Marks-2,4 Marks-1)

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 – 2 : Subgroups, Co-Sets and Lagrange's Theorem(8 Marks-2,4 Marks-2)

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. Coset Definition – properties of Cosets-Index of a subgroups of a finite groups-Lagrange's Theorem.

UNIT –3 : Normal Subgroups(8 Marks-2,4 Marks-1)

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 – Sub group of index 2 is a normal sub group – simple group

UNIT – 4: Homomorphism:(8 Marks-2,4 Marks-2)

Quotient group – criteria for the existence of a quotient group.

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

UNIT – 5 : Permutation Group and Cyclic Groups (8 Marks-2,4 Marks-2)

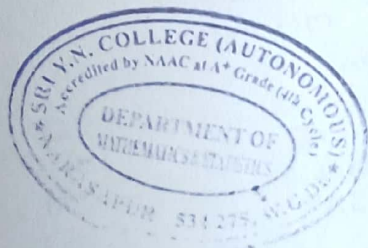
Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem.

Definition of cyclic group – elementary properties – classification of cyclic groups.

Prescribed Text Book: A Text Book of B.Sc Mathematics Volume-II (S.Chand& Company)(V.Venkateswara Rao, N.Krishnamurthy, B.V.S.S.Sarma, S.Anjaneya Sastry

Reference Books :

1. A. First course in Abstract Algebra, by J.B. Fraleigh Published by Narosa Publishing house.
2. Modern Algebra by M.L. Khanna.



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SEMESTER-III
BLUE PRINT
MATHEMATICS MINOR

Course-2 : GROUP THEORY

Time: 3Hrs.

Max. Marks:60

SECTION - I

Answer any FIVE Questions, each question carries FOUR marks. $5 \times 4M = 20M$

Groups	: 1 question
Subgroups, Co-sets & Lagrange's theorem	: 2 question
Normal Sub groups	: 1 question
Homomorphism	: 2 questions
Permutations and Cyclic groups	: 2 questions

**Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks. $5 \times 8M = 40M$**

SECTION- II

Groups	: 2 questions
Subgroups, Co-sets & Lagrange's theorem	: 2 questions
Normal Subgroups	: 1 question

SECTION-III

Normal Subgroups	: 1 question
Homomorphisms	: 2 questions
Permutations and Cyclic groups	: 2 questions



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Affiliated to Adikavi Nannayya University
II B.Sc Mathematics Major (for 2023 – 2027 batch, w.e.f 2024-25)
Course-2 : GROUP THEORY
Model Question Paper

Time: 3Hrs

Max Marks: 60

SECTION - I

Answer any FIVE Questions, each question carries FOUR marks. 5x4M = 20M

1. Show that the set Q^+ of all positive rational numbers forms an abelian group under the composition "o" defined by $aob = \frac{ab}{3} \forall a, b \in Q^+$
2. If H is any subgroup of a group G, then prove that $H^{-1}=H$.
3. Prove that any two left (right) co-sets of a subgroup are either disjoint or identical.
4. Prove that every sub group of an abelian group is normal.
5. Let G be a multiplicative group and $f : G \rightarrow G$ such that for $a \in G$, $f(a)=a^{-1}$, then prove that f is one-one onto and f is homomorphism iff G is commutative.
6. The homomorphic image of a group is a group.
7. Find the order of the cycle (1 4 5 7).
8. Show that the group $(G=\{1,2,3,4,5,6\}, \times_7)$ is cyclic. Also write down all its generators.

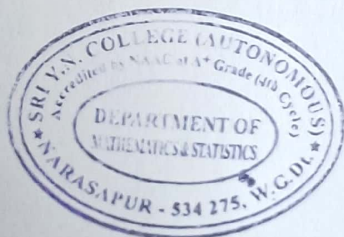
Answer any FIVE questions. Choosing atleast TWO questions from each section. 5x8M = 40M
Each question carries EIGHT marks.

SECTION – II

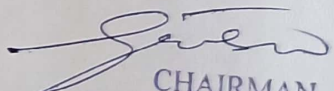
9. Prove that in a group G, for $a, b, x, y \in G$ the equation $ax=b$ and $ya=b$ have unique solutions.
10. Define Order of an element of a group. In a group G for $a, b \in G$, $O(a)=5$, $b \neq e$ and $aba^{-1} = b^2$, then find $O(b)$.
11. Prove that union of two subgroups is also a subgroup iff one is contained in another.
12. If H is a subgroup of group G, then Prove that there is one to one correspondence between the set of all distinct left cosets of H in G and the set of all distinct right cosets of H in G
13. Prove that a subgroup H of a group G is a normal subgroup of G iff the product of two right cosets of H in G is again a right coset of H in G.

SECTION – III

14. If G is a group and H is a subgroup of index 2 in G, then prove that H is a normal subgroup of G.
15. Let G be a group and G^1 be a non empty set. If there exists a mapping f of G onto G^1 such that $f(ab)=f(a)f(b)$ for $a, b \in G$, then prove that G^1 is a group.
16. Let f be a homomorphism of a group G onto a group G^1 . Let K be the Kernel of f. Prove that the necessary and sufficient condition for f to be an isomorphism is that $K=\{e\}$, where e is the identity element in G.
17. If $f=(1\ 2\ 3\ 4\ 5\ 8\ 7\ 6)$, $g=(4\ 1\ 5\ 6\ 7\ 3\ 2\ 8)$ are cyclic permutations, then show that $(fg)^{-1}=g^{-1}f^{-1}$.
18. Prove that a group of prime order is cyclic.



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SRI Y.N.COLLEGE(Autonomous), Narsapur
Affiliated to Adikavi Nannayya University

II B.Sc Mathematics Major Syllabus for IV semester
Course 9 - RING THEORY (for 2023-2027 batch, w.e.f 2024-25)

Course Outcomes

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

1. acquire the basic knowledge of rings, fields and integral domains
2. get the knowledge of subrings and ideals
3. construct composition tables for finite quotient rings
4. study the homomorphisms and isomorphisms with applications.
5. get the idea of division algorithm of polynomials over a field.

Syllabus

Unit – 1 : Rings and Fields (8 Marks - 2,4 Marks - 2)

Definition of a ring and Examples –Basic properties – Boolean rings – Fields – Divisors of 0 and Cancellation Laws– Integral Domains – Division ring - The Characteristic of a Ring, Integral domain and Field – Non Commutative Rings - Matrices over a field – The Quaternion ring.

Unit – 2 : Subrings and Ideals (8 Marks - 2,4 Marks - 2)

Definition and examples of Subrings – Necessary and sufficient conditions for a subset to be a subring – Algebra of Subrings – Centre of a ring – left, right and two sided ideals – Algebra of ideals – Equivalence of a field and a commutative ring without proper ideals

Unit - 3: Principal ideals and Quotient rings (8 Marks - 2,4 Marks - 1)

Definition of a Principal ideal ring(Domain) – Every field is a PID – The ring of integers is a PID – Example of a ring which is not a PIR – Cosets – Algebra of cosets – Quotient rings – Construction of composition tables for finite quotient rings of the ring Z of integers and the ring Z_n of integers modulo n .

Unit – 4 : Homomorphism of Rings (8 Marks - 2,4 Marks - 2)

Homomorphism of Rings – Definition and Elementary properties – Kernel of a homomorphism – Isomorphism – Fundamental theorems of homomorphism of rings – Maximal and prime Ideals – Prime Fields

Unit – 5 : Rings of Polynomials (8 Marks - 2,4 Marks - 1)

Polynomials in an indeterminate – The Evaluation morphism -- The Division Algorithm in $F[x]$ – Irreducible Polynomials – Ideal Structure in $F[x]$ – Uniqueness of Factorization $F[x]$.

Activities :Seminar/ Quiz/ Assignments/ Applications of ring theory concepts to Real life Problem /Problem Solving Sessions.

Text book :Modern Algebra by A.R.Vasishta and A.K.Vasishta, Krishna Prakashan Media Pvt. Ltd.

Reference books

1. A First Course in Abstract Algebra by John. B. Farleigh, Narosa Publishing House.
2. Linear Algebra by Stephen. H. Friedberg and Others,Pearson Education India



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SEMESTER-IV
BLUE PRINT
MATHEMATICS MAJOR

Course -9 : RING THEORY

Time: 3Hrs.

Max.Marks:60

SECTION - I

Answer any FIVE questions, each question carries FOUR marks.

5 x 4M = 20M

Unit - I : 2questions

Unit - II : 2 questions

Unit - III : 1 question

Unit - IV : 2 questions

Unit - V : 1 question

Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks.

5 x 8M = 40M

SECTION - II

Unit - I : 2 questions

Unit - II : 2 questions

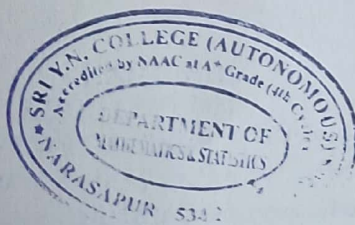
Unit - III : 1 question

SECTION- III

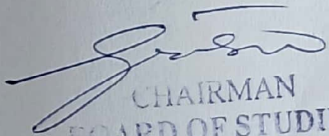
Unit - III : 1 question

Unit - IV : 2 questions

Unit - V : 2 questions



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Affiliated to Adikavi Nannayya University
II B.Sc Mathematics Major - IV semester
Course 9 : Ring Theory (for 2023 – 2027 batch, w.e.f 2024-25)
Model Question Paper

Time: 3Hrs

SECTION – I

Max. Marks: 60

Answer any FIVE questions. Each question carries FOUR marks

5 x 4M = 20M

1. If R is a Boolean ring, then prove that (i) $a + a = 0 \forall a \in R$, (ii) $a + b = 0 \Rightarrow a = b$ and (iii) R is commutative under multiplication.
2. In an integral domain D , two non-zero elements $a, b \in D$ are associates iff $a|b$ and $b|a$.
3. Show that the set of matrices $\begin{bmatrix} a & b \\ 0 & c \end{bmatrix}$ is a subring of the ring of 2×2 matrices whose elements are integers.
4. Prove that a field has no proper non trivial ideals.
5. Prove that every Euclidean ring possesses unity element.
6. Prove that in the ring Z of integers the ideal generated by prime integer is a maximal ideal.
7. Is the ring $2Z$ isomorphic to the ring $3Z$?
8. Find the sum and product of $f(x) = 5 + 4x + 2x^2 + 2x^3$ and $g(x) = 1 + 4x + 5x^2 + 3x^3$ over the ring Z_6 . Find $\deg(f(x)+g(x))$ and $\deg(f(x).g(x))$.

Answer any FIVE questions, choosing atleast two from each section.

Each question carries EIGHT marks

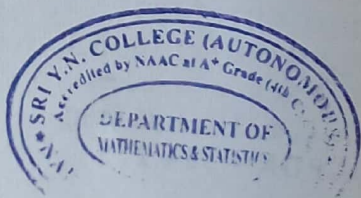
5 x 8M = 40M

SECTION – II

9. Prove that a ring has no zero divisors iff the cancellation laws hold in R .
10. Prove that the set $Z[i] = \{a + ib \mid a, b \in Z, i^2 = -1\}$ of Gaussian integers is an integral domain w.r.t addition and multiplication of numbers.
11. If a ring and $C(R) = \{x \in R \mid xa = ax, \forall a \in R\}$, then prove that $C(R)$ is a subring of R .
12. If U_1 and U_2 are two ideals of a ring R , then prove that $U_1 + U_2 = \{x + y \mid x \in U_1, y \in U_2\}$
13. Prove that the ring of integers Z is a Principal ideal ring.

SECTION – III

14. If U is an ideal of a ring R then the set $\frac{R}{U} = \{x + U \mid x \in R\}$ is a ring with respect to the induced operations of addition (+) and multiplication ($\bullet$) of cosets defined follows : $(a + U) + (b + U) = (a + b) + U$ and $(a + U) \bullet (b + U) = ab + U$ for $a + U, b + U \in \frac{R}{U}$
15. Prove that every quotient ring of a ring is a homomorphic image of the ring.
16. Prove that an ideal U of a commutative ring R with unity is maximal iff the quotient ring R/U is a field.
17. State and prove Division algorithm theorem of a ring of polynomials.
18. Prove that $F[x]$ is a principal ideal ring.



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SRI Y.N.COLLEGE(Autonomous), Narsapur
Affiliated to Adikavi Nannayya University
II B.Sc Mathematics Major Syllabus for IV semester
Course 10 – REAL ANALYSIS (for 2023-2027 batch, w.e.f 2024-25)

UNIT – I : REAL NUMBERS

The algebraic and order properties of $\mathbb{R}$, Absolute value and Real line, Completeness property of $\mathbb{R}$, Applications of supreme property; intervals. **(No. Question is to be set from this portion)**

Real Sequences (8 Marks-2,4 Marks-2)

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, Limit Point of Sequence, Subsequences and the Bolzano-weierstrass theorem – Cauchy Sequences – Cauchy's general principle of convergence theorem.

UNIT –II : INFINITIE SERIES(8 Marks-2,4Marks-2)

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. Canchy's n^{th} root test or Root Test.
3. D-Alembert's Test or Ratio Test.
4. Alternating Series – Leibnitz Test.

Absolute convergence and conditional convergence, semi convergence.

UNIT – III : CONTINUITY (8 Marks-1,4 Marks-1)

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, uniform continuity.

UNIT – IV (12 hrs) : DIFFERENTIATION & MEAN VALUE THEOREMS

(8Marks-2,4 Marks-2)

The derivability of a function, on an interval, at a point, Derivability and continuity of a function, Graphical meaning of the Derivative, Mean value Theorems; Rolle's Theorem, Lagrange's Theorem, Cauchy's Mean value Theorem.

ADDITIONAL INPUT:

Generalized Mean value Theorems - Taylor's Theorem(Statement Only), Maclaurin's Theorem(Statement only), Expansion of functions with different forms of remainders, Taylor's MaclaurinsSeries, power series representation of functions.

UNIT – V : RIEMANN INTEGRATION(8 Marks-3,4 Marks-1)

Riemann Integral, Riemann integral functions, Darboux theorem. Necessary and sufficient condition for $\mathbb{R}$ – integrability, Properties of integrable functions, Fundamental theorem of integral calculus, integral as the limit of a sum, Mean value Theorems.

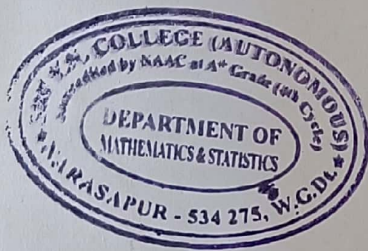
Activities : Seminar/ Quiz/ Assignments/ Applications of ring theory concepts to Real life Problem /Problem Solving Sessions.

Prescribed Text Book:

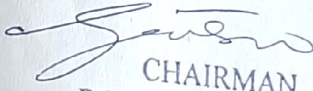
A Text Book of B.Sc Mathematics Volume-II (S.Chand & Company)
(V.Venkateswara Rao, N.Krishnamurthy, B.V.S.S.Sarma, S.Anjaneya Sastry)

REFERENCE TEXT BOOKS :

1. "Introduction to Real Analysis" by RABERT g BARTELY and .D.R. SHERBART Published by John Wiley.
2. Elements of Real Analysis on per UGC Syllabus by Shanthi Narayan and Dr. M.D. Raisinghania Published by S. Chand & Company Pvt. Ltd., New Delhi.



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SEMESTER-IV
BLUE PRINT
MATHEMATICS MAJOR

Course -10 : REAL ANALYSIS

Time: 3Hrs.

Max. Marks:60

SECTION-I
Answer any FIVE Questions, each question carries FOUR marks. $5 \times 4M = 20M$

Real Sequences	: 2 questions
InfiniteSeries	: 2 questions
Continuity	: 1 question
Differentiation	: 2 questions
Riemann Integration	: 1 question

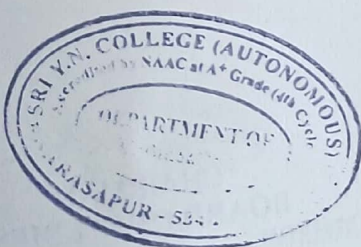
Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks. $5 \times 8 M = 40M$

SECTION-II

Real Sequences	: 2 questions
Infinite Series	: 2 questions
Continuity	: 1 question

SECTION-III

Differentiation& Generalized Mean value theorems	: 2 questions
Riemann Integration	: 3 questions



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Affiliated to Adikavi Nannayya University

II B.Sc Mathematics Major Model Paper for IV semester
Course 10 – REAL ANALYSIS (for 2023-2027 batch, w.e.f 2024-25)

Time: 3Hrs

SECTION - I

Max Marks: 60

Answer any FIVE Questions, each question carries FOUR marks. 5x4M = 20M

1. If $\{s_n\}$ is a Cauchy sequence then prove that $\{s_n\}$ is convergent.
2. Prove that $\lim \left[\frac{1}{(n+1)^2} + \frac{1}{(n+2)^2} + \dots + \frac{1}{(n+n)^2} \right] = 0$.
3. Test for the convergence of $\sum_{n=1}^{\infty} \frac{2^n - 2}{2^{n+1}} x^n$, $x > 0$
4. Examine the convergence of $\sum (-1)^n \frac{1}{n} \left(1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n} \right)$.
5. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be such that $f(x) = \frac{\frac{1}{e^x} - \frac{-1}{e^x}}{\frac{1}{e^x} + e^{\frac{-1}{x}}}$ if $x \neq 0$ and $f(0) = 1$ discuss the continuity at $x=0$.
6. Discuss the applicability of Lagrange's mean value theorem for $f(x) = x(x-1)(x-2)$ on $[0, \frac{1}{2}]$.
7. Prove that $\tan x > x > \sin x \forall x \in (0, \frac{\pi}{2})$.
8. Evaluate $\int_0^{\frac{\pi}{4}} (\sec^4 x - \tan^4 x) dx$.

Answer any FIVE questions. Choosing at least TWO questions from each section. Each question carries EIGHT marks.

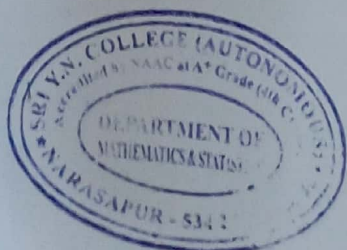
5x8M = 40M

SECTION – II

9. Prove that a monotone sequence is convergent iff it is bounded.
10. State and prove Cauchy's general principle of convergence.
11. State and prove D-Alembert's test.
12. State and prove Cauchy's n^{th} root test.
13. Examine the continuity of f defined by $f(x) = |x| + |x-1|$ at $x=0, 1$.

SECTION-III

14. Determine the constants a, b so that the function f defined by $f(x) = 2x + 1$, if $x \leq 1$, $f(x) = ax^2 + b$ if $1 < x < 3$; $f(x) = 5x + 2a$ if $x \geq 3$ is continuous everywhere.
15. State and prove Rolle's theorem.
16. If $f: [a, b] \rightarrow \mathbb{R}$ is monotonic on $[a, b]$, then prove that f is integrable on $[a, b]$.
17. State and prove First mean value theorem.
18. Show that $\frac{1}{4} < \int_0^{1/4} \frac{dx}{\sqrt{1-x^2}} < \frac{1}{\sqrt{15}}$.



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II B.Sc Mathematics Major Syllabus for 1st semester Course 11- INTEGRAL TRANSFORMS (for 2023-2027 batch, w.e.f 2024-25)

Learning Outcomes

Students after successful completion of the course will be able to

1. understand the application of Laplace transforms to solve ODEs
2. understand the application of Laplace transforms to solve Simultaneous DEs
3. understand the application of Laplace transforms to Integral equations
4. basic knowledge of Fourier-Transformations
5. Comprehend the properties of Fourier transforms and solve problems related to finite Fourier transforms.

Syllabus

Unit – 1 (8 Marks -2,4 Marks -2)

Application of Laplace Transform to solutions of Differential Equations

Solutions of ordinary Differential Equations - Solutions of Differential Equations with constants coefficients - Solutions of Differential Equations with Variable coefficients.

Unit – 2 (8 Marks -2,4 Marks -1)

Application of Laplace Transform to solutions of Differential Equations

Solutions of Simultaneous Ordinary Differential equations - Solutions of Partial Differential Eqns.

Unit – 3 : Application of Laplace Transforms to Integral Equations(8 Marks -2,4 Marks -1)

Definitions of Integral Equations - Abel's Integral Equation - Integral Equation of Convolution Type - Integral Differential Equations - Application of L.T. to Integral Equations.

Unit – 4: Fourier Transforms - I (8 Marks -2,4 Marks -2)

Definition of Fourier Transform - Fourier sine Transform - Fourier cosine Transform - Linear Property of Fourier Transform - Change of Scale Property for Fourier Transform - sine Transform and cosine transform shifting property - Modulation theorem.

Unit – 5 : Fourier Transforms – II (8 Marks -2,4 Marks -2)

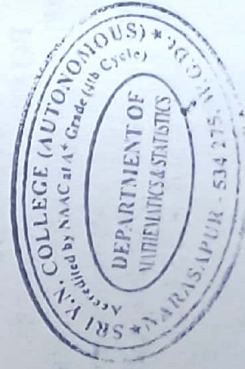
Definition of Convolution - Convolution theorem for Fourier transform - Parseval's Identity - Relationship between Fourier and Laplace transforms - problems related to Integral Equations - **Finite Fourier Transforms** - Finite Fourier Sine Transform - Finite Fourier Cosine Transform - Inversion formula for sine and cosine transforms only - statement and related problems.

Activities : Seminar/ Quiz/ Assignments/Applications of Integral Transforms in real life problems /Problem Solving Sessions.

Text Book:B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.

Reference Book

1. Fourier Series and Integral Transformations by Dr.S. Sreenadh and others, published by S.Chand and Co, New Delhi
2. E.M. Stein and R. Shakarchi, Fourier analysis: An introduction, (Princeton University Press, 2003).
3. R.S. Strichartz, A guide to Distribution theory and Fourier transforms, (World scientific, 2003).




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SEMESTER-IV
BLUE PRINT
MATHEMATICS MAJOR

Course- 11 : INTEGRAL TRANSFORMATIONS

Time: 3Hrs.

Max.Marks:60

SECTION - I

Answer any FIVE questions, each question carries FOUR marks.

$$5 \times 4M = 20M$$

Unit - I	: 2 questions
Unit - II	: 1 question
Unit - III	: 1 questions
Unit - IV	: 2 questions
Unit - V	: 2 questions

Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks.

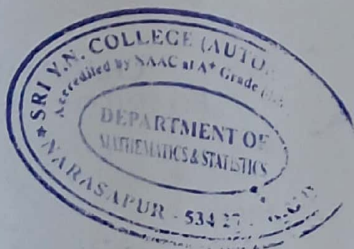
$$5 \times 8M = 40M$$

SECTION - II

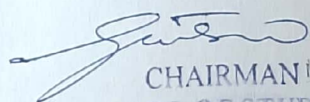
Unit - I	: 2 questions
Unit - II	: 2 questions
Unit - III	: 1 question

SECTION- III

Unit - III	: 1 question
Unit - IV	: 2 questions
Unit - V	: 2 questions



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SECTION – I

5 x 4M = 20M

Answer any FIVE questions. Each question carries FOUR marks

1. Solve $(D^2 + 4D + 5)y = 5$, given that $y(0) = 0, y'(0) = 0$
2. Solve the integral equation $y + \int_0^t y \, dt = 1 - e^{-t}$.
3. If $y(x, t)$ is a function of x and t , prove that (i) $L(\frac{\partial y}{\partial t}) = p\bar{y}(x, p) - y(x, 0)$.
4. Solve $F'(t) = t + \int_0^t \cos u F(t-u) \, du, F(0) = 4$.
5. Find the Fourier transform of $f(x) = \frac{1}{x}$.
6. Find the Fourier cosine transform of e^{-x^2} .
7. Solve the integral equation $\int_0^\infty f(x) \cos \lambda x \, dx = e^{-\lambda}$
8. Find the finite Fourier sine transform of $f(x) = x^3$ in $(0, \pi)$.

Answer any FIVE questions, choosing atleast two from each section.

5 x 8M = 40M

Each question carries EIGHT marks

SECTION – II

9. Solve $(D^2 + 9)y = \cos 2t$ if $y(0) = 1, y(\frac{\pi}{2}) = -1$.
10. Solve $ty'' + (t-1)y' - y = 0$ with $y(0) = 5, y(\infty) = 0$.
11. Solve $(D^2 - 3)x - 4y = 0, x + (D^2 + 1)y = 0, t > 0$ if $x = y = Dy = 0, Dx = 2$ when $t = 0$.
12. Solve $\frac{\partial y}{\partial t} = 3 \frac{\partial^2 y}{\partial x^2}$, where $y(\frac{\pi}{2}, t) = 0, (\frac{\partial y}{\partial x})_{x=0} = 0$ and $y(x, 0) = 30 \cos 5x$.
13. Solve $F(t) = 1 + \int_0^t \sin(t-u) F(u) \, du$ and verify your solution.

SECTION – III

14. Solve the integral equation $\int_0^t \frac{F(u) \, du}{\sqrt{t-u}} = 1 + t + t^2$.
15. State and prove change of scale property for Fourier transform and Modulation theorem.
16. Find Fourier Sine transform of $\frac{e^{-ax}}{x}$ and hence deduce that $\int_0^\infty \frac{e^{-ax} - e^{-bx}}{x} \sin px \, dx = \tan^{-1} \frac{p}{a} - \tan^{-1} \frac{p}{b}$.
17. Using Parseval's identity, show that $\int_0^\infty \frac{dx}{(x^2 + a^2)(x^2 + b^2)} = \frac{\pi}{2ab(a+b)}$.
18. Find the finite sine and cosine transform of $f(x) = \sin ax$ in $(0, \pi)$



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SRI Y.N.COLLEGE(Autonomous), Narsapur
Affiliated to Adikavi Nannayya University

II B.Sc Mathematics Minor Syllabus for IV semester
Course 3 - RING THEORY (for 2023-2027 batch, w.e.f 2024-25)

Course Outcomes

- After successful completion of this course, the student will be able to
1. acquire the basic knowledge of rings, fields and integral domains
 2. get the knowledge of subrings and ideals
 3. construct composition tables for finite quotient rings
 4. study the homomorphisms and isomorphisms with applications.
 5. get the idea of division algorithm of polynomials over a field.

Syllabus

Unit – 1 : Rings and Fields (8 Marks - 2,4 Marks - 2)

Definition of a ring and Examples –Basic properties – Boolean rings - Fields – Divisors of 0 and Cancellation Laws– Integral Domains – Division ring - The Characteristic of a Ring, Integral domain and Field – Non Commutative Rings - Matrices over a field – The Quaternion ring.

Unit – 2 : Subrings and Ideals (8 Marks - 2,4 Marks - 2)

Definition and examples of Subrings – Necessary and sufficient conditions for a subset to be a subring – Algebra of Subrings – Centre of a ring – left, right and two sided ideals – Algebra of ideals – Equivalence of a field and a commutative ring without proper ideals

Unit - 3: Principal ideals and Quotient rings (8 Marks - 2,4 Marks - 1)

Definition of a Principal ideal ring(Domain) – Every field is a PID – The ring of integers is a PID – Example of a ring which is not a PIR -- Cosets – Algebra of cosets – Quotient rings – Construction of composition tables for finite quotient rings of the ring $\mathbb{Z}$ of integers and the ring $\mathbb{Z}_n$ of integers modulo n .

Unit – 4 : Homomorphism of Rings (8 Marks - 2,4 Marks - 2)

Homomorphism of Rings – Definition and Elementary properties – Kernel of a homomorphism – Isomorphism – Fundamental theorems of homomorphism of rings – Maximal and prime Ideals – Prime Fields

Unit – 5 : Rings of Polynomials (8 Marks - 2,4 Marks - 1)

Polynomials in an indeterminate – The Evaluation morphism -- The Division Algorithm in $F[x]$ – Irreducible Polynomials – Ideal Structure in $F[x]$ – Uniqueness of Factorization $F[x]$.

Activities :Seminar/ Quiz/ Assignments/ Applications of ring theory concepts to Real life Problem /Problem Solving Sessions.

Text book :Modern Algebra by A.R.Vasishta and A.K.Vasishta, Krishna Prakashan Media Pvt. Ltd.

Reference books

1. A First Course in Abstract Algebra by John. B. Farleigh, Narosa Publishing House.
2. Linear Algebra by Stephen. H. Friedberg and Others, Pearson Education India



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SEMESTER-IV
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MATHEMATICS MINOR

Course -3 : RING THEORY

Time: 3Hrs.

Max.Marks:60

SECTION - I

Answer any FIVE questions, each question carries FOUR marks.

5 x 4M = 20M

Unit - I	: 2questions
Unit - II	: 2 questions
Unit - III	: 1 question
Unit - IV	: 2 questions
Unit - V	: 1 question

Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries EIGHT marks.

5 x 8M = 40M

SECTION – II

Unit - I	: 2 questions
Unit - II	: 2 questions
Unit – III	: 1 question

SECTION- III

Unit - III	: 1 question
Unit - IV	: 2 questions
Unit - V	: 2 questions



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Affiliated to Adikavi Nannayya University
II B.Sc Mathematics Minor - III semester
Course 3 : Ring Theory (for 2023 – 2027 batch, w.e.f 2024-25)
Model Question Paper

Time: 3Hrs

Max. Marks: 60

SECTION – I

5 x 4M = 20M

Answer any FIVE questions. Each question carries FOUR marks

1. If R is a Boolean ring, then prove that (i) $a + a = 0 \forall a \in R$, (ii) $a + b = 0 \Rightarrow a = b$ and (iii) R is commutative under multiplication.
2. Find all solutions of $x^2 - x + 2 = 0$ over $\mathbb{Z}_3$ (i).
3. Let R be a ring and $a \in R$ be fixed element, then prove that $S = \{x \in R / ax = 0\}$ is a sub ring of R .
4. Prove that a field has no proper non trivial ideals.
5. Prove that every Euclidean ring possesses unity element.
6. Prove that in the ring $\mathbb{Z}$ of integers the ideal generated by prime integer is a maximal ideal.
7. Prove that the homomorphic image of a ring is a ring.
8. Find the factors of $x^4 + 4$ in $\mathbb{Z}_5[x]$.

Answer any FIVE questions, choosing atleast two from each section.
Each question carries EIGHT marks

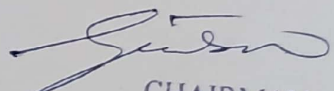
5 x 8M = 40M

SECTION – II

9. Prove that a ring has no zero divisors iff the cancellation laws hold in R .
10. Prove that the set of all 2×2 matrices over the field of complex numbers is a ring with unity under addition and multiplication of matrices.
11. If a ring and $C(R) = \{x \in R / xa = ax, \forall a \in R\}$, then prove that $C(R)$ is a subring of R .
12. If U_1 and U_2 are two ideals of a ring R , then prove that $U_1 \cup U_2$ is an ideal of R iff $U_1 \subset U_2$ or $U_2 \subset U_1$.
13. Prove that the ring of integers is an Euclidean ring.

SECTION – III

14. If U is an ideal of a ring R then the set $\frac{R}{U} = \{x + U \mid x \in R\}$ is a ring with respect to the induced operations of addition (+) and multiplication ($\bullet$) of cosets defined follows : $(a + U) + (b + U) = (a + b) + U$ and $(a + U) \bullet (b + U) = ab + U$ for $a + U, b + U \in \frac{R}{U}$.
15. If f is a homomorphism of a ring R into the ring R^1 , then prove that f is an into isomorphism iff $\ker f = \{0\}$.
16. If M is a maximal ideal of the ring of integers $\mathbb{Z}$, then prove that M is generated by prime integer.
17. State and prove Factor theorem.
18. Prove that $F[x]$ is a principal ideal ring.


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Affiliated to Adikavi Nannayya University
II B.Sc Mathematics Minor Syllabus for IV semester
Course 4 – REAL ANALYSIS (for 2023-2027 batch, w.e.f 2024-25)

UNIT – I : REAL NUMBERS

The algebraic and order properties of $\mathbb{R}$, Absolute value and Real line, Completeness property of $\mathbb{R}$, Applications of supreme property; intervals. **(No. Question is to be set from this portion)**

Real Sequences (8 Marks-2,4 Marks-2)

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, Limit Point of Sequence, Subsequences and the Bolzano-weierstrass theorem – Cauchy Sequences – Cauchy's general principle of convergence theorem.

UNIT –II : INFINITIE SERIES(8 Marks-2,4Marks-2)

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. Canchy's n^{th} root test or Root Test.
3. D-Alembert's Test or Ratio Test.
4. Alternating Series – Leibnitz Test.

Absolute convergence and conditional convergence, semi convergence.

UNIT – III : CONTINUITY (8 Marks-1,4 Marks-1)

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, uniform continuity.

UNIT – IV (12 hrs) : DIFFERENTIATION & MEAN VALUE THEOREMS

(8Marks-2,4 Marks-2)

The derivability of a function, on an interval, at a point, Derivability and continuity of a function, Graphical meaning of the Derivative, Mean value Theorems; Rolle's Theorem, Lagrange's Theorem, Cauchy's Mean value Theorem.

ADDITIONAL INPUT:

Generalized Mean value Theorems - Taylor's Theorem(Statement Only), Maclaurin's Theorem(Statement only), Expansion of functions with different forms of remainders, Taylor's MaclaurinsSeries, power series representation of functions.

UNIT – V : RIEMANN INTEGRATION(8 Marks-3,4 Marks-1)

Riemann Integral, Riemann integral functions, Darboux theorem. Necessary and sufficient condition for $\mathbb{R}$ – integrability, Properties of integrable functions, Fundamental theorem of integral calculus, integral as the limit of a sum, Mean value Theorems.

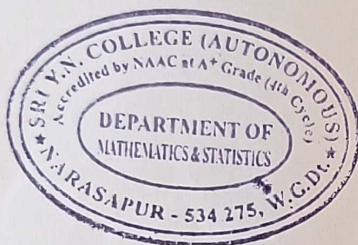
Activities : Seminar/ Quiz/ Assignments/ Applications of ring theory concepts to Real life Problem /Problem Solving Sessions.

Prescribed Text Book:

A Text Book of B.Sc Mathematics Volume-II (S.Chand& Company)
(V.Venkateswara Rao, N.Krishnamurthy, B.V.S.S.Sarma, S.Anjaneya Sastry)

REFERENCE TEXT BOOKS :

- 1."Introduction to Real Analysis" by RABERT g BARTELY and .D.R. SHERBART Published by John Wiley.
2. Elements of Real Analysis on per UGC Syllabus by Shanthi Narayan and Dr. M.D. RaisinghaniaPublished by S. Chand & Company Pvt. Ltd., New Delhi.



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SEMESTER-IV
BLUE PRINT
MATHEMATICS MINOR

Course -4 : REAL ANALYSIS

Time: 3Hrs.

Max. Marks:60

SECTION-I

Answer any FIVE Questions, each question carries FOUR marks. $5 \times 4M = 20M$

Real Sequences	: 2 questions
InfiniteSeries	: 2 questions
Continuity	: 1 question
Differentiation	: 2 questions
Riemann Integration	: 1 question

**Answer any FIVE questions. Choosing at least TWO questions from each section.
Each question carries EIGHT marks.**

$5 \times 8 M = 40M$

SECTION-II

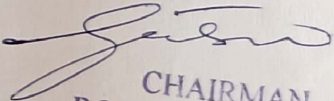
Real Sequences	: 2 questions
Infinite Series	: 2 questions
Continuity	: 1 question

SECTION-III

Differentiation& Generalized Mean value theorems	: 2 questions
Riemann Integration	: 3 questions



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SRI Y.N.COLLEGE(Autonomous), Narsapur
Affiliated to Adikavi Nannayya University
II B.Sc Mathematics Minor Model Paper for IV semester
Course 4 – REAL ANALYSIS (for 2023-2027 batch, w.e.f 2024-25)

Time: 3Hrs

SECTION -I

Max Marks: 60

Answer any FIVE Questions, each question carries FOUR marks. 5x4M =20M

1. Prove that every convergent sequence is bounded.
2. Prove that the sequence $\{s_n\}$ where $s_n = \frac{1}{n+1} + \frac{1}{n+2} + \dots + \frac{1}{n+n}$ is convergent.
3. Test for convergence $\sum \frac{1}{2^n + 3^n}$.
4. Examine the convergence of $\sum (-1)^n \frac{1}{n} \left(1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n}\right)$.
5. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be such that $f(x) = \frac{\frac{1}{e^x} - \frac{-1}{x}}{\frac{1}{e^x} + \frac{-1}{x}}$ if $x \neq 0$ and $f(0)=1$ discuss the continuity at $x=0$.
6. Discuss the applicability of Rolle's theorem $f(x) = \log \left(\frac{x^2+ab}{x(a+b)} \right)$ in $[a, b]$, $a>0$.
7. Prove that $\tan x > x > \sin x \forall x \in (0, \frac{\pi}{2})$.
8. Evaluate $\int_0^{\frac{\pi}{4}} (\sec^4 x - \tan^4 x) dx$.

Answer any FIVE questions. Choosing at least TWO questions from each section. Each question carries EIGHT marks.

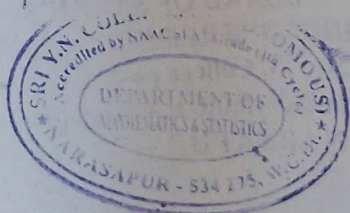
SECTION – II

5x8M = 40M

9. Prove that a monotone sequence is convergent iff it is bounded.
10. State and prove Cauchy's general principle of convergence.
11. State and prove D-Alembert's test.
12. State and prove Cauchy's n^{th} root test.
13. Show that $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = \frac{x-|x|}{x}$ for $x \neq 0$ and $f(x) = 2$ for $x = 0$ is continuous at all points of $\mathbb{R}$ except at $x = 0$.

SECTION-III

14. If $f: I = [a, b] \rightarrow \mathbb{R}$ is continuous on $[a, b]$, then prove that f is bounded on $[a, b]$ and attains its bounds.
15. State and prove Rolle's theorem.
16. If $f: [a, b] \rightarrow \mathbb{R}$ is monotonic on $[a, b]$, then prove that f is integrable on $[a, b]$.
17. State and prove Fundamental theorem of integral calculus.
18. Prove that $\frac{1}{\pi} \leq \int_0^1 \frac{\sin \pi x}{1+x^2} dx \leq \frac{2}{\pi}$



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Affiliated to Adikavi Nannaya University
III B.Sc Mathematics (for 2022-2025 batch w.e.f 2022-2023)
Paper VI , Syllabus for V semester
NUMERICAL METHODS

UNIT- I: (10 Marks -2)(5 Marks -2)

ADDITIONAL INPUT: Errors in Numerical computations :

Errors and their Accuracy, Mathematical Preliminaries, Errors and their Analysis, Absolute, Relative and Percentage Errors, A general error formula, Error in a series approximation.

Finite Differences and Interpolation with Equal intervals:

Introduction, Forward differences, Backward differences, Central Differences, Symbolic relations, nth Differences of Some functions, Advancing Difference formula, Differences of Factorial Polynomial, Summation of Series. Newton's formulae for interpolation, Central Difference Interpolation Formulae.

UNIT- II: (10 Marks -2)(5 Marks -2)

Interpolation with Equal and Unequal intervals:

Gauss's Forward interpolation formulae, Gauss's backward interpolation formulae, Stirling's formula, Bessel's formula. Interpolation with unevenly spaced points, divided differences and properties, Newton's divided differences formula. Lagrange's interpolation formula, Lagrange's Inverse interpolation formula.

UNIT- III: (10 Marks -2)(5 Marks -1)

Numerical Differentiation:

Derivatives using Newton's forward difference formula, Newton's back ward difference formula, Derivatives using central difference formula, Stirling's interpolation formula, Newton's divided difference formula, Maximum and minimum values of a tabulated function.

UNIT- IV: (10 Marks -2)(5 Marks -2)

Numerical Integration:

General quadrature formula one errors, Trapezoidal rule, Simpson's 1/3- rule, Simpson's 3/8 - rule, and Weddle's rules, Euler - McLaurin Formula of summation and quadrature, The Euler transformation.

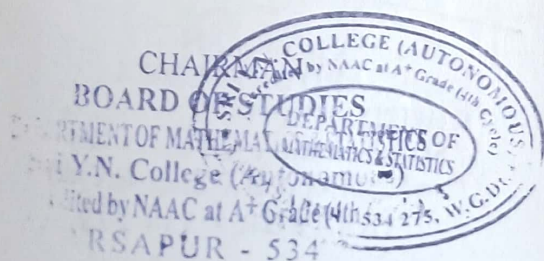
UNIT- V: (10 Marks -2)(5 Marks -1)

Numerical solution of ordinary differential equations:

Introduction, Solution by Taylor's Series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge - Kutta methods.

PRESCRIBED TEXT BOOK:

1. Numerical Analysis by Dr. A Anjaneyulu, published by Deepti Publications.
2. S.Ranganatham, Dr.M.V.S.S.N.Prasad, Dr.V.RameshBabu, Numerical Analysis, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055



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SEMESTER-V
BLUE PRINT
Paper VI : NUMERICAL METHODS

Time: 3Hrs.

Max. Marks:75

PART-I(5 x 5 = 25 M)

Answer any FIVE Questions, each question carries FIVE marks.

Errors in Numerical computations &

Finite Differences and Interpolation with Equal intervals

: 2 questions

Interpolation with Equal and Unequal intervals

: 2 questions

Numerical Differentiation

: 1 question

Numerical Integration

: 2 questions

Numerical solution of ordinary differential equations

: 1 question

PART-II(5 x 10 M= 50 M)

**Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries 10 marks.**

**Note: Under SECTION-A (Q.NO:13) & SECTION-B (Q.NO:14) will be given from
UNIT-III.**

SECTION-A

Errors in Numerical computations &

Finite Differences and Interpolation with Equal intervals

: 2 questions

Interpolation with Equal and Unequal intervals

: 2 questions

Numerical Differentiation

: 1 question

SECTION-B

Numerical Differentiation

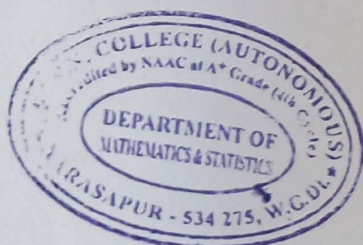
: 1 question

Numerical Integration

: 2 questions

Numerical solution of ordinary differential equations

: 2 questions



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Affiliated to AdikaviNannaya University
III B.Sc. Mathematics – Semester V - Paper VI
NUMERICAL METHODS

Model Question Paper (for 2021-2024 batch w.e.f 2022-2023)

Time: 3Hrs

Max Marks:75

Answer any FIVE Questions, each question carries FIVE marks.

PART-I

5x5M = 25M

1. Evaluate the sum $s = \sqrt{3} + \sqrt{5} + \sqrt{7}$ to four significant digits and find its absolute and relative errors.
2. Given $u_0 = 3, u_1 = 12, u_2 = 81, u_3 = 200, u_4 = 100, u_5 = 8$, find $\Delta^2 u_0$.
3. State and prove Stirling's formula
4. If $f(x) = \frac{1}{x}$ then find $f(a,b)$, where $f(a,b)$ is the first divided difference.
5. Using the following table compute $\frac{dy}{dx}$ at $x=1$.

x	1	2	3	4	5	6
y	1	8	27	64	125	216

6. Find the value of $\int_1^5 \log_{10} x \, dx$ taking 8 subintervals correct to 4 decimal places, by Trapezoidal rule.
7. Evaluate $\int_0^1 \frac{1}{1+x} \, dx$, correct to five decimal places by Euler Maclaurins formula.
8. Using Taylor's series expansion to find a solution of the differential equation $\frac{dy}{dx} = (0.1)(x^3 + y^3)$ with $y(0) = 1$ correct to 4 decimal places.

PART-II

Answer any FIVE questions. Choosing atleast TWO questions from each section.
Each question carries 10 marks.

5x10M = 50M

SECTION – A

9. If $u = \frac{5xy^2}{z^3}$, then find relative maximum error in u , given that $x = \Delta y = \Delta z = 0.001$ and $x = y = z = 1$.

10. Using Newton's Backward interpolation formula, compute $f(7.5)$

x	1	2	3	4	5	6	7	8
f(x)	1	8	27	64	125	216	343	512

11. State and prove Gauss backward interpolation formula.

12. Using Lagrange's interpolation formula, find $f(10)$

x	5	6	9	11
f(x)	12	13	14	16

13. Find the value of $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at $x = 1$ to the given data

x	1	2	3	4	5	6
y	1	8	27	64	125	216

SECTION - B

14. Find the maximum and the minimum values of the function $y = f(x)$ from the following data.

x	0	1	2	3	4	5
y	0	0.25	0	2.25	16	56.25

15. Find the value of integral $\int_0^1 \frac{1}{1+x^2} dx$ by Simpson's $\frac{1}{3}$ rd rule. Hence obtain the approximate value of n .

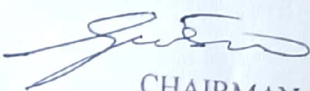
16. Evaluate $\int_4^{5.2} \log x dx$ by using Weddle's rule.

17. Use Runge Kutta method of fourth order to find an approximate value of y when $x=0.1$ and $x=0.2$ given that $x=0$ when $y=1$ and $\frac{dy}{dx} = x + y$

18. Using the Euler's modified method, find $y(0.2)$ for $\frac{dy}{dx} = x + \sqrt{y}$ with $y(0)=1$.



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Affiliated to Adikavi Nannayya University
III B.Sc Mathematics (for 2022-2025 batch w.e.f 2022-2023)
Paper VII Syllabus for V semester
SPECIAL FUNCTIONS

Unit – 1:

Beta and Gamma functions, Chebyshev polynomials (10 Marks -2)(5 Marks -2)
Euler's Integrals-Beta and Gamma Functions, Elementary properties of Gamma Functions, Transformation of Gamma Functions. Another form of Beta Function, Relation between Beta and Gamma Functions. Chebyshev polynomials, orthogonal properties of Chebyshev polynomials, recurrence relations, generating functions for Chebyshev polynomials.

Unit – 2: Power series and Power series solutions of ordinary differential equations (10 Marks -2)(5 Marks -1)

Introduction, summary of useful results, power series, radius of convergence, theorems on Power series, Introduction of power series solutions of ordinary differential equation, Ordinary and singular points, regular and irregular singular points, power series solution.

Unit – 3: Hermite polynomials (10 Marks -2)(5 Marks -2)

Hermite Differential Equations, Solution of Hermite Equation, Hermite polynomials, generating function for Hermite polynomials. Other forms for Hermite Polynomials, Rodrigues formula for Hermite Polynomials, to find first few Hermite Polynomials. Orthogonal properties of Hermite Polynomials, Recurrence formulae for Hermite Polynomials.

Unit – 4: Legendre polynomials - (10 Marks -2)(5 Marks -1)

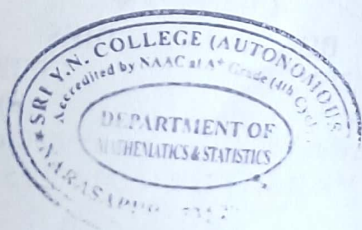
Definition, Solution of Legendre's equation, Legendre polynomial of degree n , generating function of Legendre polynomials. Definition of $P_n(x)$ and $Q_n(x)$, General solution of Legendre's Equation (derivations not required) to show that $P_n(x)$, is the coefficient of h^n in the expansion of $(1 - 2xh + h^2)^{-\frac{1}{2}}$. Orthogonal properties of Legendre's polynomials, Recurrence formulas for Legendre's Polynomials.

Unit – 5: Bessel's equation -(10 Marks -2)(5 Marks -2)

Definition, Solution of Bessel's equation, Bessel's function of the first kind of order n , Bessel's function of the second kind of order n . Integration of Bessel's equation in series form=0, Definition of $J_n(x)$, recurrence formulae for $J_n(x)$, Generating function for $J_n(x)$, orthogonally of Bessel functions.

Reference Books:

1. Dr.M.D.Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
2. J.N.Sharma and Dr.R.K.Gupta, Differential equations with special functions, Krishna Prakashan Mandir.
3. Shanti Narayan and Dr.P.K.Mittal, Integral Calculus, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
4. George F.Simmons, Differential Equations with Applications and Historical Notes, Tata McGRAW-Hill Edition, 1994.
5. Shepley L.Ross, Differential equations, Second Edition, John Willy & sons, New York, 1974.



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SEMESTER-V
BLUE PRINT

Time: 3Hrs.

Max. Marks:75

PART-I (5 x 5M = 25 M)

Answer any **FIVE** Questions, each question carries **FIVE** marks.

Beta and Gamma functions, Chebyshev polynomials	: 2 questions
Power series and Power series solutions of ordinary differential equations	: 1 question
Hermite polynomials	: 2 questions
Legendre polynomials	: 1 question
Bessel's equation	: 2 questions

PART-II (5 x 10 M= 50 M)

Answer any **FIVE** questions. Choosing atleast **TWO** questions from each section.
Each question carries 10 marks.

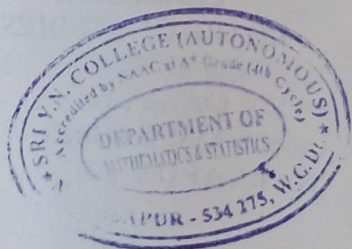
Note: Under **SECTION-A (Q.NO:13) & SECTION-B (Q.NO:14)** will be given from
UNIT-III.

SECTION-A

Beta and Gamma functions, Chebyshev polynomials	: 2 questions
Power series and Power series solutions of ordinary differential equations	: 2 questions
Hermite polynomials	: 1 question

SECTION-B

Hermite polynomials	: 1 question
Legendre polynomials	: 2 questions
Bessel's equation	: 2 questions



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Affiliated to Adikavi Nannaya University
III B.Sc. Mathematics – Semester V - Paper VII

MATHEMATICAL SPECIAL FUNCTIONS
Model Question Paper (for 2022-2025 batch w.e.f 2022-2023)

Time: 3Hrs

Max Marks:75

PART-I

Answer any FIVE Questions, each question carries FIVE marks.

5x5M = 25M

1. Compute $\Gamma\left(-\frac{1}{2}\right)$
2. Evaluate $\int_0^2 \frac{x^2 dx}{\sqrt{(2-x)}}$.
3. Find the radius of convergence of the power series $\sum \frac{(n+1)}{(n+2)(n+3)} x^n$.
4. Prove that $H_n''(x) = 4n(n-1)H_{n-2}(x)$
5. Prove that if $m < n$, $\frac{d^m}{dx^m} \{H_n(x)\} = \frac{2^m n!}{(n-m)!} H_{n-m}(x)$
6. Prove that $(2n+1)xP_n = (n+1)P_{n+1} + nP_{n-1}$
7. Show that $J_{-\frac{1}{2}}(x) = \sqrt{\left(\frac{2}{\pi x}\right)} \cos x$.
8. Prove that $J_2 = J_0^{11} - x^{-1}J_0^1$

PART-II

Answer any FIVE questions. Choosing atleast TWO questions from each section.

Each question carries 10 marks.

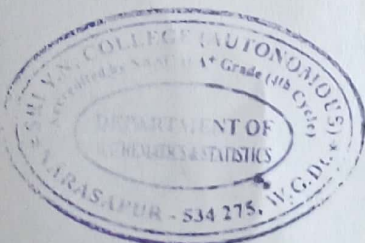
5x10M = 50M

SECTION – A

9. Prove that $\beta(l, m) = \frac{\Gamma(l)\Gamma(m)}{\Gamma(l+m)}$.
10. Show that $2^n \Gamma\left(n + \frac{1}{2}\right) = 1.3.5 \dots (2n-1)\sqrt{\pi}$
11. Find the power series solution of the equation $(x^2 - 1)y'' + xy' - xy = 0$ in powers of x (i.e., about $x = 0$).
12. Show that $x = 0$ is a regular point of $(2x + x^3)y'' - y' - 6xy = 0$ and find its solution about $x = 0$.
13. Prove that $\int_{-\infty}^{\infty} e^{-x^2} H_n(x) H_m(x) dx = \begin{cases} 0 & \text{if } m \neq n \\ 2^n \sqrt{\pi} n! & \text{if } m = n \end{cases}$

SECTION-B

14. Show that $\sum_{r=0}^n \frac{H_k(x) H_k(z)}{2^k k!} = \frac{H_{n+1}(y) H_n(x) - H_{n+1}(x) H_n(y)}{2^{n+1} n! (y-x)}$
15. Prove that $P_n(x) = \frac{1}{n! 2^n} \frac{d^n}{dx^n} (x^2 - 1)^n$
16. Prove that (i) $\int_{-1}^1 P_m(x) P_n(x) dx = 0$ if $m \neq n$ (ii) $\int_{-1}^1 [P_n(x)]^2 dx = \frac{2}{2n+1}$ if $m = n$
17. Prove that $J_n^1(x) = nJ_n(x) - xJ_{n+1}(x)$.
18. Prove that $\frac{d}{dx} [J_n^2 + J_{n+1}^2] = 2\left(\frac{n}{x} + J_n^2 - \frac{n+1}{x} J_{n+1}^2\right)$



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SRI Y.N.COLLEGE(Autonomous), Narsapur
SKILL DEVELOPMENT COURSE - ANALYTICAL SKILLS
Syllabus for BA, B.Sc, B.Com Programmes
Semester – I (for 2024 -28 admitted batch, w.e.f. 2023-24)

Course Objective: Intended to inculcate quantitative analytical skills and reasoning as an inherent ability in students.

Course Outcomes:

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

- 1) Understand the basic concepts of arithmetic ability, quantitative ability, logical reasoning, business computations and data interpretation and obtain the associated skills.
- 2) Acquire competency in the use of verbal reasoning.
- 3) Apply the skills and competencies acquired in the related areas
- 4) Solve problems pertaining to quantitative ability, logical reasoning and verbal ability inside and outside the campus.

UNIT – I :

Arithmetic ability: (10 Questions)

Algebraic operations BODMAS, Fractions, Divisibility rules, LCM & GCD (HCF).

Verbal Reasoning : (10 Questions)

Number Series, Coding & Decoding, Blood relationship, Clocks, Calendars.

UNIT – II :

Quantitative aptitude (10 Questions)

Averages, Ratio and proportion, Problems on ages, Time-distance – speed.

Business computations (10 Questions)

Percentages, Profit & loss, Partnership, simple compound interest.

UNIT – 3:

Data Interpretation: (2 Questions)

Tabulation, Bar Graphs, Pie Charts, Line Graphs, Venn diagram.

Recommended Co – Curricular Activities

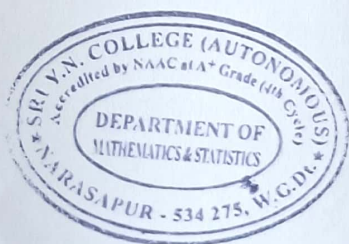
Surprise tests / Viva – Voice / Problem Solving / Group discussion.

Text Book:

1. Quantitative Aptitude for Competitive Examination by R S Agrawal, S.Chand publications.

Reference Books:

1. Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar, New Delhi-110055
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw Hill Publications.



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SRI Y.N.COLLEGE(Autonomous),Narsapur
I B.Sc, B.A, B.Com, BBA, BCA Hon's - Semester - I
SKILL DEVELOPMENT COURSE - ANALYTICAL SKILLS
Model Question Paper (for 2024-28 batch w. e. f 2023-2024)

Time: 2Hrs

Max Marks: 50
50 x 1 = 50M

Answer ALL the questions. Each question carries ONE mark.

SECTION-A(Unit-I & II)

1. Solve $5172.49 + 378.352 + x = 9318.678$
(a) 7637.683 (b) 7367.368 (c) 3767.836 (d) 7763.638
2. Solve $0.014 \times 0.014 = ?$
(a) 0.000196 (b) 0.00196 (c) 19.6 (d) 196
3. Find the value of $2 - [2 - \{2 - 2(2 + 2)\}]$
(a) -4 (b) 4 (c) 6 (d) None of these
4. Evaluate $\frac{8 - [5 - (-3 + 2)] + 2}{|5 - 3| - |5 - 8| + 3}$
(a) 2 (b) 3 (c) 4 (d) 5
5. $\frac{4335}{4(?)24} \div 1\frac{7}{8} = \frac{289}{528}$ Find the missing digit in place of '?'
(a) 1 (b) 2 (c) 8 (d) None of these
6. Which of the following has fractions in ascending order?
(a) $\frac{2}{3}, \frac{3}{5}, \frac{7}{9}, \frac{9}{11}, \frac{8}{9}$ (b) $\frac{3}{5}, \frac{2}{3}, \frac{9}{11}, \frac{7}{9}, \frac{8}{9}$ (c) $\frac{3}{5}, \frac{2}{3}, \frac{7}{9}, \frac{9}{11}, \frac{8}{9}$ (d) $\frac{8}{9}, \frac{9}{11}, \frac{7}{9}, \frac{2}{3}, \frac{3}{5}$
7. The sum of all two digit numbers divisible by 5 is
(a) 1035 (b) 1245 (c) 1230 (d) 945
8. The largest 4 digit number exactly divisible by 88 is
(a) 9944 (b) 9768 (c) 9988 (d) 8888
9. Find the L.C.M of 16, 24, 36 and 54
(a) 433 (b) 432 (c) 324 (d) 234
10. The L.C.M. of $\frac{1}{3}, \frac{5}{6}, \frac{2}{9}, \frac{4}{27}$ is :
(a) $\frac{1}{54}$ (b) $\frac{10}{27}$ (c) $\frac{20}{3}$ (d) None of these
11. 1, 9, 25, 49, ?, 121
(a) 64 (b) 81 (c) 91 (d) 100
12. 589654237, 89654237, 8965423, 965423, ?
(a) 58965 (b) 65423 (c) 89654 (d) 96542
13. CIRCLE is related to RICELC in the same way as SQUARE is related to
(a) QSUERA (b) QUSERA (c) UQSAER (d) UQSERA
14. In a certain code, BRAIN is written as * % ÷ # × and TIER is written as \$ # + %. How is RENT written in that code?
(a) % × # \$ (b) % # × \$ (c) % + × \$ (d) + × % \$
15. B is the husband of P. Q is the only grandson of E, who is wife of D and mother-in-law of P. How is B related to D?
(a) Nephew (b) Cousin (c) Son-in-law (d) Son
16. E is the son of A. D is the son of B. E is married to C. C is B's daughter. How is D related to E?
(a) Brother (b) Uncle (c) Father-in-law
(d) Brother-in-law (e) None of these
17. How many times do the hands of a clock coincide in a day?
(a) 20 (b) 21 (c) 22 (d) 24
18. How many times in a day, are the hands of a clock in straight line but opposite in direction?
(a) 20 (b) 22 (c) 24 (d) 48
19. What was the day of the week on 16th July, 1776?
(a) Monday (b) Wednesday (c) Tuesday (d) Saturday

20. On 6th march, 2005 Monday falls. What was the day of the week on 6th March, 2004.
 (a) Sunday (b) Saturday (c) Tuesday (d) Wednesday
21. Find the average of all prime numbers between 30 and 50
 (a) 40 (b) 41 (c) 55.5 (d) 39.8
22. A batsman makes a score of 87 runs in the 17th innings and thus increases his average by 3. Find his average after 17th inning.
 (a) 38 (b) 40 (c) 45 (d) 39
23. If $A : B = \frac{1}{2} : \frac{1}{8}$, $B : C = \frac{1}{3} : \frac{5}{9}$ and $C : D = \frac{5}{6} : \frac{3}{4}$, then the ratio $A : B : C : D$ is :
 (a) 4 : 6 : 8 : 10 (b) 6 : 4 : 8 : 10 (c) 6 : 8 : 9 : 10 (d) 8 : 6 : 10 : 9
24. If $0.75 : x :: 5 : 8$, then x is equal to
 (a) 1.12 (b) 1.20 (c) 1.25 (d) 1.30
25. Present ages of Sammer and Anand are in the ratio of 5: 4 respectively. Three years hence, the ratio of their ages will become 11 : 9 respectively. What is Anand's present age in years?
 (a) 24 (b) 27 (c) 40 (d) Cannot be determined (e) None of these
26. Sachin is younger than Rahul by 4 years. If their ages are in the respective ratio of 7 : 9, how old is Sachin?
 (a) 16 years (b) 18 years (c) 28 years
 (d) cant be determined (e) None of these
27. A cyclist covers a distance of 750m in 2 min 30 sec. What is the speed in km/hr of the cyclist?
 (a) 18 km /hr (b) 20 km /hr (c) 22 km /hr (d) 25 km
28. A train covers a distance of 10 km in 12 minutes. If its speed is decreased by 5 km / hr the time taken by it to cover the same distance will be :
 (a) 10 min (b) 11 min 20 sec (c) 13 min (d) 13 min 20 sec
29. A thief steals a car at 2.30 p.m. and drives it at 60kmph. The theft is discovered at 3 p.m. and the owner sets off in another car at 75kmph. When will he overtake the thief?
 (a) 4.30 p.m. (b) 4.45 p.m. (c) 5 p.m. (d) 5.15p.m.
30. A man's speed with the current is 15kmph and the speed of the current is 2.5kmph. The man's speed against the current is
 (a) 8.5kmph (b) 9kmph (c) 10kmph (d) 12.5kmph
31. What is 15% of Rs.34?
 (a) Rs. 3.40 (b) Rs.3.75 (c) Rs.4.50 (d) Rs.5.10
32. 65 % of ? = 20% of 422.50
 (a) 84.5 (b) 130 (c) 139.425 (d) 200
33. If on selling 12 notebooks, a seller makes a profit equal to the selling price of 4 note books, what is his percent profit?
 (a) $16\frac{2}{3}$ (b) 25 (c) 50 (d) Data inadequate (e) None of these
34. A, B and C enter into a partnership with a capital in which A's contribution is Rs.10,000. If out of a total profit of Rs.1000, A gets Rs.500 and B gets Rs.300, then C's capital is :
 (a) Rs.4000 (b) Rs.5000 (c) Rs.6000 (d) Rs.9000
35. P and Q started a business investing Rs.85,000 and Rs.15,000 respectively. In what ratio the profit earned after 2 years be divided between P and Q respectively?
 (a) 3 : 4 (b) 3 : 5 (c) 15 : 23 (d) 17 : 23 (e) None of these

36. Reena and Shaloo are partners in a business. Reena invests Rs. 35,000 for 8 months and Shaloo invests Rs.42,000 for 10 months. Out of a profit of Rs.31,750, Reena's share is :
 (a) Rs.9471 (b) Rs.12,628 (c) Rs.18,040 (d) Rs.18,942
37. A sum of Rs.12,500 amounts to Rs.15,500 in 4 years at the rate of simple interest. What is the rate of interest?
 (a) 3% (b) 4% (c) 5% (d) 6% (e) None of these
38. The differences between the simple interest received from two different sources on Rs.1500 for 3 years is Rs.13.50. The difference between their rates of interest is :
 (a) 0.1 % (b) 0.2% (c) 0.3% (d) 0.4% (e) None of these
39. Find the compound interest on Rs.10,000 in 2 years at 4% per annum, the interest being compounded half-yearly.
 (a) Rs.852.23 (b) Rs.824.32 (c) Rs.258.94 (d) Rs.843.16
40. Rs.800 becomes Rs.956 in 3 years at a certain rate of simple interest. If the rate of interest is increased by 4%, what amount will Rs.800 become in 3 years?
 (a) Rs.1020.80 (b) Rs.1025 (c) Rs.1052
 (d) Data inadequate (e) None of these

SECTION – B (Unit – III)

(Q.No 41 – 45)

Study the following table carefully and answer the questions given below.

Classification of 100 students based on the marks obtained by them in Physics and Chemistry in an Examination

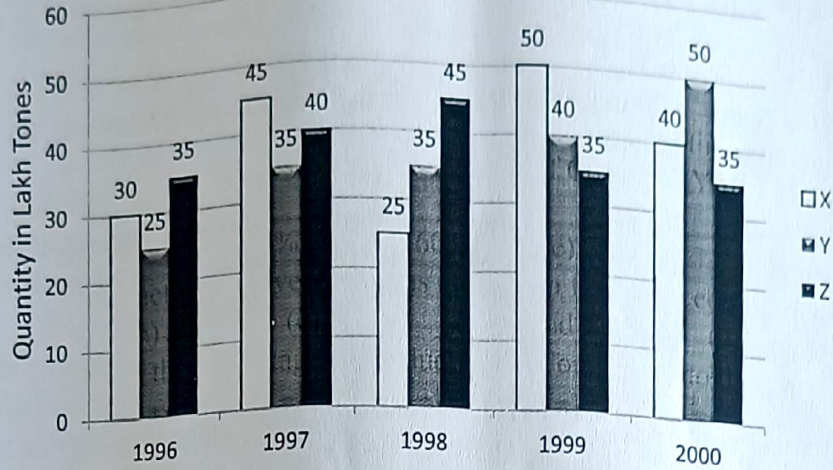
Marks out of 50 Subject	40 and Above	30 and Above	20 and Above	10 and Above	0 and Above
Physics	9	32	80	92	100
Chemistry	4	21	66	81	100
Average	7	27	73	87	100

41. The number of students scoring less than 40% marks in aggregate is:
 (a)13 (b) 19 (c) 20 (d) 27 (e) 34
42. If at least 60% marks in Physics are required for pursuing higher studies in Physics, how many students will be eligible to pursue higher studies in Physics?
 (a)27 (b) 32 (c) 34 (d) 41 (e) 68
43. What is the difference between the number of students passed with 30 as cut-off marks in Chemistry and those passed with 30 as cut-off marks in aggregate?
 (a) 3 (b) 4 (c) 5 (d) 6 (e) 7
44. The percentage of the number of students getting at least 60% marks in Chemistry over those getting at least 40% marks in aggregate, is approximately:
 (a) 21% (b) 27% (c) 29% (d) 31% (e) 34%
45. If it is known that at least 23 students were eligible for a symposium on Chemistry, the minimum qualifying marks in Chemistry for eligibility to Symposium would lie in the range :
 (a) 40 -50 (b) 30-40 (c) 20-30 (d) Below 20 (e) Cannot be determined

(Q.No 46 – 50)

The bar graph provided below gives the data of the production of paper (in lakh tones) by three different companies X, Y and Z over the years. Study the graph and answer the questions that follow.

Production of Paper (in lakh tones) by three companies X, Y and Z over the years



46. What is the difference between the production of Company Z in 1998 and Company Y in 1996?
 (a) 2,00,000 tons (b) 20,00,000 tons (c) 20,000 tons (d) 2,00,00,000 tons
 (e) None of these
47. What is the ratio of the average production of Company X in the period 1998-2000 to the average production of Company Y in the same period?
 (a) 1 : 1 (b) 15 : 17 (c) 23 : 25 (d) 27 : 29 (e) None of these
48. What is the percentage increase in the production of Company Y from 1996 to 1999?
 (a) 30% (b) 45% (c) 50% (d) 60% (e) 75%
49. The average production for five years was maximum for which company?
 (a) X (b) Y (c) Z (d) X and Y both (e) X and Z both
50. In which year was the percentage of production of Company Z to the production of Company Y the maximum?
 (a) 1996 (b) 1997 (c) 1998 (d) 1999 (e) 2000



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