

GOVT.DEGREE COLLEGE KODUR



Department of Mathematics

SYLLABUS



ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Programme: B.Sc. Mathematics (Major)

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Essentials and Applications of Mathematical, Physical and Chemical Sciences	5	4
		2	Advances in Mathematical, Physical and Chemical Sciences	5	4
	II	3	Differential Equations & Problem Solving Sessions	5	4
		4	Analytical Solid Geometry & Problem Solving Sessions	5	4
II	III	5	Group Theory & Problem Solving Sessions	5	4
		6	Numerical Methods & Problem Solving Sessions	5	4
		7	Laplace Transforms & Problem Solving Sessions	5	4
		8	Special Functions & Problem Solving Sessions	5	4
	IV	9	Ring Theory & Problem Solving Sessions	5	4
		10	Introduction to Real Analysis & Problem Solving Sessions	5	4
		11	Integral Transforms & Problem Solving Sessions	5	4
III	V	12	Linear Algebra & Problem Solving Sessions	5	4
		13	Vector Calculus & Problem solving Sessions	5	4
		14	Functions of a complex variables & Problem solving Sessions (OR) Advanced Numerical Methods & Problem Solving Sessions	5	4
		15	Number Theory & Problem Solving Sessions (OR) Mathematical Statistics & Problem Solving Sessions	5	4
	VI	Semester Internship/Apprenticeship with 12 Credits			
IV	VII	16	Algebra (OR) Classical Mechanics	5	4
		17	Real Analysis (OR) Discrete Mathematics	5	4
		18	Basic Topology (OR) Cryptography	5	4
		SEC			
		19	Lattice Theory & Boolean Algebra	5	4

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits	
			(OR) Finite Element Analysis			
		20	Graph Theory (OR) Mathematical Finance	5	4	
	VIII	21	Advanced Algebra (OR) Elements of Elasticity & Fluid Dynamics	5	4	
		22	Advanced Analysis (OR) Advanced Linear Algebra	5	4	
		23	Advanced Topology (OR) Differential Geometry	5	4	
		SEC				
		24	Ordinary Differential Equations (OR) Applications of Algebra	5	4	
		25	Operation Research (OR) Mathematical Modelling	5	4	

SEMESTER-I

COURSE 1: ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES

Theory

Credits: 4

5 hrs/week

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 principles can be used to explain and predict phenomena in different contexts.
- 5 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 and significance- Periodic Table- Electronic Configuration, chemical changes, classification of matter, Biomolecules- carbohydrates, proteins, fats and 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.

Application 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 - Internet, 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
12. Cyber Security Essentials by James Graham, Richard Howard, Ryan Olson

STUDENT ACTIVITIES

UNIT I: ESSENTIALS OF MATHEMATICS:

1: Complex Number Exploration

Provide students with a set of complex numbers in both rectangular and polar forms.

They will plot the complex numbers on the complex plane and identify their properties

2: Trigonometric Ratios Problem Solving

Give students a set of problems that require the calculation of trigonometric ratios and their relations.

Students will solve the problems using the appropriate trigonometric functions (sine, cosine, tangent, etc.) and trigonometric identities.

3: Vector Operations and Applications

Provide students with a set of vectors in Cartesian form.

Students will perform vector addition and subtraction operations to find the resultant vectors.

They will also calculate the scalar and vector products of given vectors.

4: Statistical Measures and Data Analysis

Give students a dataset containing numerical values.

Students will calculate the mean, median, and mode of the data, as well as other statistical measures if appropriate (e.g., range, standard deviation).

They will interpret the results and analyze the central tendencies and distribution of the data.

UNIT II: ESSENTIALS OF PHYSICS:

1. Concept Mapping

Divide students into groups and assign each group one of the topics.

Students will create a concept map illustrating the key concepts, relationships, and applications related to their assigned topic.

Encourage students to use visual elements, arrows, and labels to represent connections and interdependencies between concepts.

2. Laboratory Experiment

Select a laboratory experiment related to one of the topics, such as motion of objects or electric and magnetic fields.

Provide the necessary materials, instructions, and safety guidelines for conducting the experiment.

Students will work in small groups to carry out the experiment, collect data, and analyze the results.

After the experiment, students will write a lab report summarizing their findings, observations, and conclusions.

UNIT III: ESSENTIALS OF CHEMISTRY

1: Chemistry in Daily Life Presentation

Divide students into groups and assign each group a specific aspect of daily life where chemistry plays a significant role, such as food and nutrition, household products, medicine, or environmental issues.

Students will research and create a presentation (e.g., PowerPoint, poster, or video) that showcases the importance of chemistry in their assigned aspect.

2: Periodic Table Exploration

Provide students with a copy of the periodic table.

Students will explore the periodic table and its significance in organizing elements based on their properties.

They will identify and analyze trends in atomic structure, such as electronic configuration, atomic size, and ionization energy.

3: Chemical Changes and Classification of Matter

Provide students with various substances and chemical reactions, such as mixing acids and bases or observing a combustion reaction.

Students will observe and describe the chemical changes that occur, including changes in color, temperature, or the formation of new substances.

4: Biomolecules Investigation

Assign each student or group a specific biomolecule category, such as carbohydrates, proteins, fats, or vitamins.

Students will research and gather information about their assigned biomolecule category, including its structure, functions, sources, and importance in the human body.

They can create informative posters or presentations to present their findings to the class.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

1: Interdisciplinary Case Studies

Divide students into small groups and provide them with interdisciplinary case studies that involve the interdisciplinary application of mathematics, physics, and chemistry.

Each case study should present a real-world problem or scenario that requires the integration of concepts from all three disciplines.

2: Design and Innovation Project

Challenge students to design and develop a practical solution or innovation that integrates mathematics, physics, and chemistry principles.

Students can choose a specific problem or area of interest, such as renewable energy, environmental conservation, or materials science.

3: Laboratory Experiments

Assign students laboratory experiments that demonstrate the practical applications of

mathematics, physics, and chemistry.

Examples include investigating the relationship between concentration and reaction rate, analyzing the behavior of electrical circuits, or measuring the properties of materials.

.4: Mathematical Modeling

Present students with real-world problems that require mathematical modeling and analysis.

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

1. Identifying the attributes of network (Topology, service provider, IP address and bandwidth of your college network) and prepare a report covering network architecture.
3. Identify the types of malwares and required firewalls to provide security.
- 4.** Latest Fraud techniques used by hackers.

SEMESTER-I

COURSE 2: ADVANCES IN MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES

Theory

Credits: 4

5 hrs/week

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:

1. 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.
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. 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.
3. 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.
4. 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.
- 5 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, nano sensors, 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
5. "Energy Storage: A Nontechnical Guide" by Richard Baxter
6. "Nanotechnology: Principles and Applications" by Sulabha K. Kulkarni and Raghvendra A. Bohara
7. "Biophysics: An Introduction" by Rodney Cotterill
8. "Medical Physics: Imaging" by James G. Webster
9. "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.
12. Digital Logic Design by Morris Mano
13. Data Communication & Networking by Bahrouz Forouzan.

STUDENT ACTIVITIES

UNIT I: ADVANCES IN BASIC MATHEMATICS

1: Straight Lines Exploration

Provide students with a set of equations representing straight lines in different forms, such as slope-intercept form, point-slope form, or general form.

Students will explore the properties and characteristics of straight lines, including their slopes, intercepts, and point of intersection.

2: Limits and Differentiation Problem Solving

Students will apply the concept of limits to solve various problems using standard limits.

Encourage students to interpret the results and make connections to real-world applications, such as analyzing rates of change or optimizing functions.

3: Integration Exploration

Students will explore the concept of integration as a reverse process of differentiation and apply basic methods of integration, such as the product rule, substitution method, or integration by parts.

Students can discuss the significance of integration in various fields, such as physics and chemistry

4: Matrices Manipulation

Students will perform operations on matrices, including scalar multiplication, matrix multiplication, and matrix transpose.

Students can apply their knowledge of matrices to real-world applications, such as solving systems of equations or representing transformations in geometry.

UNIT II: ADVANCES IN PHYSICS:

1: Case Studies

Provide students with real-world case studies related to renewable energy, nanotechnology, biophysics, medical physics, or shape memory materials.

Students will analyze the case studies, identify the challenges or problems presented, and propose innovative solutions based on the recent advances in the respective field.

They will consider factors such as energy generation, energy storage, efficiency, sustainability, materials design, biomedical applications, or technological advancements.

2: Experimental Design

Assign students to design and conduct experiments related to one of the topics: renewable energy, nanotechnology, biophysics, medical physics, or shape memory materials.

They will identify a specific research question or problem to investigate and design an

experiment accordingly.

Students will collect and analyze data, interpret the results, and draw conclusions based on their findings.

They will discuss the implications of their experimental results in the context of recent advances in the field.

3: Group Discussion and Debate

Organize a group discussion or debate session where students will discuss the ethical, social, and environmental implications of the recent advances in renewable energy, nanotechnology, biophysics, medical physics, and shape memory materials.

Assign students specific roles, such as proponent, opponent, or moderator, and provide them with key points and arguments to support their positions.

UNIT III: ADVANCES IN CHEMISTRY:

1. Experimental Design and Simulation

In small groups, students will design experiments or simulations related to the assigned topic.

For example, in the context of computer-aided drug design, students could design a virtual screening experiment to identify potential drug candidates for a specific disease target.

For nano sensors, students could design an experiment to demonstrate the sensitivity and selectivity of nano sensors in detecting specific analytes.

Chemical biology-related activities could involve designing experiments to study enzyme-substrate interactions or molecular interactions in biological systems.

Students will perform their experiments or simulations, collect data, analyze the results, and draw conclusions based on their findings.

2. Case Studies and Discussion

Provide students with real-world case studies related to the impact of chemical pollutants on ecosystems and human health.

Students will analyze the case studies, identify the sources and effects of chemical pollutants, and propose mitigation strategies to minimize their impact.

Encourage discussions on the ethical and environmental considerations when dealing with chemical pollutants.

For the dye removal using the catalysis method, students can explore case studies where catalytic processes are used to degrade or remove dyes from wastewater.

Students will discuss the principles of catalysis, the advantages and limitations of the catalysis method, and its applications in environmental remediation.

3: Group Project

Assign students to work in groups to develop a project related to one of the topics.

The project could involve designing a computer-aided drug delivery system, developing a nano sensor for a specific application, or proposing strategies to mitigate the impact of chemical pollutants on

ecosystems.

Students will develop a detailed project plan, conduct experiments or simulations, analyze data, and present their findings and recommendations.

Encourage creativity, critical thinking, and collaboration throughout the project.

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

1: Mathematical Modelling Experiment

Provide students with a mathematical modelling experiment related to one of the topics. For example, in the context of renewable energy, students can develop a mathematical model to optimize the placement and configuration of solar panels in a solar farm.

Students will work in teams to design and conduct the experiment, collect data, and analyze the results using mathematical models and statistical techniques.

They will discuss the accuracy and limitations of their model, propose improvements, and interpret the implications of their findings in the context of renewable energy or the specific application area.

2: Case Studies and Group Discussions

Assign students to analyze case studies related to the applications of mathematical modelling in nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, or water treatment.

Students will discuss the mathematical models and computational methods used in the case studies, analyze the outcomes, and evaluate the effectiveness of the modelling approach.

Encourage group discussions on the challenges, ethical considerations, and potential advancements in the field.

Students will present their findings and engage in critical discussions on the advantages and limitations of mathematical modelling in solving complex problems in these areas.

3. Group Project

Assign students to work in groups to develop a group project that integrates mathematical modelling with one of the application areas: renewable energy, nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, or water treatment.

The project could involve developing a mathematical model to optimize the delivery of radiation therapy in medical physics or designing a mathematical model to optimize waste management practices.

Students will plan and execute their project, apply mathematical modelling techniques, analyze the results, and present their findings and recommendations.

Encourage creativity, critical thinking, and collaboration throughout the project.

UNIT V: Advanced Applications of computer Science

Students must be able to convert numbers from other number system to binary number systems

1. Identify the networking media used for your college network

Identify all the networking devices used in your college premises.

SEMESTER-II

COURSE 3: DIFFERENTIAL EQUATIONS

Theory

Credits: 4

5 hrs/week

Course Outcomes

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

1. solve first order first degree linear differential equations.
2. convert a non-exact homogeneous equation to exact differential equation by using an integrating factor.
3. know the methods of finding solution of a differential equation of first order but not of first degree.
4. solve higher-order linear differential equations for both homogeneous and non-homogeneous, with constant coefficients.
5. understand and apply the appropriate methods for solving higher order differential equations.

Course Content

Unit – 1

Differential Equations of first order and first degree

Linear Differential Equations – Bernoulli's Equations - Exact Differential Equations –Integrating factors - Equations reducible to Exact Equations by Integrating Factors -

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

Unit – 2

Differential Equations of first order but not of first degree

Equations solvable for p , Equations solvable for y , Equations solvable for x – Clairaut's equation - Orthogonal Trajectories: Cartesian and Polar forms.

Unit – 3

Higher order linear differential equations

Solutions of homogeneous linear differential equations of order n with constant coefficients - Solutions of non-homogeneous linear differential equations with constant coefficients by means of polynomial operators

(i) $Q(x) = e^{ax}$ (ii) $Q(x) = \sin ax$ (or) $\cos ax$

Unit – 4

Higher order linear differential equations (continued.)

Solution to a non-homogeneous linear differential equation 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 – 5

Higher order linear differential equations with non-constant coefficients

Linear differential Equations with non-constant coefficients; Cauchy-Euler Equation; Legendre Equation; Method of variation of parameters

Activities

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

Text Book

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

Reference Books

1. Ordinary and Partial Differential Equations by Dr. M.D. 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 -Srinivas Vangala&Madhu Rajesh, published by Spectrum University Press.

SEMESTER-II

COURSE 4: ANALYTICAL SOLID GEOMETRY

Theory

Credits: 4

5 hrs/week

Course Outcomes

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

1. understand planes and system of planes
2. know the detailed idea of lines
3. understand spheres and their properties
4. know system of spheres and coaxial system of spheres
5. understand various types of cones

Course Content

Unit – 1 The Plane

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

Unit – 2 The Line

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

Unit – 3 The Sphere

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 – 4 Spheres (continued)

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.

Unit – 5 Cones

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

Activities

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

Text Book

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

Reference Books

1. A text Book of Analytical Geometry of Three Dimensions, by P.K. Jain and Khaleel Ahmed, published by Wiley Eastern Ltd., 1999.
2. Co-ordinate Geometry of two and three dimensions by P. Balasubrahmanyam, K.Y. Subrahmanyam, G.R. Venkataraman published by TataMcGraw -Hill Publishers.
3. Solid Geometry by B. Rama Bhupal Reddy, published by Spectrum University Press.



ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

(A Statutory body of the Government of Andhra Pradesh)

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REVISED SYLLABUS OF B.A. /B.Sc. MATHEMATICS UNDER CBCS FRAMEWORK WITH EFFECT FROM 2020-2021

PROGRAMME: THREE-YEAR B.A. /B.Sc. MATHEMATICS

(With Learning Outcomes, Unit-wise Syllabus, References, Co-curricular Activities & Model Q.P.)

For Fifteen Courses of 1, 2, 3 & 4 Semesters)

(To be Implemented from 2020-21 Academic Year)

A.P. STATE COUNCIL OF HIGHER EDUCATION

B.A./B.Sc. MATHEMATICS

REVISED SYLLABUS FOR CORE COURSES

CBCS/ SEMESTER SYSTEM

(w.e.f. 2020-21 Admitted Batch)

CORE COURSES STRUCTURE

(Sem-I to Sem-IV)

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

COURSE-I
CBCS/ SEMESTER SYSTEM
B.A./B.Sc. MATHEMATICS (w.e.f. 2020-21 Admitted Batch)
DIFFERENTIAL EQUATIONS
SYLLABUS (75 Hours)

Course Outcomes:

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

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

Course Syllabus:

UNIT – I (12 Hours)

Differential Equations of first order and first degree:

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

UNIT – II (12 Hours)

Orthogonal Trajectories

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

Equations solvable for p ; Equations solvable for y ; Equations solvable for x ; Equations that do not contain x (or y); Equations homogeneous in x and y ; Equations of the first degree in x and y – Clairaut's Equation.

UNIT – III (12 Hours)

Higher order linear differential equations-I:

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

General Solution of $f(D)y=Q$ when Q is a function of x , $\frac{1}{f(D)}$ is expressed as partial fractions.

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

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

UNIT – IV (12 Hours)

Higher order linear differential equations-II:

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

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

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

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

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

UNIT –V (12 Hours)

Higher order linear differential equations-III :

Method of variation of parameters; Linear differential Equations with non-constant coefficients; The Cauchy-Euler Equation, Legendre's linear equations.

Co-Curricular Activities(15 Hours)

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

Text Book :

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

Reference Books :

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

COURSE-II
CBCS/ SEMESTER SYSTEM
(w.e.f. 2020-21 Admitted Batch)
B.A./B.Sc. MATHEMATICS
THREE DIMENSIONAL ANALYTICAL SOLID GEOMETRY
Syllabus (75 Hours)

Course Outcomes:

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

1. get the knowledge of planes.
2. basic idea of lines, sphere and cones.
3. understand the properties of planes, lines, spheres and cones.
4. express the problems geometrically and then to get the solution.

Course Syllabus:

UNIT – I (12 Hours)

The Plane :

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

UNIT – II (12 hrs)

The Line :

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

UNIT – III (12 hrs)

The Sphere :

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 (12 hrs)

The Sphere and Cones :

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.

Definitions of a cone; vertex; guiding curve; generators; Equation of the cone with a given vertex and guiding curve; equations of cones with vertex at origin are homogenous; Condition that the general equation of the second degree should represent a cone;

UNIT – V (12 hrs)

Cones :

Enveloping cone of a sphere; right circular cone: equation of the right circular cone with a given vertex, axis and semi vertical angle: 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.

Co-Curricular Activities(15 Hours)

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

Text Book :

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

Reference Books :

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

COURSE-III
CBCS/ SEMESTER SYSTEM
(w.e.f. 2020-21 Admitted Batch)
B.A./B.Sc. MATHEMATICS
ABSTRACT ALGEBRA
SYLLABUS (75 Hours)

Course Outcomes:

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

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

Course Syllabus:

UNIT – I (12 Hours)

GROUPS :

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

UNIT – II (12 Hours)

SUBGROUPS :

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

Co-sets and Lagrange's Theorem :

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

UNIT –III (12 Hours)

NORMAL SUBGROUPS :

Definition of normal subgroup – proper and improper normal subgroup–Hamilton group – criterion for a subgroup to be a normal subgroup – intersection of two normal subgroups – Sub group of index 2 is a normal sub group –quotient group – criteria for the existence of a quotient group.

UNIT – IV (12 Hours)

HOMOMORPHISM :

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 – V (12 Hours)

RINGS :

Definition of Ring and basic properties, Boolean Rings, divisors of zero and cancellation laws Rings, Integral Domains, Division Ring and Fields, The characteristic of a ring - The characteristic of an Integral Domain, The characteristic of a Field, Sub Rings.

Co-Curricular Activities(15 Hours)

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

Text Book :

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

Reference Books :

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

COURSE-IV
CBCS/ SEMESTER SYSTEM
(w.e.f. 2020-21 Admitted Batch)
B.A./B.Sc. MATHEMATICS
REAL ANALYSIS
SYLLABUS (75 Hours)

Course Outcomes:

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

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

Course Syllabus:

UNIT - I (12Hours)

REAL NUMBERS :

The algebraic and order properties of \mathbb{R} , Absolute value and Real line, Completeness property of \mathbb{R} , Applications of supremum property; intervals. Sequences and their limits, Range and Boundedness of Sequences, Limit of a sequence and Convergent sequence.

(No question is to be set from this portion).

INFINITE SERIES :

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

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

Absolute convergence and conditional convergence.

UNIT – II (12 Hours)

CONTINUITY :

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

Continuous functions : Continuous functions, Combinations of continuous functions, Continuous Functions on intervals, uniform continuity.

UNIT – III (12 Hours)

DIFFERENTIATION AND MEAN VALUE THEORMS :

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

UNIT – IV(12 Hours)

RIEMANN INTEGRATION :I

Riemann Integral, Riemann integral functions, Darboux theorem. Necessary and sufficient condition for R – integrability, Another definition of Riemann integral, Some classes of Bounded integrable functions.

UNIT –V(12 Hours)

RIEMANN INTEGRATION :II

Properties of integrals functions, Fundamental theorem of integral calculus, integral as the limit of a sum, Mean value Theorems.

Co-Curricular Activities(15 Hours)

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

Text Book:

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

Reference Books:

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

COURSE-V
CBCS/ SEMESTER SYSTEM
(w.e.f. 2020-21 Admitted Batch)
B.A./B.Sc. MATHEMATICS
LINEAR ALGEBRA
SYLLABUS (75 Hours)

Course Outcomes:

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

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

Course Syllabus:

UNIT – I (12 Hours)

Vector Spaces-I:

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

UNIT –II (12 Hours)

Vector Spaces-II:

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

UNIT –III (12 Hours)

Linear Transformations:

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

UNIT –IV (12 Hours)

Matrices – I :

Matrices, Elementary Properties of Matrices, Rank of Matrix, Normal form, Echelon form , Inverse of a matrix by using elementary operations.

UNIT –V (12 Hours)

Matrices – II :

Linear Equations: System of Homogeneous and non homogeneous Linear Equations.

Characteristic equations, Characteristic Values & Vectors of a square matrix, Cayley – Hamilton Theorem and problems.

Co-Curricular Activities(15 Hours)

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

Text Book:

Linear Algebra by J.N. Sharma and A.R. Vasista, published by Krishna Prakashan Mandir, Meerut- 250002.

Reference Books :

1. Matrices by Shanti Narayana, published by S.Chand Publications.
2. Linear Algebra by Kenneth Hoffman and Ray Kunze, published by Pearson Education (low priced edition),New Delhi.
3. Linear Algebra by Stephen H. Friedberg et. al. published by Prentice Hall of India Pvt. Ltd. 4th Edition, 2007.

Recommended Question Paper Patterns and Models
BLUE PRINT FOR QUESTION PAPER PATTERN
COURSE-I, DIFFERENTIAL EQUATIONS

Unit	TOPIC	S.A.Q(including choice)	E.Q(including choice)	Total Marks
I	Differential Equations of 1 st order and 1 st degree	2	2	30
II	Orthogonal Trajectories, Differential Equations of 1 st order but not of 1 st degree	2	2	30
III	Higher Order Linear Differential Equations (with constant coefficients) – I	2	2	30
IV	Higher Order Linear Differential Equations (with constant coefficients) – II	2	2	30
V	Higher Order Linear Differential Equations (with non constant coefficients)	2	2	30
TOTAL		10	10	150

S.A.Q. = Short answer questions (5 marks)

E.Q. = Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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Total Marks = 75 M

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CBCS/ SEMESTER SYSTEM
(W.e.f 2020-21 Admitted Batch)
B.A./B.Sc. MATHEMATICS
COURSE-I, DIFFERENTIAL EQUATIONS

MATHEMATICS MODEL PAPER

Time: 3Hrs

Max.Marks:75M

SECTION - A

Answer any **FIVE** questions. Each question carries **FIVE** marks **5 X 5 M=25 M**

1. Solve $(1 + e^{x/y}) dx + e^{x/y} (1 - \frac{x}{y}) dy = 0$.

2. Solve $(y - e^{\sin^{-1} x}) \frac{dx}{dy} \pm \sqrt{1 - x^2} = 0$

3. Solve $y + px = p^2x^4$.

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

5. Solve $(D^2 - 3D + 2) = \cosh x$

6. Solve $(D^2 + 9) = e^x - \cos 2x$

7. Solve $(D^2 - 4D + 3)y = \sin 3x \cos 2x$.

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

9. Solve $x^2y'' - 2x(1+x)y' + 2(1+x)y = x^3$

10. Solve $[(5 + 2x)^2D^2 - 6(5 + 2x)D + 8]y = 0$

SECTION - B

Answer **ALL** the questions. Each question carries **TEN** marks. **5 X 10 M = 50 M**

11. Solve $x \frac{dy}{dx} + y = y^2 \log x$.

(Or)

12. Solve $(y + \frac{1}{3}y^3 + \frac{1}{2}x^2) dx + \frac{1}{4}(x + xy^2) dy = 0$.

13. Solve $pe^2 + 2p\cot x = y^2$.

(Or)

14. Find the orthogonal trajectories of the family of curves

$x^{2/3} + y^{2/3} = a^{2/3}$ where 'a' is the parameter.

15. Solve $(D^3 + D^2 - D - 1)y = \cos 2x$.

(Or)

16. Solve $(D^2 - 3D + 2)y = \sin e^{-x}$.

17. Solve $(D^2 - 2D + 4)y = 8(x^2 + e^{2x} + \sin 2x)$

(Or)

18. $\frac{d^2y}{dx^2} + 3 \frac{dy}{dx} + 2y = xe^x \sin x$

19. Solve $(D^2 - 2D)y = e^x \sin x$ by the method of variation of parameters.

(Or)

20. Solve $3x^2 \frac{d^2y}{dx^2} + \frac{x}{dx} \frac{dy}{dx} + \frac{y}{dx} = x$

BLUE PRINT FOR QUESTION PAPER PATTERN
COURSE-II, THREE DIMENSIONAL ANALYTICAL SOLID GEOMETRY

Unit	TOPIC	S.A.Q(including choice)	E.Q(including choice)	Total Marks
I	The Plane	2	2	30
II	The Right Line	2	2	30
III	The Sphere	2	2	30
IV	The Sphere & The Cone	2	2	30
V	The Cone	2	2	30
TOTAL		10	10	150

S.A.Q. = Short answer questions (5 marks)

E.Q. = Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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Total Marks = 75 M
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CBCS/ SEMESTER SYSTEM

(w.e.f. 2020-21 Admitted Batch)

B.A./B.Sc. MATHEMATICS

COURSE-II, THREE DIMENSIONAL ANALYTICAL SOLID GEOMETRY

Time: 3Hrs

Max.Marks:75 M

SECTION - A

Answer any FIVE questions. Each question carries FIVE marks 5 X 5 M=25 M

1. Find the equation of the plane through the point $(-1,3,2)$ and perpendicular to the planes $x+2y+2z=5$ and $3x+3y+2z=8$.
2. Find the bisecting plane of the acute angle between the planes $3x-2y-6z+2=0$, $-2x+y-2z-2=0$.
3. Find the image of the point $(2,-1,3)$ in the plane $3x-2y+z=9$.
4. Show that the lines $2x + -4 = 0 = y + 2z$ and $x + 3z - 4 = 0$, $2x + 5z - 8 = 0$ are coplanar.
5. A variable plane passes through a fixed point (a, b, c) . It meets the axes in A, B, C . Show that the centre of the sphere $OABC$ lies on $ax^{-1}+by^{-1}+cz^{-1}=2$.
6. Show that the plane $2x-2y+z+12=0$ touches the sphere $x^2+y^2+z^2-2x-4y+2z-3=0$ and find the point of contact.
7. If r_1, r_2 are the radii of the two orthogonal spheres, then show that the radius of the circle of their intersection is $\frac{r_1 r_2}{\sqrt{r_1^2 + r_2^2}}$
8. Find the equation to the cone which passes through the three coordinate axes and the lines $\frac{x}{1} = \frac{y}{-2} = \frac{z}{3}$ and $\frac{x}{2} = \frac{y}{1} = \frac{z}{1}$
9. Find the equation of the enveloping cone of the sphere $x^2 + y^2 + z^2 + 2x - 2y = 2$ with its vertex at $(1, 1, 1)$.
10. Show that reciprocal cone of $ax^2 + by^2 + cz^2 = 0$ is the cone $\frac{x^2}{a} + \frac{y^2}{b} + \frac{z^2}{c} = 0$

SECTION - B

Answer ALL the questions. Each question carries TEN marks. 5 X 10 M = 50 M

11. A plane meets the coordinate axes in A, B, C . If the centroid of $\triangle ABC$ is (a,b,c) , show that the equation of the plane is $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 3$.

(OR)

12. A variable plane is at a constant distance p from the origin and meets the axes in A, B, C . Show that the locus of the centroid of the tetrahedron $OABC$ is $x^2+y^2+z^2=16p^2$.

13. Find the shortest distance between the lines

$$\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}; \quad \frac{x+3}{-3} = \frac{y+7}{2} = \frac{z-6}{4}$$

(OR)

14. 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 and the plane containing the lines.

15. Show that the two circles $x^2+y^2+z^2-y+2z=0$, $x-y+z=2$;

$x^2+y^2+z^2+x-3y+z-5=0$, $2x-y+4z-1=0$ lie on the same sphere and find its equation.

(OR)

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

17. Find the limiting points of the coaxial system of spheres

$$x^2+y^2+z^2-8x+2y-2z+32=0, \quad x^2+y^2+z^2-7x+z+23=0.$$

(OR)

18. Find the equation to the cone with vertex is the origin and whose

base curve is $x^2+y^2+z^2+2ux+d=0$.

19. Prove that the equation $\sqrt{fx} \pm \sqrt{gy} \pm \sqrt{hz} = 0$ represents a cone that touches the coordinate planes and find its reciprocal cone.

(OR)

20. Find the equation of the sphere $x^2+y^2+z^2-2x+4y-1=0$ having its generators parallel to the line $x=y=z$.

BLUE PRINT FOR QUESTION PAPER PATTERN
COURSE-III, ABSTRACT ALGEBRA

Unit	TOPIC	S.A.Q(including choice)	E.Q(including choice)	Total Marks
I	Groups	2	2	30
II	Subgroups, Cosets & Lagrange's theorem	2	2	30
III	Normal Subgroups	2	2	30
IV	Homomorphisms	2	2	30
V	Rings	2	2	30
Total		10	10	150

S.A.Q. = Short answer questions (5 marks)

E.Q. = Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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 Total Marks = 75 M

CBCS/ SEMESTER SYSTEM
(w.e.f. 2020-21 Admitted Batch)
B.A./B.Sc. MATHEMATICS
COURSE-III, ABSTRACT ALGEBRA

Time: 3Hrs

Max.Marks:75M

SECTION - A

Answer any FIVE questions. Each question carries FIVE marks 5 X 5 M=25 M

1. Show that the set $G = \{x/x = 2^a 3^b \text{ and } a, b \in \mathbb{Z}\}$ is a group under multiplication
2. Define order of an element. In a group G, prove that if $a \in G$ then $O(a) = O(a)^{-1}$.
3. If H and K are two subgroups of a group G, then prove that HK is a subgroup \Leftrightarrow
 $HK=KH$
4. Prove that any two Right (left) cosets of a subgroup are either identical or disjoint.
5. If G is a group and H is a subgroup of index 2 in G then prove that H is a normal subgroup.
6. Define Normal Subgroup and Prove that every subgroup of an abelian group is normal .
7. If G, G^1 are two groups and $f: G \rightarrow G^1$ is homomorphism then show that
 - (a) $f(e) = e^1 \forall e \in G, e^1 \in G^1$
 - (b) $f(a^{-1}) = [f(a)]^{-1} \forall a \in G$
8. Prove that, every homomorphism image of an abelian group is an abelian.
9. Prove that the characteristic of an integral domain is either prime or zero.
10. Prove that the intersection of two subrings of a ring is also a subring

SECTION - B

Answer ALL the questions. Each question carries TEN marks. 5 X 10 M = 50 M

11. Show that the set of n^{th} roots of unity forms an abelian group under multiplication.

(Or)

12. In a group G, for $a, b \in G$, $O(a)=5$, $b \neq e$ and $aba^{-1} = b^2$. Find $O(b)$.

13. The Union of two subgroups is also a subgroup \Leftrightarrow one is contained in the other.

(Or)

14. State and prove Lagrange's theorem.

15. 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 .

(Or)

16. If M, N are two Normal subgroups of G such that $M \cap N = \{e\}$ then show that every element of M commutes with every element of N .

17. State and prove fundamental theorem of homomorphisms of groups.

(Or)

18. If G and G^1 are two groups and $f: G \rightarrow G^1$ is onto Homomorphism then prove that f is Isomorphism $\Leftrightarrow \ker f = \{e\}$.

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

(Or)

20. Prove that the characteristic of a field is either zero or prime.

BLUE PRINT FOR QUESTION PAPER PATTERN
COURSE-IV, REAL ANALYSIS

Unit	TOPIC	S.A.Q(including choice)	E.Q(including choice)	Total Marks
I	Real Number System and Real Sequence	2	2	30
II	Infinite Series	2	2	30
III	Limits and Continuity	2	2	30
IV	Differentiation and Mean Value Theorem	2	2	30
V	Riemann Integration	2	2	30
	TOTAL	10	10	150

S.A.Q. = Short answer questions (5 marks)

E.Q. = Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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Total Marks = 75 M

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CBCS/ SEMESTER SYSTEM
(w.e.f. 2020-21 Admitted Batch)
B.A./B.Sc. MATHEMATICS
COURSE-IV, REAL ANALYSIS

Time: 3Hrs

Max.Marks:75M

SECTION - A

Answer any **FIVE** questions. Each question carries **FIVE** marks **5 X 5 M=25 M**

1. Test the convergence of the series $\sum_{n=1}^{\infty} (\sqrt[3]{n^3 + 1} - n)$.
2. Test for Convergence $\sum_{n=1}^{\infty} \frac{1}{2n+3n}$
3. Examine for continuity of the function f defined by $f(x) = |x| + |x - 1|$ at $x=0$ and 1 .
4. Show that the function f defined by $f(x) = x^3$ is uniformly continuous on $[-2, 2]$
5. Show that $f(x) = x \sin \frac{1}{x}$, $x \neq 0$; $f(x) = 0$, $x = 0$ is continuous but not derivable at $x=0$.
6. Verify Rolle's theorem for the function $f(x) = x^3 - 6x^2 + 11x - 6$ on $[1, 3]$.
7. If $f(x) = x^2 \forall x \in [0, 1]$ and $p = \{0, \frac{1}{4}, \frac{2}{4}, \frac{3}{4}, 1\}$ then find $L(p, f)$ and $U(p, f)$.
8. If $f \in R[a, b]$ and m, M are infimum and supremum of f on $[a, b]$ then show that $m(b - a) \leq \int_a^b f(x) dx \leq M(b - a)$
9. prove that if $f: [a, b] \rightarrow \mathbb{R}$ is continuous on $[a, b]$ then f is R - integrable on $[a, b]$.
10. By considering the integral $\int_0^1 \frac{1}{1+x} dx$ show that $\log_2 = \lim_{n \rightarrow \infty} \left[\frac{1}{n+1} + \frac{1}{n+2} + \dots + \frac{1}{2n} \right]$.

SECTION -B

Answer **ALL** the questions. Each question carries **TEN** marks. **5 X 10 M = 50 M**

11. State and Prove Cauchy's nth root test.

(OR)

12. Test the convergence of $\sum \frac{x^n}{x^n + a^n}$ ($x > 0, a > 0$)

13. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be such that

$$f(x) = \frac{\sin(a+1)x + \sin x}{x} \text{ for } x < 0$$

$$= c \quad \text{for } x = 0$$

$$= \frac{(x+bx^2)^{1/2} - x^{1/2}}{bx^{3/2}} \text{ for } x > 0$$

Determine the values of a, b, c for which the function f is continuous at x=0.

(OR)

14. Define uniform continuity, If a function f is continuous on [a b] then f is uniformly continuous on [a b]

15. Using Lagrange's theorem, show that $x > \log(1+x) > \frac{x}{(1+x)} \forall x > 0$.

(OR)

16. State and prove Cauchy's mean value theorem.

17. State and prove Riemman's necessary and sufficient condition for R- integrability.

(OR)

18. Prove that $f(x) = \sin x$ is integrable on $[0, \pi/2]$ and $\int_0^{\pi/2} \sin x dx = 1$

19. State and prove Fundamental theorem of integral calculus.

(OR)

20. Prove that $\frac{\pi^3}{24} \leq \int_0^{\pi} \frac{x^2}{5+3\cos x} dx \leq \frac{\pi^3}{6}$.

BLUE PRINT FOR QUESTION PAPER PATTERN
COURSE-V, LINEAR ALGEBRA

Unit	TOPIC	S.A.Q (including choice)	E.Q (including choice)	Marks Allotted
I	Vector spaces - I	2	2	30
II	Vector spaces - II	2	2	30
III	Linear Transformation	2	2	30
IV	Matrices - I	2	2	30
V	Matrices - II	2	2	30
Total		10	10	150

S.A.Q. = Short answer questions (5 marks)

E.Q. = Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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Total Marks = 75 M

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CBCS/ SEMESTER SYSTEM
(w.e.f. 2020-21 Admitted Batch)
B.A./B.Sc. MATHEMATICS
COURSE-V, LINEAR ALGEBRA

Time: 3Hrs

Max.Marks:75M

SECTION - A

Answer any **FIVE** questions. Each question carries **FIVE** marks **5 X 5 M=25 M**

1. Let p, q, r be fixed elements of a field F . Show that the set W of all triads (x, y, z) of elements of F , such that $px+qy+rz=0$ is a vector subspace of $V_3(\mathbb{R})$.
2. Define linearly independent & linearly dependent vectors in a vector space. If α, β, γ are linearly independent vectors of $V(\mathbb{R})$ then show that $\alpha + \beta, \beta + \gamma, \gamma + \alpha$ are also linearly independent.
3. Prove that every set of $(n + 1)$ or more vectors in an n dimensional vector space is linearly dependent.
4. Show that any two bases of vector space (F) have the same number of elements.
5. The mapping $T : V_3(\mathbb{R}) \rightarrow V_3(\mathbb{R})$ is defined by $T(x, y, z) = (x-y, x-z)$. Show that T is a linear transformation.
6. Let $T: \mathbb{R}^3 \rightarrow \mathbb{R}^2$ and $H: \mathbb{R}^3 \rightarrow \mathbb{R}^2$ be defined by $T(x, y, z) = (3x, y+z)$ and $H(x, y, z) = (2x-z, y)$. Compute i) $T+H$ ii) $4T-5H$ iii) TH iv) HT .

7. Find the rank of the matrix $A = \begin{bmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \\ 0 & -1 & -1 \end{bmatrix}$ by reducing to normal form.

8. Reduce the matrix $A = \begin{bmatrix} 5 & 3 & 14 & 4 \\ 0 & 1 & 2 & 1 \\ 1 & -1 & 2 & 0 \end{bmatrix}$ into echelon form and find its rank.

9. Solve the system of equations $x+y-3z+2w=0, 2x-y+2z-3w=0, 3x-2y+z-4w-4x+y-3z+w=0$.

10. If the matrix A is non-singular, show that the eigen values of A^{-1} are the reciprocal of the eigen values of A .

SECTION - B

Answer **ALL** the questions. Each question carries **TEN** marks. **5 X 10 M = 50 M**

11. Define vector space. Let $V(F)$ be a vector space. Let W be a non empty sub set of V . Prove that the necessary and sufficient condition for W to be a subspace of V is $a, b \in F$ and $\alpha, \beta \in V \Rightarrow a\alpha + b\beta \in W$.

(OR)

12. Prove that the four vectors $(1,0,0)$, $(0,1,0)$, $(0,0,1)$ and $(1,1,1)$ of $V_3(C)$ form linearly dependent set, but any three of them are linearly independent.

13. Define dimension of a finite dimensional vector space. If W is a subspace of a finite dimensional vector space $V(F)$ then prove that W is finite dimensional and $\dim W \leq n$.

(OR)

14. If W be a subspace of a finite dimensional vector space $V(F)$ then Prove that

$$\dim V/W = \dim V - \dim W.$$

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

(OR)

16. State and prove Rank Nullity theorem.

17. Obtain two non singular matrices P and Q Such that $PAQ = \begin{bmatrix} I_r & O \\ O & O \end{bmatrix}$ where

$$A = \begin{bmatrix} 3 & 2 & -1 & 5 \\ 5 & 1 & 4 & -2 \\ 1 & -4 & 11 & -19 \end{bmatrix} \quad (\text{OR})$$

18. Find the inverse of $A = \begin{bmatrix} 0 & 1 & 2 & 2 \\ 1 & 1 & 2 & 3 \\ 2 & 2 & 2 & 3 \\ 3 & 3 & 3 & 3 \end{bmatrix}$ using elementary row operations.

19. Solve the system $\lambda x + y + z = 0$, $x + \lambda y + z = 0$, $x + y + \lambda z = 0$, if the system has nonzero solution.

(OR)

20. State and prove Cayley-Hamilton theorem.

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