ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

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 (T) Differential Equations & Problem Solving Sessions (P)	5	4
		4	Analytical Solid Geometry & Problem Solving Sessions (T) Analytical Solid Geometry & Problem Solving Sessions (P)	5	4
II	III	5	Group Theory &Problem Solving Sessions(T) Group Theory &Problem Solving Sessions(P)	5	4
		6	Numerical Methods & Problem Solving Sessions(T) Numerical Methods & Problem Solving Sessions (P)	5	4
		7	Laplace Transforms & Problem Solving Sessions (T) Laplace Transforms & Problem Solving Sessions(P)	5	4
		8	Special Functions & Problem Solving Sessions (T) Special Functions & Problem Solving Sessions (P)	5	4
	IV	9	Ring Theory & Problem Solving Sessions (T) Ring Theory & Problem Solving Sessions (P)	5	4
		10	Introduction to Real Analysis & Problem Solving Sessions (T) Introduction to Real Analysis & Problem Solving Sessions(P)	5	4
		11	Integral Transforms & Problem Solving Sessions (T) Integral Transforms & Problem Solving Sessions (P)	5	4
III	V	12	Linear Algebra &Problem Solving Sessions (T) Linear Algebra &Problem Solving Sessions (P)	5	4
		13	Vector Calculus & Problem solving Sessions (T) Vector Calculus & Problem solving Sessions (P)	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 andproblems **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

2. 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**.**

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Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

Course – I & II Model Paper Time:3Hrs (70 Marks)

SECTION A (Multiple Choice Questions) ***30 x 1 = 30 M***

30 Multiple Choice Questions (Each Unit 6 Questions)

SECTION B (Fill in the blanks) ***10 x 1 = 10 M***

10 Fill in the Blanks (Each Unit 2 Questions)

SECTION C (Very short answer questions) ***10 x 1 = 10 M***

10 Very short answer questions (Each Unit 2 Questions)

SECTION D (Matching) (From 5 Units) ***2 x 5 = 10 M***

1 A

B

C

D

E

2 A

B

C

D

E

SECTION E (True or False) ***10 x 1 = 10 M***

10 True or False (Each Unit 2 Questions)

Single Major (w.e.f. AY 2023-24)
SEMESTER-I
COURSE – 1 ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICAL & CHEMICAL SCIENCES

Time:3hrs *MAX MARKS: 70 M*

I Multiple Choice Questions 3x10=30M

1. If Arg(Z) < 0 the Arg (-Z) – arg (Z) = [ ]
   a) π b) $\frac{\pi}{4}$ c) $\frac{-\pi}{2}$ d) $\frac{\pi}{2}$
2. If $\left|\frac{Z_1}{Z_2}\right| = 1$ and Arg $(Z_1 Z_2) = 0$ then [ ]
   a) $Z_1 = Z_2$ b) $|Z_1|^2 = Z_1 Z_2$ c) $Z_1 Z_2 = 1$ d) None of these
3. The value of $\sin 50^\circ - \sin 70^\circ + \sin 10^\circ$ is equal to [ ]
   a) 1 b) 0 c) ½ d) 2
4. If $\bar{a} + m\bar{b} + 3\bar{c}$, $-2\bar{a} + 3\bar{b} - 5\bar{c}$ and $\bar{a} - 3\bar{b} - 5\bar{c}$ are coplanar m= _____[ ]
   a) 2 b) -1 c) 1 d) -9/7
5. If the vectors $2\bar{i} + \lambda\bar{j} - k$ and $4\bar{i} - 2\bar{j} + 2\bar{k}$ are perpendicular to each other, then
   λ = _____ [ ]
   a) 2 b) 5 c) 3 d) 1
6. Find the mode for the following data 0,0,1,1,2,2,2,4,5. [ ]
   a) 1 b) 0 c) 4 d) 2
7. Newton – Second is the unit of [ ]
   a) Velocity b) Angular Momentum c) Momentum d) Energy
8. If the force applied to a body is doubled and the mass is cut in half. What would be the acceleration ratio? [ ]
   a) 1:2 b) 2:1 c) 1:4 d) 4:1
9. Which unit is used to measure angle the S.I system? [ ]
   a) Radian b) Steradian c) Degree d) Minute
10. The mass – Energy relation is given by [ ]
    a) $E = mc^2$ b) F = ma c) P = mv d) W = Fd
11. How many types of Robots are there [ ]
    a) 7 b) 10 c) 6 d) 8
12. Light energy emitted by stars is due to [ ]
    a) Breaking of nuclei b) Joining of nucles
    c) Burning of nuclei d) Reflection of Solar Light
13. Organic chemistry is the study of _____. [ ]
    a) Nitrogen based compoundsb) Carbon based compounds
    c) Copper based compounds d) Chromium based compounds
14. Number of electrons present in outer shell of chlorine atom is ____[ ]
    a) 5 b) 6 c) 7 d) 8
15. Which of the following is a disacchanide _____ [ ]
    a) Sucrose b) Glucose c) Fructose d) Ribose
16. The Monomers present in proteins are _____ [ ]
    a) Alcohols b) Acids c) Amino acids d) Esters
17. Lipids composed mainly of _____ [ ]
    a) C, H, N b) C, H, O c) O, N, S d) N, S, Cl

18. Vitamin by is also known as _____ [ ]
a) Vitamin – H b) Vitamin – O c) Vitamin – Bd) Vitamin – L
19. Who is introduced in Calculus _____. [ ]
a) Isaac Newton b) Goff fried Leibniz
c) Both of the mentioned d) None of the mentioned
20. How many systems does a robot have _____. [ ]
a) 2 b) 6 c) 4 d) 3
21. A place where power information (or) a result leaves a system. [ ]
a) Chassis b) Output c) Sensor d) Input
22. The main electronic component used in first generation computers was [ ]
a) Transistors b) Vacuum Tubes and Valves
c) Integrated Circuits d) None of above
23. Magnetic disk is an example of [ ]
a) Secondary memory b) Primary memory
c) Main memory d) Both 1 & 2
24. http stands for [ ]
a) hypertext transfer protocol b) hypertext transmission protocol
c) high transfer transport protocol d) hyper transfer text protocol
25. What is the full form of WWW? [ ]
a) World Wide Web b) World with Web
c) Work Wide Web d) World Wide Wet
26. Which one of the following is a type of antivirus program? [ ]
a) Quick heal b) Mcafee
c) Kaspersky d) All of the above
27. Hackers usually used the computer virus for _____purpose. [ ]
a) To log, monitor each and every user's stroke
b) To gain access the sensitive information like user's Id and Passwords
c) To corrupt the user's data stored in the computer system
d) All of the above
28. Which of the following is an example of f BDD screening technique [ ]
a) U V spectroscopy b) HPLC c) NMR spectroscopy d) None
29. Fertilizers mainly consists of _____ [ ]
a) N, P, K b) O, N, Cl c) C, O, K d) H, P, O
30. The substance that facilitate chemical reactions without being consumed is [ ]
a) Reactions b) Product c) Catalyst d) Inhibin

SECTION – B

II Fill in the Blanks 10x1=10M

1. Find the value of $\sqrt{3}\cos ec20^\circ - \sec 20^\circ$ is _____.
2. The area of the parallelogram whose diagonals are $3\hat{i}+\hat{j}-2\hat{k}$ and $\hat{i}-3\hat{j}+4\hat{k}$ is _____.
3. _____is the number of cycles made by a sounding body per unit time.
4. A light year is a unit of _____.
5. EXPAND SAR _____.
6. Peptide bond formula _____.
7. A robot is a _____.
8. Differential equations that _____the definition of linear are nonlinear.
9. A string of 8 bits is _____
10. ROM stands for _____

SECTION – C

III Answer the following Short Questions **10x1=10M**

1. If 3 tan A = 5 then Find Sin A and Cos A.
2. Find A.M from the following distribution.

Wages	100	120	140	160	180	200
No of workers	4	8	12	7	6	3

3. Write any two applications of Semi – Conductor?
4. Define Zeroth law of Thermodynamics? with example.
5. Expand FBDD.
6. What are fat soluble vitamins?
7. Define Newton's 1st Law.
8. Write any two application of Environmental monitoring?
9. What is E-mail?
10. What is a gateway?

SECTION – D

III Match the following **10x1=10M**

1. A. Unit Vector in the direction $\bar{a} = 3\bar{i} - 2\bar{j} + 6\bar{k}$ ( ) a) Angular Momentum
   B. Polar form $-1 + \sqrt{3}i$ ( ) b) Glucose
   C. Joule x Sec ( ) c) $\frac{1}{7}\left(3\bar{i} - 2\bar{j} + 6\bar{k}\right)$
   D. Mass of a proton ( ) d) $2\left[\cos\left(\frac{2\pi}{3}\right) + i\sin\left(\frac{2\pi}{3}\right)\right]$
   E. Reducing Sugar ( ) e) 1.676×10^{-24} grams

2. A. Vitamin – B12 ( ) a) Newton
   B. Force ( ) b) Newton second
   C. Impulse ( ) c) RBC formation
   D. Punch Card ( ) d) Computer games
   E. Joy Stick ( ) e) Hollerith code

SECTION – E

IV True (or) False **10x1=10M**

1. If Z is a complex number then ZZ is purely real.
2. If Z is a complex number such that $Z^2 = \left(\bar{Z}\right)^2$ then purely real.
3. The Mass of a body is equivalent to the ratio of the force action on it to the acceleration it generates.
4. The region of the atmosphere above troposphere is known as Lithosphere.
5. Essential Amino acids can be synthesized by the human body
6. Electrons fill the lowest energy levels first
7. For every action is nature here is an unequal and opposite reaction.
8. The special theory of relativity is concerned with frames of reference that are not experiencing any acceleration.
9. A terabyte is equal to 1 million gigabytes
10. Remote browser access is used to avoid browser-based hacking.

SEMESTER-I
COURSE 2: ADVANCES IN MATHEMATICAL, PHYSICALAND 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 memorymaterials.

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 oneco systems 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
2. Identify all the networking devices used in your college premises.

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Course – I & II Model Paper Time: 3Hrs (70 Marks)

SECTION A (Multiple Choice Questions) ***30 x 1 = 30 M***

30 Multiple Choice Questions (Each Unit 6 Questions)

SECTION B (Fill in the blanks) ***10 x 1 = 10 M***

10 Fill in the Blanks (Each Unit 2 Questions)

SECTION C (Very short answer questions) ***10 x 1 = 10 M***

10 Very short answer questions (Each Unit 2 Questions)

SECTION D (Matching) (From 5 Units) ***2 x 5 = 10 M***

1 A

B

C

D

E

2 A

B

C

D

E

SECTION E (True or False) ***10 x 1 = 10 M***

10 True or False (Each Unit 2 Questions)

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

Single Major (w.e.f. AY 2023-24)
SEMESTER-I
Model Paper
COURSE -2 ADVANCES OF MATHEMATICAL, PHYSICAL & CHEMICAL SCIENCES
Time: 3Hrs ***MAX MARKS: 70 M***

I **Multiple Choice Questions** **3x10=30M**

SECTION – A

1. The equation of the line passing through the point (1, 2) and perpendicular to the line x+y+1=0 is [ ]
   a) y-x+1=0 b) y-x-1=0 c) y-x+2=0 d) y-x-2=0
2. $\lim_{x \to 0} \frac{1-\cos 2x}{x^2}$ is equal to [ ]
   a) 0 b) 1 c) 2 d) 4
3. The derivative of $\cos^{-1}(2x^2-1)$ w.r.to $\cos^{-1}(x)$ is [ ]
   a) 2 b) $\frac{-1}{2\sqrt{1-x^2}}$ c) $\frac{2}{x}$ d) 1- x^2
4. $\int e^{\tan x} \sec^2 x \, dx$ = [ ]
   a) $e^{\tan x}$ b) $e^{\sin x}$ c) $\tan x$ d) $\sin x$
5. If $2x+y=\begin{bmatrix} 1 & 0 \\ -3 & 2 \end{bmatrix}$ and $2x-y=\begin{bmatrix} 3 & 4 \\ -1 & 2 \end{bmatrix}$ then X is equal to [ ]
   a) $\begin{bmatrix} 4 & 4 \\ -4 & 4 \end{bmatrix}$ b) $\begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}$ c) $\begin{bmatrix} -1 & -2 \\ -1 & 0 \end{bmatrix}$ d) None of these
6. If $A=[aij]_{mxn}$ such that aij = 0 for $i \neq j$ then A is [ ]
   a) a row matrix b) a column matrix
   c) a diagonal matrix d) a scalar matrix
7. Which of the following is an renewable energy source [ ]
   a) Coal b) Natural gas c) Solar d) Nuclear
8. What is the main purpose of Photovoltaic cells in solar panels [ ]
   a) Heat generation b) Electricity generation c) Water purification d) Carbon captune
9. Which renewable energy source is harnessed from the earth's Internal heat? [ ]
   a) Solar b) Wind c) Geothermal d) Hydro
10. What is the fundamental principle behind quantum mechanics [ ]
    a) Classical Mechanics b) Quantum Superposition c) Newton law of motion d) Maxwell's equation
11. What is the primary application of proton therapy in medical physics? [ ]
    a) Diagnostic Imaging b) Radiation therapy c) Magnetic resonance Imaging
    d) Computed Tomography (C.T)
12. What is the primary advantage of using quantum dob in solar cells? [ ]
    a) Low cost b) High efficiency
    c) Fast charging d) Large size
13. The Binding capacity between the drug and target is known as [ ]
    a) Virtual Screening b) Docking Score c) ADMET d) None
14. The Increased sensitivity of Nanosensors is due to [ ]
    a) High Surface-to-volume ratio b) Low surface-to-volume ratio
15. The green pigment chlorophyll is affected by [ ]
    a) Co_2 b) No_2 c) So_2 d) CH_4

16. What is the Photo catalyst used in the dye renoval catalysis method [ ]

a) Oxygen b) Hydrogen c) Titanium Oxide d) Zinc

17. Which phase of Shape memory alloy occurs at higher temperature & has a needle – like structure [ ]

a) Martensite b) Austenite c) Hysterisis d) None

18. The Pollutant causing Global warming [ ]

a) Co_2 b) So_2 c) No_2 d) O_3

19. In Quantum mechanics, the Schrodinger Equation is a fundamental Equation, used to model the behavior of particles. What does the Schrodinger Equation describe [ ]

a) Stability b) Wave-Particle duality
c) Degidity d) Massive

20. What is the term used to describe the process of using nano particles to enhance imaging techniques for medical diagnostics [ ]

a) Nano Scopy b) Nano Therapy c) Nano Diagnose d) None of these

21. How can nano medicine contribute to personalized medicine? [ ]

a) By increasing the cost of medical treatment.
b) By using a one-size –fits all approach.
c) By tailoring based on an individual's genetic make-up.
d) By avoiding the use of advanced technologies.

22. In radiation therapy, What does the term "brancy therapy" refer to [ ]

a) External beam radiation therapy
b) Radiation therapy using photons
c) Internal radiation therapy involving the placement of radio active sources directly within or close to the tumor.
d) Radiation therapy without the use of imaging.

23. What is the purpose of coagulation in the water treatment process? [ ]

a) Removing dissolved minerals
b) Disinteching water
c) Settling suspended particals
d) Adjusting PH levels

24. What is the purpose of green building design and construction? [ ]

a) maximizing energy consumption
b) minimizing the use of sustainable materials
c) Reducing the environmental impact of buildings
d) Ignoring energy – efficient technologies

25. Hybrid system combine which two types of signals? [ ]

a) Analog and Analog b) Digital and Digital c) Analog and Digital d) Continuous and Finite

26. Which error detection technique can detect a wide range of errors including burst errors and most multiple bits.

a) Hamming code b) Read- Solomon code c) Parity check d) CRC

27. Which layer of the OSI model does a router operate at [ ]

a) Transport layer b) Network layer c) Transport layer d) Data link layer

28. What technology allows DSL modems to separate voice and data signals.

a) Dail-up modem b) DSL modem c) Wireless modem d) Cable modem

Ans b) DSL modem

29. What protocol do bridges use to prevent network loops? [ ]

a) Internet Protocol b) Transmission Control Protocol (TCP)
c) Simple Network Management Protocol (SNMP) d) Spanning Tree Protocol (STP)

30. The……. between two words is the number of difference between corresponding bits

a) Hamming code b) Hamming distance [ ]
c) Hamming rule d) Hamming data

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SECTION – B

III Fill in the Blanks **10x1=10M**

1. Tidal energy is an Example for _____energy.
2. _____are the particles used in quantum dots.
3. Expand CADD _____
4. First step in the purification of water _____
5. _____is an application for Medical Physics.
6. MRI stands for _____
7. $\int e^x \sin x \cos x dx =$ _____.
8. Equation of the lines through the point (3, 2) and making an angle of 45° with the line x-2y = 3 are _____.
9. A computer understands only.....code
10. ..... converts audio and video into digital information

SECTION – C

III Answer the following Questions **10x1=10M**

1. Give some Examples for renewable sources?
2. Information stored in quantum computer in the form of?
3. What is the difference between MRI and C.T. Scan?
4. Name two applications of Nanotechnology?
5. Solid waste Management? (SWM)
6. Expand ADMET
7. $\lim_{x \to 0} \frac{ax + x\cos x}{b\sin x}$; Evaluate
8. Evaluate $\int x(\log x)^2 dx$
9. What are the key design issues of the computer networks?
10. What is multiplexing?

SECTION – D

III Match the following **10x1=10M**

1. A. Wind energy ( ) a) Orthodontic applications
   B. Solar energy ( ) b) Non invasile imaging
   C. Minamata ( ) c) Harness the kinetic energy of wind to produce electricity
   D. Ni-Ti wire ( ) d) Convert sunlight into electricity
   E. Magnetic Resonance Imaging ( ) e) Mercury
2. A. Fluoroscene microscopy ( ) a) 3
   B. $\begin{bmatrix} 3 & -4 \\ m & 5 \end{bmatrix} = 3$ then m value is ( ) b) Moniterity cellular
   C. $\frac{d}{dx}[\log(\sec x + \tan x)]$ ( ) c) F1
   D. 1111000l ( ) d) Guided media
   E. Ethernet cable ( ) e) (secx)

SECTION – E

IV True (or) False **10x1=10M**

1. Quantum dots are the nano particles, are primarily used for structural Reintor cement in medical implants?
2. Quantum mechanics is a branch of physics Extensively used mathematical Models, to describe the behavior of particles at atomic and subatomic level.
3. The Mass of a body is equivalent to the ratio of the force action on it to the acceleration it generates.
4. The region of the atmosphere above troposphere is known as Lithosphere.
5. Essential Amino acids can be synthesized by the human body
6. Electrons fill the lowest energy levels first
7. The equation of a line with slope m and making an intercept c on y axis is y=mx
8. Intercept form of a line which cuts a and b respectively on the x and y axis

   Then $\frac{x}{a}+\frac{y}{b}=1$
9. A university would use a CAN to converts its composes in two cities.
10. Gateway device is operate at transport layer.

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-II

COURSE 3: Differential Equations & ProblemSolving Sessions

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.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-II

COURSE 4: Analytical Solid Geometry & Problem Solving Sessions

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 from 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.

ADIKAVI NANNAYA UNIVERSITY :: RAJAMAHENDRAVARAM
SINGLE MAJOR/MINOR (w.e.f: 2023-2024 AB)
MATHEMATICS
MODEL QUESTION PAPER-THEORY
SEMESTER-II
COURSE-III- Differential Equations & ProblemSolving Sessions

Time: 3 hours Max. Marks: 70

SECTION-A

Answer any FIVE Questions. Each question carries 4 Marks. **5 X** 4 = 20 M**arks**.

1. Solve the differential equation $\frac{dy}{dx} + 2xy = e^{-x^2}$.
2. Solve the differential equation $(hx + by + f)dy + (ax + hy + g)dx = 0$.
3. Find the orthogonal trajectories of the family of parabolas $y^2 = 4ax$, a being the parameter.
4. Solve the differential equation $(y - px)(p - 1) = p$.
5. Solve the differential equation $(D^2 - 5D + 6)y = e^{4x}$.
6. Solve the differential equation $(D^2 + 4)y = x \sin x$.
7. Solve the differential equation $x^2 \frac{d^2y}{dx^2} + 2x \frac{dy}{dx} - 4y = x^3$.
8. Solve $(D^2 + a^2)y = \tan a\,x$ by the method of variation of parameters.

SECTION-B

Answer ALL questions. Each question carries 10 Marks. **5 X** 10 = 50 M**arks**.

9. (a) For $x > 0$, find the solution of the equation $\frac{dy}{dx} + \frac{y}{x} = y^2 x \sin x$, given that $y = 1$ when $x = \pi$.

(OR)

(b) Solve the differential equation $x^2y\,dx - (x^3 + y^3)dy = 0$.

10. (a) Solve the differential equation $p^2 + 2py \cot x = y^2$.

(OR)

(b) Solve the differential equation $y^2 \log y = xpy + p^2$

11. (a) Solve the differential equation $(D^2 - 3D + 2)y = \cosh x$.

(OR)

(b) Solve the differential equation $(D^2 - 4D + 3)y = \sin 3x \cos 2x$.

12. (a) Solve the differential equation $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} - 13y = 8e^{2x}\sin 2x$.

(OR)

(b) Solve the differential equation $(D^2 - 3D + 2)y = 2x^2$.

13. (a) Solve $(1 + 2x)^2\frac{d^2y}{dx^2} - 6(1 + 2x)\frac{dy}{dx} + 16y = 8(1 + 2x)^2$.

(OR)

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

ADIKAVI NANNAYA UNIVERSITY :: RAJAMAHENDRAVARAM

SINGLE MAJOR (w.e.f: 2023-2024 AB)

MATHEMATICS

MODEL QUESTION PAPER-THEORY

SEMESTER-II

COURSE-IV- Analytical Solid Geometry & Problem Solving Sessions

Time: 3 hours Max. Marks: 70

SECTION-A

Answer any FIVE Questions. Each question carries 4 Marks. **5 X** $4 = 20$ M**arks**.

1. Find the equation of the plane passing through the points $(1,2,1), (1,1,0), (-2,2,-1)$.
2. Find the angle between the planes $x + 2y + 3z = 5,\ 3x + 3y + z = 9$.
3. Show that the line $\frac{x+1}{-1} = \frac{y+2}{3} = \frac{z+5}{5}$ lies in the plane $x + 2y - z = 0$.
4. Find the image of the point $(2, -1, 3)$ in the plane $3x - 2y + z = 9$.
5. Find the equation of the sphere through the circle $x^2 + y^2 + z^2 = 9; 2x + 3y + 4z = 5$ and the point $(1, 2, 3)$.
6. Show that the spheres $x^2 + y^2 + z^2 + 6y + 2z + 8 = 0, x^2 + y^2 + z^2 + 6x + 8y + 4z + 20 = 0$ are orthogonal.
7. Show that the line $\frac{x}{1} = \frac{y}{-1} = \frac{z}{-1}$ is a generator of the cone $5yz + 8zx - 3xy = 0$.
8. Find the equation of the cone which passes through the three coordinate axes and the lines $\frac{x}{1} = \frac{y}{-2} = \frac{z}{3}$ and $\frac{x}{2} = \frac{y}{1} = \frac{z}{1}$.

SECTION-B

Answer ALL questions. Each question carries 10 Marks. **5 X** $10 = 50$ M**arks**.

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

(OR)

(b) Find the equations of the bisectors of the angles between the planes $3x - 2y + 6z + 2 = 0$ and $2x - y + 2z + 2 = 0$..

10. (a) Find the length and equations of S.D. line between the lines $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-1}{2}$ and $\frac{x-4}{4} = \frac{y-5}{5} = \frac{z-2}{3}$.

(OR)

(b) 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.

Find the point of their intersection and the plane containing the lines.

11. (a) 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.

(OR)

(b) Find the Centre and radius of the circle $x^2 + y^2 + z^2 = 25; 2x + 3y + 2z = 9$.

12. (a) If r_1, r_2 are the radii of two orthogonal spheres, then prove that the radius of the circle of their intersection is $\frac{r_1 r_2}{\sqrt{r_1^2 + r_2^2}}$.

(OR)

(b) Find the limiting points of the coaxial system of spheres determined by the spheres

$x^2 + y^2 + z^2 + 3x - 3y + 6 = 0$ and $x^2 + y^2 + z^2 - 6y - 6z + 6 = 0$.

13. (a) Prove that the angle between the lines of intersection of the plane $x + y + z = 0$ with the cone $ayz + bzx + cxy = 0$ is $\frac{\pi}{3}$ if $\frac{1}{a} + \frac{1}{b} + \frac{1}{c} = 0$.

(OR)

(b) Find the equation of the right circular cone whose vertex is (3, 2, 1), axis line $\frac{x-3}{4} = \frac{y-2}{1} = \frac{z-1}{3}$ and semi vertical angle 30^0.

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-III

COURSE 5: GROUP THEORY

Theory Credits: 4 5 hrs/week

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

Course Content

Unit – 1
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 – 2
Sub Groups

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

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

Unit – 4
Homomorphisms

Quotient groups, 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
Permutations and Cyclic Groups

Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem.
Cyclic Groups - Definition of cyclic group – elementary properties – classification of cyclic groups.

Activities

Seminar/ Quiz/ Assignments/ Applications of Group Theory to Real life Problem /Problem Solving Sessions.

Text Book

Modern Algebra by A.R.Vasishtha and A.K.Vasishtha, KrishnaPrakashanMedia Pvt. Ltd., Meerut.

Reference Books

1. Abstract Algebra by J.B. Fraleigh, Published by Narosa publishing house.
2. Modern Algebra by M.L. Khanna, Jai Prakash and Co. Printing Press, Meerut
3. Rings and Linear Algebra by Pundir&Pundir, published by PragathiPrakashan

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-III

COURSE 6: NUMERICAL METHODS

Theory | Credits: 4 | 5 hrs/week

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

Course Content

Unit – 1

The calculus of finite differences

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

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

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

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

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

Activities

Seminar/ Quiz/ Assignments/ Applications of Numerical methods to Real life Problem /Problem Solving Sessions.

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, (6^{th} 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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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-III

COURSE 7: LAPLACE TRANSFORMS

Theory | Credits: 4 | 5 hrs/week

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

Course Content

Unit – 1
LAPLACE TRANSFORMS – I

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

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 TRNASFORM – III

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

Unit – 4
INVERSE LAPLACE TRANSFORMS – I

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

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.

Activities

Seminar/ Quiz/ Assignments/ Applications of Laplace Transforms to Real life Problem /Problem Solving Sessions.

Text Book

LaplaceTransforms by A.R.Vasishtha,Dr.R.K.Gupta,KrishnaPrakashanMedia 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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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-III

COURSE 8: SPECIAL FUNCTIONS

Theory Credits: 4 5 hrs/week

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 unction.

Course Content

Unit–1
Beta and Gamma functions, Chebyshev polynomials

Euler'sIntegrals-Betaand Gamma Functions, Elementary properties of GammaFunctions, TransformationofGamma Functions.

Another form of BetaFunction, Relation between BetaandGamma Functions. Chebyshevpolynomials, orthogonalpropertiesofChebyshevpolynomials,recurrence relations, generatingfunctions for Chebyshev polynomials.

Unit–2
PowerseriesandPowerseriessolutionsofordinarydifferentialequations

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

Unit–3
Hermitepolynomials

HermiteDifferential Equations, Solution of HermiteEquation,Hermite polynomials, generating function for Hermite polynomials.OtherformsforHermitePolynomials,RodriguesformulaforHermite Polynomials, to find first fewHermite Polynomials.OrthogonalpropertiesofHermitePolynomials,RecurrenceformulaeforHermitePolynomials.

Unit–4
Legendrepolynomials

Definition,SolutionofLegendre'sequation,Legendrepolynomialofdegree n, generating function of Legendrepolynomials.Definitionof$P_n(x)$and$Q_n(x)$,GeneralsolutionofLegendre'sEquation(derivationsnot required)toshowthat$P_n(x)$isthecoefficientofh^n, in the expansionof $(1-2xh+h^2)^{-1/2}$OrthogonalpropertiesofLegendre'spolynomials,RecurrenceformulasforLegendre's Polynomials.

Unit–5
Bessel'sequation

Definition, Solution of Bessel'sequation,Bessel's function of the firstkind of ordern,Bessel'sfunction of thesecondkindofordern.

IntegrationofBessel'sequationinseriesform=0, Definition of $J_n(x)$ recurrenceformulaefor$J_n(x)$ Generating function for$J_n(x)$,orthogonally of Bessel functions.

Activities

Seminar/ Quiz/ Assignments/ Applications of Special functions to Real life Problem /Problem Solving Sessions.

Text Book

SpecialFunctions by J.N.SharmaandDr.R.K.Gupta,KrishnaPrakashan,

ReferenceBooks

1. Dr.M.D.Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
2. Shanti Narayan and Dr.P.K.Mittal, Integral Calculus, S. Chand &CompanyPvt. Ltd., Ram Nagar, New Delhi-110055.
3. GeorgeF.Simmons,Differential Equations with Applications and Historical Notes, Tata McGRAW-Hill Edition, 1994.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)
SEMESTER-IV

COURSE 9: RING THEORY

Theory Credits: 4 5 hrs/week

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.

Course Content

Unit – 1

Ringsand Fields

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 – NonCommutative Rings - Matrices over a field – The Quaternion ring.

Unit – 2

Subrings and Ideals

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 III: Principal ideals and Quotient rings

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

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

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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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)
SEMESTER-IV

COURSE 10: INTRODUCTION TO REAL ANALYSIS

Theory Credits: 4 5 hrs/week

Course Outcomes

After successful completion of this course, the student will be ableto

1. get clearidea about the real numbers and real valued functions.
2. obtaintheskillsofanalysingtheconceptsandapplyingappropriatemethodsfortesting convergence of a sequence/ series.
3. Test the continuity and differentiability and Riemann integration of a function.
4. Know the geometric a linter pretation of mean value theorems.
5. know about the fundamental theorem of integral calculus

Course Contents

Unit – 1
REALNUMBERS,REAL SEQUENCES

The algebraic and order properties of R - Absolute value and Real line - Completeness property of R - Applications of supremum property - intervals. (**No question is to be set from this portion)** 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 -Subsequencesand the Bolzano-weierstrass theorem – Cauchy Sequences – Cauchy's general principle of convergence.

Unit – 2
INFINITIE SERIES

Introduction to series -convergenceofseries -Cauchy'sgeneralprincipleof convergencefor series tests for convergence of series - Series of non-negative terms - P-test - Cauchy'snth roottest -D'-Alembert'sTest-AlternatingSeries–Leibnitz Test.

Unit –3
LIMIT & CONTINUITY

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 - Combinations of continuous functions - Continuous Functions on intervals - uniform continuity.

Unit – 4
DIFFERENTIATION ANDMEANVALUETHEORMS

The derivability of a function at a point and and on an interval - Derivability and continuity of a function -MeanvalueTheorems -Rolle'sTheorem,Lagrange's Theorem, Cauchy's Mean value Theorem

Unit – 5
RIEMANNINTEGRATION

Riemann Integral - Riemann integral functions - Darboux theorem -Necessary and sufficientcondition for 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 Real Analysis to Real life Problem /Problem Solving Sessions.

Text Book

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

Reference Books

1. ElementsofRealAnalysis by ShanthiNarayan andDr.M.D.Raisinghania, S. Chand & Company Pvt. Ltd., New Delhi.
2. Principles of Mathematical Analysis by Walter Rudin, McGraw-Hill Ltd.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-IV

COURSE 11: INTEGRAL TRANSFORMS WITH APPLICATIONS

Theory Credits: 4 5 hrs/week

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.

Course Content

Unit – 1
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
Application of Laplace Transform to solutions of Differential Equations

Solutions of Simultaneous Ordinary Differential equations - Solutions of Partial Differential Equations**.**

Unit – 3
Application of Laplace Transforms to Integral Equations

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

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

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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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-V

COURSE 12: LINEAR ALGEBRA

Theory Credits: 4 5 hrs/week

Course Outcomes

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

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

Course Content

UNIT – I
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
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
Linear Transformations

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

UNIT –IV
Matrices

Characteristic equation - Characteristic Values - Characteristic vectors of a square matrix - Cayley Hamilton Theorem – problems on Cayley Hamilton Theorem.

UNIT –V
Inner product space

Inner product spaces- Euclidean and unitary spaces- Norm or length of a Vector- Schwartz inequality- Triangle Inequality- Parallelogram law- Orthogonality- Orthonormal set- Problems on Gram– Schmidt orthogonalisation process - Bessel's inequality.

Activities :

Seminar/ Quiz/ Assignments/Applications of Linear Algebra in real life problems\ Problem Solving.

Text Books

1. Linear Algebra by J.N. Sharma and A.R. Vasishtha, published by Krishna Prakashan Media (P) Ltd.
2. Matrices by A.R.Vasishtha and A.K.Vasishtha published by Krishna Prakashan Media (P) Ltd.

Reference Books

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

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-V

COURSE 13: VECTOR CALCULUS

Theory Credits: 4 5 hrs/week

Course Outcomes

Students after successful completion of the course will be able to

1. Learn multiple integrals as anaturalextension of definite integraltoa function of two variables in the case of double integral/three variables in the case of tripleintegral.
2. Learnapplicationsintermsoffindingsurfaceareabydoubleintegralandvolumebytripleintegral .
3. Determinethegradient,divergence and curlof avector and vectori dentities.
4. Evaluateline,surfaceandvolumeintegrals.
5. understand relation between surface and volume integrals (Gauss divergence theorem),relation between line integral and volumeintegral(Green'stheorem),relation between line and surface integral(Stokestheorem)

Course Content

Unit–1
MultipleIntegrals-I

Introduction -Doubleintegrals -Evaluationofdoubleintegrals –Propertiesofdouble integrals - Regionofintegration -double integration in PolarCo-ordinates – Change of variables in double integrals –change of order of integration.

Unit–2
Multipleintegrals-II

Tripleintegral -regionofintegration -changeofvariables -Plane areasbydoubleintegrals - surfaceareabydoubleintegral -Volumeasadoubleintegral,volumeasatripleintegral.

Unit–3
Vectordifferentiation

Vector differentiation –ordinary – derivatives of vectors – Differentiability –Gradient –Divergence - Curloperators - Formulaeinvolvingtheseparators.

Unit–4
Vectorintegration

Line Integralswithexamples - Surface Integralwithexamples - Volumeintegralwithexamples.

Unit–5
Vectorintegrationapplications

Gausstheoremandapplicationsof Gausstheorem - Green'stheoreminplane and applicationsofGreen'stheorem - Stokes's the orem and applications of Stokestheorem.

Activities

Seminar/ Quiz/ Assignments/ Applications of Vector calculus to Real life Problems /Problem Solving Sessions.

Text Book

A text Book of Higher Engineering Mathematics by B.S.Grawal, Khanna Publishers, 43rd Edition

ReferenceBooks

1. Vector Calculus by P.C.Matthews, Springer Verlag publications.
2. Vector Analysis by Murray Spiegel, Schaum Publishing Company, NewYork

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-V

COURSE 14: FUNCTIONS OF A COMPLEX VARIABLE

Theory Credits: 4 5 hrs/week

Course Outcomes

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

1. determine a Bilinear transformation under given condition
2. know about continuity, compactness and connectedness of sets in complex plane
3. know the necessary condition and sufficient condition for f(z)to be analytic
4. know about the inverse of an analytic function
5. know about the convergence of sequences and the necessary & sufficient condition for a sequence to be convergent
6. know the power series expansion of elementary functions

Course Content

Unit – 1
Bilinear Transformations

Extended Complex Plane – Resultant and Inverse of a bilinear transformation – The linear group – Geometrical significance of the transformation. Angle preserving property of Bilinear Transformation– Determination of Bilinear transformations under given condition, some special bilinear transformations.

Unit – 2
Topological Considerations

Neighbourhood of a point – Interior, exterior and frontier points of a set, open and closed sets. Connected sets, Domains and continua - a theorem on Nests of closed Rectangular domains- Bolzano Weierstrass theorem- Hein-Borel theorem. Limits - algebraic operations with limits – continuity and uniform continuity – compactness – connectedness - Jordan curve theorem - connectedness of line segments and polygonal lines. Branch line and Branch point - Characterisation of open connected sets by polygonal lines.

Unit – 3
Analytic functions

Differentiable functions of a complex variable - Geometrical representation of a variable - Analytic function- Elementary rules and chain rule - Derivatives of polynomials and rational functions - The necessary condition and sufficient condition for $f(z)$to be analytic - Analytic functions in a Domain – Derivative of w in polar form - Construction of $f(z)$.

Unit – 4
Inverse of an analytic function and infinite series

The inverse of an analytic function – neighbourhood preserving mappings - Domain preserving and angle preserving property of analytic mappings.

Convergent sequences, necessary and sufficient condition for a sequence to be convergent, Cauchy sequence, Convergence of infinite series. Cauchy general principle of convergence for a series. Absolute convergence of a series. Abel's and Dirichilet's tests. Rearrangement of series, product of series.

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

Unit – 5
Power Series

Power series - exponential, trigonometric and hyperbolic functions - zeros of $sin\ z, cos\ z$ - periods of $sin\ z, cos\ z, E(z)$ - A law of logarithms - Analytic character of $log\ z$ - generalized a^b - Analytic character of z^n - $\text{Cos}^{-1}\ z$, $\text{Sin}^{-1}\ z$ and derivatives of $\text{Cos}^{-1}\ z$, $\text{Sin}^{-1}\ z$.

Activities

Seminar/ Quiz/ Assignments/ Applications of Functions of complex variables to Real life Problem /Problem Solving Sessions.

Text Book

Theory of Functions of a Complex variable by Shanti Narayan &Dr. P. K. Mittal, S. Chand &Company Ltd.

Reference Books

1. Theory of Functions of a Complex Variable by A. I. Markushevich, Second Edition, AMS Chelsea Publishing
2. Theory And Applications by M. S. Kasara, Complex Variables, 2nd Edition, Prentice Hall India Learning Private Limited

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-V

COURSE 14: ADVANCED NUMERICAL METHODS

Theory Credits: 4 5 hrs/week

Course Outcomes

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

1. find derivatives using various difference formulae
2. understand the process of Numerical Integration
3. solveSimultaneous Linear systems of Equations
4. understand Iterative methods
5. find Numerical Solution of Ordinary Differential Equations

Course Content

UNIT – I
Numerical Differentiation

Derivatives using Newton's forward difference formula - Newton's backward difference formula- Derivatives using central difference formula - Stirling's interpolation formula - Newton's divided difference formula.

UNIT – II
Numerical Integration

General quadrature formula on errors - Trapezoidal rule – Simpson's 1/3 rule - Simpson's 3/8 rule- Weddle's rule - Euler-Maclaurin formula of summation and quadrature - The Euler transformation.

UNIT – III
Solution of Simultaneous Linear systems of Equations – I

Solution of linear systems - Direct Methods - Matrix inversion method – Gaussian elimination method- Gauss Jordan Method.

UNIT – IV
Solution of Simultaneous Linear systems of Equations – II

Method of factorization - solution of Tridiagonal systems - Iterative methods - Jacobi's method - Gauss - Siedal method.

UNIT – V
Numerical Solution of Ordinary Differential Equations

Introduction – solution of Taylor's series – Picard's method of successive approximations – Euler's method – Modified Euler's method – Runge-Kutta methods.

Activities

Seminar/ Quiz/ Assignments/ Applications of Numerical methods to Real life Problem /Problem Solving Sessions.

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 Publications.
2. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S .R. K. Iyengar and R. K. Jain, New Age International Publishers.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-V

COURSE 15: NUMBER THEORY

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. understand the fundamental theorem of arithmetic
2. understand Mobius function, Euler quotient function, The Mangoldt function , Liouville's function, The divisor functions and the generalized convolutions.
3. understand Euler's summation formula, application to the distribution of lattice points and the applications to μ (n) and Λ (n)
4. understand the concepts of congruencies, residue classes and complete residues systems.
5. Comprehend the concept of quadratic residues mod p and quadratic non residues mod p.

UNIT-I

The Fundament Theorem of Arithmetic

Introduction, Divisibility, Greatest common divisor, Prime numbers, The fundamental theorem of arithmetic, The series of reciprocals of the primes, The Euclidean algorithm, The greatest common divisor of more than two numbers

UNIT-II

Arithmetical Functions And Dirichlet Multiplication

Introduction- The Mobius function $\mu(n)$ – The Euler quotient function $\varphi(n)$ - A relation connecting φ and μ - A product formula for $\varphi(n)$ - The Dirichlet product of arithmetical functions- Dirichlet inverses and the Mobius inversion formula- The Mangoldt function $\Lambda(n)$- multiplicative functions- multiplicative functions and Dirichlet multiplication- The inverse of a completely multiplicative function-Liouville's function $\lambda(n)$ - The divisor functions $\sigma_\alpha(n)$

UNIT-III

Averages Of Arithmetical Functions

Introduction- The big oh notation. Asymptotic equality of functions- Euler's summation formula- Some elementary asymptotic formulas-The average order of $d(n)$- The average order of the divisor functions $\sigma_\alpha(n)$- The average order of $\varphi(n)$- An application to the distribution of lattice points visible from the origin- The average order of $\mu(n)$ and $\Lambda(n)$-The partial sums of a Dirichlet product- Applications to $\mu(n)$ and $\Lambda(n)$

UNIT-IV

Congruences

Definition and basic properties of congruences- Residue classes and complete residue systems- Linear congruences- Reduced residue systems and the Euler- Fermat theorem- Polynomial congruences modulo p. Lagrange's theorem- Applications of Lagrange's theorem- Simultaneous linear congruences. The Chinese remainder theorem- Applications of the Chinese remainder theorem

UNIT-V

Quadratic Residues and the Quadratic Reciprocity Law

Quadratic Residues, Legendre's symbol and its properties, Evaluation of $(-1/p)$ and $(2/p)$, Gauss lemma, The Quadratic reciprocity law, Applications of the reciprocity law, The Jacobi Symbol, Gauss sums and the quadratic reciprocity law, the reciprocity law for quadratic Gauss sums, Another proof of the quadratic reciprocity law.

Activities

Seminar/ Quiz/ Assignments/ Applications of Number theory to Real life Problem /Problem Solving Sessions

Text Book

Introduction to Analytic Number Theory by T.M.Apostol, Springer Verlag-New York, Heidalberg-Berlin-1976.

Reference Books

1. Elementary Number Theory by G.A.Jones and J.M.Jones, , Springer
2. Elementary Number Theory by David, M. Burton, 2nd Edition UBS Publishers.
3. Number Theory by Hardy & Wright, Oxford Univ., Press.
4. Elements of the Theory of Numbers by Dence, J. B &Dence T.P, Academic Press

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)
SEMESTER-V

COURSE 15: MATHEMATICAL STATISTICS

Theory Credits: 4 5 hrs/week

Course Outcomes

After completion of the course, student will be able to

1. understandthe probability set function and conditional probability
2. understand about random variables, discrete and continuous type distributions
3. understand the distribution of two random variables and expectation of a random variables
4. know binomial and related distributions
5. normal distributions and the applications of normal distributions

Unit – 1
Probability and Distributions

Sets – set functions – The probability set function – counting rules – additional properties of probability- conditional probability and independence - simulations

Unit – 2
Probability and Distributions continued..

Random Variables - Discrete Random Variables - Continuous Random Variables -Quantiles- Transformations - Mixtures of Discrete and Continuous Type Distributions
Expectation of a Random Variable - Computation for an Estimation of the Expected Gain - Some Special Expectations - Important Inequalities

Unit – 3
Multivariate Distributions

Distributions of Two Random Variables - Marginal Distributions - Expectation –Transformations Bivariate Random Variables - Conditional Distributions and Expectations - Independent Random Variables - The Correlation Coefficient - Extension to Several Random Variables
Multivariate Variance-Covariance Matrix- Transformations for Several Random Variables - Linear combinations of Random Variables

Unit – 4
Some Special Distributions

The Binomial and Related Distributions - Negative Binomial and Geometric Distributions - multinomial Distribution- Hypergeometric Distribution - The Poisson Distribution - The Γ, $\chi 2$and β Distributions - The $\chi 2$-Distribution - The β-Distribution

Unit – 5
Normal Distribution

The Normal Distribution. - Contaminated Normals - The Multivariate Normal Distribution - Bivariate Normal Distribution - Multivariate - Normal Distribution. General Case- Applications -t- and F-Distribution

Activities

Seminar/ Quiz/ Assignments/ Applications of Mathematical statistics to Real life Problem /Problem Solving Sessions.

Text Book

Introduction to Mathematical Statistics by Robert V Hogg, Joseph W MacKeen, Eighth Edition, Allen T Craig, Pearson

Reference Books

1. Fundamentals of Statistics by Goon A.M., Gupta M.K. and Dasgupta B., (2002) Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Fundamentals Of Mathematical Statistics by Gupta, S. C. and Kapoor, V.K. (2008): 4 thEdition (Reprint), Sultan Chand &Sons
3. Mathematical Statistics with Applications by Miller, Irwin and Miller, Marylees(2006) John E.Freund's, (7th Edn.), Pearson Education, Asia.
4. Introduction to the Theory of Statistics by Mood, A.M. Graybill, F.A. and Boes, D.C., (2007), 3rdEdn., (Reprint), Tata McGraw-Hill Pub. Co.Ltd.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VII

COURSE 16: ALGEBRA

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. understand the direct product of groups and application of Sylow's theorems
2. understand the homomorphic relation between the groups, sum and direct sum of ideals
3. know factorizing the domains and factorization of polynomials
4. know about submodules and direct sums
5. about Free modules and Representation of linear mappings

UNIT-I
Structure theorems of groups

Direct products-Finitely generated abelian groups-Invariants of a finite abelian group-Sylow theorems. (Sections 8.1 to 8.4 of the Chapter 8 in the Prescribed Text Book.)

UNIT-II
Ideals and Homomorphisms

Ideals-Homomorphisms-Sums and direct sums of ideals- Maximal and prime ideals-Nilpotent and nil ideals-Zorn's lemma. (Sections 10.1 to10.6 of the Chapter 10 in the Prescribed Text Book.)

UNIT-III
Unique factorization domains and Euclidean domains

Unique factorization domains-Principal ideal domains-Euclidean domains-Polynomial rings over UFD (Sections 11.1 to 11.4 of the Chapter 11 in the Prescribed Text Book.)

UNIT IV
Modules and Vector Spaces

Definition and examples – Submodules and direct sums – R-homomorphisms and quotient modules (Sections 1,2& 3 of Chapter - 14)

UNIT V
Free Modules

Completely reducible modules – Free modules – Representation of linear mappings – Rank of linear mapping(Sections 4 to 7 of Chapter - 14)

Activities

Seminar/ Quiz/ Assignments/ Applications of Algebra to Real life Problem /Problem Solving

Text Book

Basic Abstract Algebra by P.B.Battacharya,S.K.jain, S.R.Nagpaul, Cambridge University Press.

Reference Book

1. TopicsinAlgebra by I.N.Herstein,2nd Edition,JohnWiley&Sons
2. AlgebrabySergeLang,RevisedThirdEdition,Springer
3. Algebra by ThomasW.Hungerford,Springer

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VII

COURSE 16: CLASSICAL MECHANICS

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. identify the basic concepts of mechanics and also learn applications of Lagrangian formulation.
2. Understand derivation of Lagrange's equations from Hamilton's principle and advantages of variational principle formulation
3. Understand the simplistic approach to canonical transformations,
4. Understand Poisson and Lagrange brackets and their invariance and the Hamilton Jacobi Equations for Hamilton's principal function
5. Understand special theory of relativity, Lorentz transformation and contractions and Lorentz transformations

Unit-I
Lagrangian Formulation

Mechanics of a particle, mechanics of a system of particles, constraints, generalized coordinates generalized velocity, generalized force and potential. D'Alembert's principle and Lagrange's equations, some applications of Lagrangian formulation (scope and treatment as in Art.1.1 to 1.4 and Art 1.6 of Text book.1).

Unit-II
Hamilton's principle to non-holonomic systems

Hamilton's principle, derivation of Lagrange's equations from Hamilton's principle, extension of Hamilton's principle to non-holonomic systems, advantages of variational principle formulation, conservation theorems and symmetry properties (scope and treatment as in Art 2.1 and 2.3 to 2.6 of Text book.1).

Unit-III
Hamiltonian formulation

Legendre transformations and the Hamilton equations of motion, cyclic coordinates and conservation theorems, derivation of Hamilton's equations from a vibrational principle, the principle of least action, the equation of canonical transformation, examples of canonical transformation, the Harmonic Oscillator, the simplistic approach to canonical transformations (scope and treatment as in Art.8.1,8.2,8.5, 8.6 and 9.1 to 9.4 of Text book.1).

Unit-IV
Canonical transformations

Poisson and Lagrange brackets and their invariance under canonical transformation.Jacobi's identity; Poisson's Theorem. Equations of motion infinitesimal canonical transformation in the Poisson bracket formulation. Hamilton Jacobi Equations for Hamilton's principal function, The harmonic oscillator problem as an example of the Hamilton – Jacobi method, the Hamilton – Jacobi equation for Hamilton's characteristic function (scope and treatment as in Art 9.5, 9.6, 10.1, 10.2 and 10.3 of Text book.1)

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

Unit-V

Lorentz transformation equations

New concept of space and Time, postulates of special theory of relativity, Lorentz transformation equations, Lorentz contraction, Time dilation, simultaneity, Relativistic formulae for composition of velocities and accelerations, proper time, Lorentz transformations form a group (scope and treatment as in chapters 1 and 2 of Text book.2).

Activities

Seminar/ Quiz/ Assignments/ Applications of Classical Mechanics to Real life Problem /Problem Solving

Text books

1. Classical mechanics by H.Goldstein, 2nd edition, Narosa Publishing House.
2. Relevant topics from Special relativity by W.Rindler, Oliver & Boyd, 1960.

Reference Book

Classical Mechanics by J.C. Upadhyaya, Himalaya Publishing House

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)
SEMESTER-VII

COURSE 17: REAL ANALYSIS

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. understand to form a metric space from any non-empty set, compact sets and connected sets
2. understand continuity of functions, compactness and connectedness
3. know the derivative of a real valued function and the applications of Mean value theorems
4. know the conditions for existence of integrals and some applications of integrals
5. know the vector valued functions, differentiation and integration of vector valued functions and their applications

UNIT I
Basic Topology

Finite, countable and uncountable sets – Metric spaces – Compact sets – Perfect sets – Connected sets (Sections 2.1 to 2.47)

UNIT II
Continuity

Limits of functions - Continuous functions – Continuity and Compactness – Continuity and Connectedness – Discontinuities.Monotonic functions (Sections 4.1 to 4.31)

UNIT III
Differentiation

The derivative of a real function – Mean Value Theorems – The continuity of Derivatives L'Hospital's Rule. (Sections 5.1 to 5.13)

UNIT IV
Riemann Stieltjes Integrals

Definition and existence of integral – properties of integrals –. (Sections 6.1 to 6.19)

UNIT V
FTC andVector Valued Functions

Integration and differentiation -Differentiation of Vector Valued Functions – Integration of Vector valued functions – Rectifiable curves. (Sections 6.20 to 6.27)
(FTC : Fundamental Theorem of Calculus)

Activities

Seminar/ Quiz/ Assignments/ Applications of Real Analysis to Real life Problem /Problem Solving

Text Book

Principles of Mathematical Analysis by Walter Rudin, Mc Graw Hill International Edition

Reference Book

Mathematical Analysisby S C Malik, Savita Arora New age International Publishers

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VII

COURSE 17: DISCRETE MATHEMATICS

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. learn the applications of graph theory in other subjects.
2. understand representations of different problems by means of graphs.
3. learn the relation between bipartite graphs and odd cycles.
4. learn the concepts of forest, binary trees, eccentricity of a vertex and radius of connected graphs.
5. learn the importance of multi graphs in other subjects like physics and chemistry.
6. learn different characterizations of modular and distributive lattices.

UNIT- I

Basic Ideas, History, Initial Concepts, Summary, Connectivity, Elementary Results, Structure Based on Connectivity (Chapters – 1 & 2 of Text Book 1)

Unit –II

Trees, Characterizations, Theorems on Trees, Tree Distances, Binary trees, Tree Enumeration, Spanning trees, Fundamental Cycles, Summary (Chapter – 3 of Text Book 1)

Unit – III

Traversability, Introduction, Eulerian Graphs, Hamiltonian Graphs, Minimal Spanning Trees, J.B.Kruskal's Algorithm, R.C.Prim's Algorithm. (Chapter 4 of Text Book 1 and Section 7.5 of Text Book 2)

Unit –IV

Poset Definition, Properties of Posets, Lattice Definition, Properties of Lattices
(Chapter 1-A of Text Book 3)

Unit –V

Definitions of Modular and Distributive Lattices and its Properties
(Chapter 1-B of Text Book 3)

Activities

Seminar/ Quiz/ Assignments/ Applications of Discrete Mathematics to Real life Problem /Problem Solving

Text books

1. Graph Theory Applications by L.R.Foulds, Narosa Publishing House, New Delhi.
2. Discrete Mathematical Structures by Kolman and Busby and Sharen Ross, Prentic Hall of India – 2000, 3rd Edition
3. Applied Abstract Algebra by Rudolf Lidl and Gunter Pilz , Published by Springer- Verlag.

Reference Book

A text Book of Discrete Mathematics by Harish Mittal, Vinay Kumar Goyal, Deepak Kumar Goyal, IK International Publishing House Pvt.Ltd, New Delhi.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VII

COURSE 18: BASIC TOPOLOGY

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. handle operations on sets and functions and their properties
2. understand the concepts of Metric spaces, open sets, closed sets, convergence, some important theorems like Cantor's intersection theorem and Baire's theorem
3. familiar with the concept of Topological spaces, continuous functions in more general and characterize continuous functions in terms of open sets, closed sets etc.
4. explain the concept of compactness in topological spaces characterize compactness in metric spaces and their properties.

UNIT I
Sets and Functions

Sets and Set inclusion – The algebra of sets – Functions – Products of sets – Partitions and equivalence relations – Countable sets – Uncountable sets – Partially ordered sets and lattices. (Chapter I: Sections 1 to 8 of the prescribed text book).

UNIT-II
Metric spaces

The definition and some examples – Open sets – Closed sets – Convergence, Completeness and Baire'stheorem . (Chapter 2: Sections 9 to 12 of the prescribed text book).

UNIT-III
Metric spaces

Continuous mappings, Spaces of continuous functions – Euclidean and Unitary spaces.(Chapter 2: Sections 13 to15 of the prescribed text book) Topological spaces: The definition and some examples – Elementary concepts– (Chapter 3: Sections 16 to 17 of the prescribed text book).

UNIT-IV
Topological spaces

Open bases and open sub bases, Weak Topologies, The function algebras C(X, R) and C(X, C). (Chapter 3: Sections 18 to 20 of the prescribed text book). Compactness: Compact spaces – Heine – Borel theorem (Chapter 4: Section 21).

UNIT-V
Compactness

Product of Spaces – Tychonoff's theorem and locally Compact spaces – Compactness for metric spaces – Ascoli's theorem. (Chapter 4: Sections 22 to 25 of the prescribed text book).

Activities

Seminar/ Quiz/ Assignments/ Applications of Topology to Real life Problem /Problem Solving

Text Book

Introduction to Topology and Modern Analysis by G. F. Simmons International Student edition – McGraw – Hill Ltd.

Reference Books

1. Schaum's Outlines : General Topology by Seymour Lipschutz
2. Topology : A first Course by James Munkres

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VII

COURSE 18: CRYPTOGRAPHY

Theory Credits: 4 5 hrs/week

Learning Outcomes

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

1. understand Divisibility and Euclidean algorithm and congruences
2. understand about Enciphering matrices
3. understand finite fields and quadratic residues
4. understandthe idea of public key cryptography
5. understand pseudo-primes and Fermat's factorization

UNIT-I
Elementary Number Theory

TimeEstimates for doing arithmetic - Divisibility and Euclidean algorithm - Congruences - Applications to factoring(Chapter-I of the Text Book)

UNIT-II
Cryptography

Some simple crypto systems - Enciphering matrices (Chapter-III of the Text Book)

UNIT-III
Finite Fields and quadratic Residues

Finite fields - Quadratic residues and Reciprocity (Chapter-II of the Text Book)

UNIT-IV
Public Key Cryptography

The idea of public key cryptography - RSA - Discrete log - Knapsack (Chapter-IV : Sections IV.1 to IV.4 (omit sec.5) of the Text Book)

UNIT-V
Primality and Factoring

Pseudoprimes - The rho method - Fermat factorization and factor bases - The Continued fraction method - The quadratic sieve method(Chapter-V of the Text Book)

Activities

Seminar/ Quiz/ Assignments/ Applications of Cryptography to Real life Problem /Problem Solving

Text Book

A Course in Number Theory and Cryptography by Neal Koblitz, Springer-Verlag, New York, 2002, Second Edition.

Reference Books

1. An Introduction to Theory of Numbers by Niven and Zuckermann, Edn. 3, Wiley Eastern Ltd., New Delhi, 1976.
2. Elementary Number Theory by David M.Burton, Wm C.Brown Publishers, Dubuque, Iowa, 1989.
3. A Classical Introduction to Modern Number Theory by K.Ireland and M.Rosen, Springer Verlag, 1972.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VII

COURSE 19: LATTICE THEORY & BOOLEAN ALGEBRA

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. understand the concept of partially ordered set and properties of partial ordered sets
2. understand the concept of lattice, semilattice and their properties
3. understand the concept of ideals and homomorphisms in lattices
4. understand the distributive and the modular lattices
5. understand the concept of Boolean algebra and properties of Boolean algebra

UNIT-I
Partly Ordered Sets

Set Theoretical Notations, Relations, partly ordered Sets, Diagrams, special Subsets of a Partlyordered set, length, Lower and Upper Bounds, The minimum and maximum condition.(Chapter 1,section 1 to 8 of the Text Book)

UNIT –II
Lattices in General

Algebras, lattices, The Lattice Theoretical Duality principle, semi Lattices, lattices as Partly orderedsets, Diagrams of lattices, Sub lattices, Ideals, Bound Elements of a lattice, Atoms and Dual Atoms,Complements, Relative Complements, Semi complements, Irreducible Prime Elements of a lattice,The Homomorphism of a lattice (Chapter 2, section 10-20 of the Text Book)

UNIT – III
Complete lattices

Complete lattices, Complete Sub lattices of a Complete lattice, Conditionally Complete Lattices,Compact Elements, Compactly Generated lattices, Subalgebra lattice of an Algebra, ClosureOperations(Chapter 3, Sections 22-27 of the Text Book)

UNIT – IV
Distributive and Modular Lattices

Distributive lattices, Infinitely Distributive and Completely Distributive lattices, Modular lattices,Characterization of Modular and Distributive lattices by their Sublattices, Distributive Sublattices ofModular Lattices, Isomorphism theorems of modular lattice, Meet representation in modular anddistributive lattices(Chapter 4 of the Text Book)

UNIT – V
Boolean algebras

Boolean algebras, De Morgan formulae, Complete Boolean algebras, Boolean algebras and Booleanrings, The algebra of relations, The lattice of Propositions, Valuations of Boolean algebras(Chapter 6 of the Text Book)

Activities

Seminar/ Quiz/ Assignments/ Applications of Lattice Theory and Boolean Algebra to Real life Problem /Problem Solving.

Text Book

Introduction to Lattice Theory, Gabor Szasz, Academic press

Reference Books

1. Lattice Theory by G. Birkhoff, Amer. Math. Soc.
2. General Lattice Theory by George Grätzer, Birkhäuser Basel (1978)

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)
SEMESTER-VII

COURSE 19: FINITE ELEMENT ANALYSIS

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. understand the concepts behind formulation methods in FEM.
2. identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.
3. develop element characteristic equation and generation of global equation.
4. apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axisymmetric and dynamic problems and solve them displacements, stress and strains induced.
5. Know the Finite element modeling, stress calculation and temperature effects

Unit - I
Fundamental Concepts

Introduction, Historical background, Outline of presentation, Stresses and Equilibrium, Boundary conditions, Strain-Displacement relations, Stress-Strain relations, Plane stress, Plane strain problems, Temperature effects, Potential energy and equilibrium. The Rayleigh-Ritz method, Hamilton's principle.Galerkin's method, Saint Venant's principle.(Chapter 1, Section 1.1. to Section 1.11)

Unit - II
One-dimensional Problems

Introduction, Finite Element Modeling: Element Division, Numbering Scheme,
Coordinates and Shape Functions, The Potential Energy Approach: Element Stiffness Matrix, Force Terms TheGalerkin Approach: Element Stiffness, Force Terms,Assembly of the global stiffness matrix and load vector. (Chapter 3, Section 3.1 to 3.6)

Unit – III
One-dimensional Problems (Continued)

Properties of K, The Finite Element Equations: Treatment of boundary conditions: Types of Boundary Conditions - Elimitwtion Approach, Penalty Approach, Multipoint Constraints Quadratic shape functions, Temperature effects, Input data file. (Chapter 3, Section 3.7 to 3.10)

Unit - IV
Trusses

Introduction, Plane trusses -Local and Global Coordinate Systems, Formulas for Calculating l and m, Element Stiffness Matrix, Stress Calculations, Temperature Effects, Three-dimensional trusses, Assembly of global stiffness matrix for the Banded and Skyline solutions - Assembly for Banded Solution, Input Data File (Chapter 4)

Unit - V
Two-dimensional Problems

Introduction, Finite element modeling, Constant strain triangle - lsoparametric Representation, Potential· Energy Approach, Element Stiffness, Force Terms, Galerkin Approach, Stress Calculations, Temperature Effects (Chapter 5, Section 5.1 to 5.3)

Activities

Seminar/ Quiz/ Assignments/ Applications of Finite Element Analysis to Real life Problem /Problem Solving.

Text Book

Introduction to Finite Elements in Engineering by Tirupathi R. Chandrupatla, Ashok D.Belegundu (chapters 1 to 8 only).

Reference Books

1. Introduction to Finite Element Method, by S.S.Rao, Elsevier
2. Finite Element Method by O.C. Zienkiewicz, Butterworth-Heinemann Ltd.
3. Introduction to Finite Element Method by J.N.Reddy,McGraw Hill Education

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)
SEMESTER-VII

COURSE 20: GRAPH THEORY

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. Be familiar with the definitions and basic theory of graphs
2. Be able to implement standard algorithms of graph theory
3. Be able to prove simple results in graph theory.
4. Identify trees and obtain spanning trees of graphs.
5. Find Euler and Hamiltonian paths and circuits in a graph

UNIT I

An Introduction to Graph

The Definition of a Graph, Graph as Models, More Definitions, Vertex Degrees, Subgraphs.(Chapter 1, Section 1.1 to 1.5 of the Text Book)

UNIT II

Matrix Representation of graphs

Paths and cycles, The Matrix Representation of graphs, Fusion(Chapter 1, Section 1.6 to 1.8)
Trees and Connectivity: Definitions and Simple Properties, Bridges, Spanning Trees
(Chapter 2, Section 2.1 to 2.3 of the Text Book)

UNIT III

Trees and Connectivity(Continuity)

Connector Problems, Shortest Path Problems, Cut Vertices and Connectivity (Chapter 2, Section 2.4 to 2.6 of the Text Book)

UNIT IV

Euler Tours and Hamiltonian Cycles

Euler Tours, The Chinses Postman Problem, Hamiltonian Graphs, The Travelling Sallesman Problem. (Chapter 3 of the Text Book)

UNIT V

Matchings

Matching and Augmenting paths; The marriage problem; The personnel assignment problem; The optimal Assignment problem. (Chapter 4 of the Text Book)

Activities

Seminar/ Quiz/ Assignments/ Applications of Graph Theory to Real life Problem /Problem Solving

Text Book

A first look at Graph Theory by John Clark & Derek Allan Holton, Allied Publishers Limited 1995.

Reference Books

1. AFirstCourseinGraphTheory by S.A.Choudham,MacmillanIndiaLtd.

2. IntroductiontoGraphTheory by RobinJ.Wilson,LongmanGroup Ltd.
3. GraphTheorywithApplications by J.A.BondyandU.S.R.Murthy,Macmillon,London

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)
SEMESTER-VII

COURSE 20: MATHEMATICAL FINANCE

Theory Credits: 4 5 hrs/week

Learning Outcomes
Upon successful completion of this course student should be able to:

1. Understand the that interest calculations and methods of calculations
2. Understand the annuities and types of Annuities and calculation interest and values of annuities
3. Understand the concept of Mathematics of Capital Budgeting and Depreciation and some methods of calculations
4. know the Comparison onthe Discount Rate to the Interest Rate
5. know the net present value, profitability index and other capital budgeting methods

UNIT– I
Mathematics of the Time Value of Money

Simple Interest : Total Interest, Rate of Interest, Term of Maturity, Current Value, Future Value, Finding n and r When the Current and Future Values are Both Known, Simple Discount, Calculating the Term in Days, Ordinary Interest and Exact Interest, Obtaining Ordinary Interest and Exact Interest in Terms of Each Other, Focal Date and Equation of Value, Equivalent Time: Finding an Average due Date, Partial Payments, Finding the Simple Interest Rate by the Dollar-Weighted Method(Unit – II section 1.1 to 1.14 of the text book)Bank Interest : Finding FV Using the Discount Formula, Finding the Discount Term and the Discount Rate, Difference Between a Simple Discount and a Bank Discount(Unit – II section 2.1 to 2.3 of the text book)

UNIT -II
Mathematics of the Time Value of Money(Continued)

Bank Interest : Comparing the Discount Rate to the Interest Rate, Discounting a Promissory Note, Discounting a Treasury Bill(Unit – II section 2.4 to 2.6 of the text book)Compound Interest: The Compounding Formula, Finding the Current Value, Discount Factor, Finding the Rate of Compound Interest, Finding the Compounding Term, The Rule of 72 and Other Rules, Effective Interest Rate, Types of Compounding, Continuous Compounding, Equations of Value for a Compound Interest, Equated Time For a Compound Interest(Unit – II section 3.1 to 3.11 of the text book)

UNIT- III
Mathematics of the Time Value of Money(Continued)

Annuities: Types of Annuities, Future Value of an Ordinary Annuity, Current Value of an Ordinary Annuity, Finding the Payment of an Ordinary Annuity, Finding the Term of an Ordinary Annuity, Finding the Interest Rate of an Ordinary Annuity, Annuity Due: Future and Current Values, Finding the Payment of an Annuity Due, Finding the Term of an Annuity Due, Deferred Annuity, Future and Current Values of a Deferred Annuity, Perpetuities(Unit – II section 4.1 to 4.12 of the text book)

MATHEMATICS OF DEBT AND LEASING : Credit and Loans :Types of Debt, Dynamics of Interest– Principal Proportions, Premature Payoff, Assessing Interest and Structuring Payments, Cost of Credit, Finance Charge and Average Daily Balance, Credit Limit vs. Debt Limit(Unit – III section 1.1 to 1.7 of the text book)

UNIT - IV
Mathematics ofdebitandleasing(Continued)

Mortgage Debt : Analysis of Amortization, Effects of Interest Rate, Term, and Down Payment on theMonthly Payment, Graduated Payment Mortgage, Mortgage Points and the Effective Rate, Assuming a Mortgage Loan, Prepayment Penalty on a Mortgage Loan, Refinancing a Mortgage Loan, Wraparound and

Balloon Payment Loans, Sinking Funds, Comparing Amortization to Sinking Fund MethodsLimit (Unit – III section 2.1 to 2.10 of the text book)

UNIT – V

Mathematics of Capital Budgeting and Depreciation

Capital Budgeting: Net Present Value, Internal Rate of Return, Profitability Index, Capitalization and Capitalized Cost, Other Capital Budgeting Methods

Depreciation and Depletion: The Straight-Line Method, The Fixed-Proportion Method, The Sum-of-Digits Method, The Amortization Method, The Sinking Fund Method

Limit (Unit – IV section 1.1 to 1.5 and 2.1 to 2.5 of the text book)

Activities

Seminar/ Quiz/ Assignments/ Applications of Mathematical Finance to Real life Problem /Problem Solving

Text Book

Mathematical Finance by M. J. Alhabeeb, A John Wiley & Sons, INC., Publication

Reference Books

1. Investment Scienceby David G. Luenberger, Oxford University Press, Delhi, 1998.
2. Futures and Other Derivatives by John C. Hull, Options, 6th Ed., Prentice-Hall India, Indianreprint, 2006.
3. An Elementary Introduction to Mathematical Finance by Sheldon Ross, 2nd Ed., CambridgeUniversity Press, USA, 2003

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VIII

COURSE 21: ADVANCED ALGEBRA

Theory Credits: 4 5 hrs/week

Learning Outcomes

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

1. define modules, submodules and give some examples of them.
2. understand reducible modules, free modules and be able to find the rank of a linear mapping
3. understand Einstein's criteria for irreducible polynomials and algebraic extensions
4. understand splitting fields and finite fields
5. understand the Fundamental theorem of Galois theory

UNIT I
Algebraic extension of fields

Irreducible polynomials and Eisenstein's criterion-Adjunction of roots-Algebraic extensions-Algebraically closed fields. (Sections 15.1 to 15.4 of the Chapter 15 in the prescribed text book.)

UNIT II
Normal and separable extensions

Splitting fields-Normal extensions-multiple roots-finite fields.(Sections 16.1 to 16.4 of the Chapter 16 in the prescribed text book.)

UNIT III

Normal and separable extensions: Separable extensions.

Galois Theory: Automorphism groups and fixed fields- fundamental theorem of Galois Theory. (Section 16.5 of the Chapter 16 and Sections 17.1 to 17.2 of the Chapter 17 in the prescribed text book.)

UNIT IV
Galois Theory

Fundamental theorem of algebra. Galois Theory and Applications of Galois Theory to Classical problems: Roots of unity and cyclotomic polynomials-Cyclic extensions (Section 17.3 of the Chapter 17 and sections 18.1and 18.2 of the Chapter 18 in the prescribed text book.)

UNIT V
Applications of Galois Theory

Applications of Galois Theory to Classical problems: Polynomials solvable by radicals-symmetric functions-Ruler and compass constructions. (Sections 18.3 and 18.4 of the Chapter 18 in the prescribed text book.)

Activities

Seminar/ Quiz/ Assignments/ Applications of Algebra to Real life Problem /Problem Solving

Text Book

Basic Abstract Algebra by P.B.Battacharya, S.K.jain, S.R.Nagpaul, Cambridge University Press.

Reference Books

1. TopicsinAlgebra by I.N.Herstein,2nd Edition,JohnWiley&Sons
2. Algebra bySergeLang,RevisedThirdEdition,Springer
3. Algebra byThomasW.Hungerford,Springer

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VIII

COURSE 21: ELEMENTS OF ELASTICITY AND FLUID DYNAMICS

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. understand the equation of continuity and general analysis of fluid motion.
2. understand the equation of motion of a fluid, Bernoulli's equation and circulation theorem.
3. understand the two dimensional fluid flows and their properties.
4. understand the various deformations and equation of compatibility.
5. understand the properties of the stress, Mohr's Diagram and certain examples of stress.

Unit-I

Kinematics of fluids, real and ideal fluids, velocity of fluid at a point, streamlines and path lines, velocity potential, velocity vector, local and particle rates of change, equation of continuity, Acceleration of fluid, conditions at a rigid boundary, General analysis of fluid motion (Chapter 2 of Text book 1)

Unit-II

Equation of motion of a fluid, pressure at a point in a fluid at rest and in a moving fluid, conditions at a boundary of two in viscid immiscible fluids, Euler's equations of motion, Bernoulli's equation. Discussion of the case of steady motion under conservative body forces, Vortex motion, Kelvin's circulation theorem. Some further aspects of vortex motion (Chapter 3(excluding sections 3.8 to 3.11) of Text book 1)

Unit-III

Some two - dimensional flows: Meaning of two - dimensional flow, use of cylindrical polar coordinates, the stream function, the complex potential for two – dimensional, irrotational, incompressible flow, complex potential for standard two – dimensional flows, some worked examples, two - dimensional image systems. The Milne- Thomson circle theorem, the theorem of Blasius (Chapter 5(excluding sections 5.10 to 5.12) of Text book 1)

Unit-IV

Analysis of strain: Deformation, affine deformation, infinitesimal affine deformation, geometrical interpretation of the components of strain, strain quadric of Cauchy, principal directions, invariants, general infinitesimal deformation, Examples of strain, equations of compatibility, finite deformations. (Chapter 1 of Text book 2)

Unit-V

Analysis of stress, body and surface forces, stress tensor, equations of equilibrium, transformation of coordinates, stress quadric of Cauchy, Mohr's diagram, examples of stress (Chapter 2 of Text book2)

Activities

Seminar/ Quiz/ Assignments/ Applications of Elements Elasticity and fluid dynamics to Real life Problem /Problem Solving

Text books

1. Text Book of Fluid Dynamics by F.Chorlton, CBS publishers and distributors, New Delhi.
2. Mathematical Theory of Elasticityby I.S.Sokolnikoff 2 nd edition; Tata Mc Graw Hill-New Delhi

Reference Books

1. Foundations of Fluid Mechanics by S.W. Yuan, Prentice Hall
2. An introduction to Fluid Dynamics by Bachelor G. K., Cambridge University Press, 2007.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)
SEMESTER-VIII

COURSE 22: ADVANCED ANALYSIS

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion this course, the student will be able to
1. solve the problems on convergence of Sequences and Series of functions
2. understand the Stone – Weierstras theorem
3. knowExponential and Logarithmic functions and Fourier Series
4. Linear transformations and differentiation
5. understand the contraction principle, the rank theorem

UNIT I
Sequences and Series of Functions

Discussion of Main Problem – Uniform Convergence - Uniform Convergence and Continuity – Uniform Convergence and Integration – Uniform Convergence and Differentiation (Sections 7.1 to 7.18)

UNIT II
Equicontinuous families of functions and Power Series

Equicontinuous families of functions – the Stone – Weierstrass theorem – Power Series (Sections 7.19 to 7.33 & 8.1 to 8.5)

UNIT III
Some Special Functions

The Exponential and Logarithmic functions – The Trigonometric functions – Algebraic completeness of the complete field – Fourier Series(Sections 8.6 to 8.16)

UNIT IV
Functions of several variables

Linear transformation – Differentiation.(Sections 9.1 to 9.21)

UNIT V
Functions of several variables (continued..)

The contraction Principle – The Inverse function Theorem – The implicit function Theorem – The Rank Theorem – Determinants(Sections 9.22 to 9.41)

Activities

Seminar/ Quiz/ Assignments/ Applications of Analysis to Real life Problem /Problem Solving

Text Book

Principles of mathematical Analysis by Walter Rudin, Mc Graw Hill International Edition

Reference Books

1. Mathematical Analysis by .Tom. M. Apostal, Narosa Publishing House

2. ElementsofRealAnalysis by ShanthiNarayan andDr.M.D.Raisinghania,S. Chand & Company Pvt. Ltd., New Delhi
3. An Introduction to Real Analysis by Robert G.Bartle and Donlad R. Sherbert, John Wiley and sons(ASIA)Pvt. Ltd.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VIII

COURSE 22: ADVANCED LINEAR ALGEBRA

Theory Credits: 4 5 hrs/week

Learning Outcomes

Upon successful completion of this course student should be able to

1. understand the basic to the analysis of a single linear transformation on a finite-dimensional vector space and the analysis of characteristic values and the rational and Jordan canonical forms.
2. understand concept of finite-dimensional inner product spaces and basic geometry, relating orthogonalization and unitary operators and normal operators.
3. know the Jordan form, computation of invariant factors
4. know the inner product spaces and their properties
5. know about unitary operators and Normal operators

UNIT-I

Elementary Canonical Forms

Introduction – Characteristic Values – Annihilating Polynomials –invariant subspaces – Simultaneous Triangulation – Simultaneous Diagonalization, Simultaneous

(Chapter 6, Section 6.1 to 6.5 of the text book)

UNIT-II

Elementary Canonical Forms(Continued)

Direct – sum Decompositions – invariant direct sums – the primary decomposition theorem

(Chapter 6, Section 6.6 to 6.8 of the text book)The Rational and Jordan Forms: cyclic subspaces and Annihilators – cyclic decompositions and the rational form.(Chapter 7, Section 7.1 to 7.2 of the text book)

UNIT-III

Elementary Canonical Forms(Continued)

The Jordan Form – Computation of Invariant Factors – Semi Simple Operators.(Chapter 7, Section 7.3 to 7.5 of the text book)

UNIT-IV

Inner product spaces

Inner products, Inner product spaces, Linear functionals and adjoints,(Chapter 8, Section 8.1 to 8.3 of the text book)

UNIT - V

Inner product spaces(continued)

Unitary operations, Normal operators(Chapter 8, Section 8.4 to 8.5 of the text book)

Activities

Seminar/ Quiz/ Assignments/ Applications of Linear Algebra to Real life Problem /Problem Solving

Text Book

Linear Algebra by Kenneth Hoffman and Ray Kunze, second edition, Prentice Hall of India Private Limited, New Delhi.

Reference Books

1. First Course in Linear Algebra by Bhattacharya, P.B., Jain, S.K and Nagpal, S.R., Wiley Eastern Ltd. New Delhi
2. Linear Algebra by Henry Helson, Hindustan Book Agency (1994)
3. Topics in Algebra by I.N. Herstein, Second edition (Wiley Eastern Ltd.)
4. Algebra by M. Artin, Prentice - Hall of India private Ltd.

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VIII

COURSE 23: ADVANCED TOPOLOGY

Theory Credits: 4 5 hrs/week

Learning Outcomes

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

1. define T_1-space, T_2 – space
2. underset and Urysohn's Lemma, and the Tietz's extension theorem
3. underst and the Stone – Chech compactification,
4. understand and can define the Connectedness of a topological space
5. understand the Weierstrass approximation theorem and Stone-Weierstrass theorems

UNIT-I
Separation

T1 spaces and Hausdorff spaces – Completely regular spaces and normal spaces – Urysohn's lemma and the Tietze's extension theorem. (Chapter 5: Sections 26 to 28 Prescribed text book).

UNIT-II
Separation (continued)

The Urysohn imbedding theorem – The Stone – Chech compactification. (Chapter 5: Sections 29 to 30 Prescribed text book). Connectedness: Connected spaces– connectedness of Rn and Cn . (Chapter 6: Section 31 Prescribed text book).

UNIT-III
Connectedness (continued)

The components of a space – Totally disconnected spaces – Locally connected spaces. (Chapter 6: Sections 32 to 34 Prescribed text book)

UNIT-IV
Approximation

The Weierstrass approximation theorem - The Stone-Weierstrass theorems (Chapter 7: Section 35 to 36 Prescribed text book).

UNIT-V
Approximation (continued)

Locally compact Hausdorff spaces – The extended StoneWeierstrass theorems. (Chapter 7: Sections 37 to 38 Prescribed text book).

Activities

Seminar/ Quiz/ Assignments/ Applications of Topology to Real life Problem /Problem Solving

Text Book

Introduction to Topology and Modern Analysis by G. F. Simmons, International Student edition – McGraw – Hill Kogakusha, Ltd.

Reference Books

1. Schaum's Outlines : General Topology by Seymour Lipschutz
2. Topology : A first Course by James Munkres,Prentice-Hall Pvt. Ltd.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VIII

COURSE 23: DIFFERENTIAL GEOMETRY

Theory Credits: 4 5 hrs/week

Course Outcomes

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

1. to know about space curves, planar curves
2. to calculate Torsion and Curvature
3. to know parametric curves on surfaces Rodrigue's formula
4. to know about minimal surfaces
5. to know contravariant and covariant

Course Contents

Unit I
Theory of Space Curves

Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae.
Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

Unit II
Theory of Surfaces

Parametric curves on surfaces. Direction coefficients.First and second Fundamental forms.Principal and Gaussian curvatures.Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines.

Unit III
Developable

Developable associated with space curves and curves on surfaces, Minimal surfaces.

Unit IV
Geodesics

Canonical geodesic equations.Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics.Torsion of a geodesic.Geodesic curvature.Gauss-Bonnet theorem.Surfaces of constant curvature.Conformal mapping.Geodesic mapping.Tissot's theorem.

Unit V
Tensors

Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction, Metric tensor and 3-index Christoffel symbols, Parallel propagation of vectors, Covariant and intrinsic derivatives, Curvature tensor and its properties, Curl, Divergence and Laplacian operators in tensor form, Physical components.

Activities

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

Text Book

An Introduction to Differential Geometry by T.J. Willmore, Dover Publications, 2012.

Reference Books

1. Elementary Differential Geometry by B. O. Neill, 2nd Ed., Academic Press, 2006.
2. Differential Geometry of Three Dimensions by C.E. Weatherburn, Cambridge University Press2003.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VIII

COURSE 24: ORDINARY DIFFERENTIALEQUATIONS

Theory Credits: 4 5 hrs/week

Learning outcomes

After successful completion of the course, students will be able to

1. comprehend the bridge between the real function theory and theory of ordinary differential equations
2. understand the basic theory behind existence, uniqueness, continuity of solutions of ordinary differential equations
3. realize the dependence of solutions on various parameters involved in the differential equations
4. recognize the significance studying differential systems and its utility in understanding higher order differential equations
5. figure out qualitative behavior of solutions of differential equations of various orders.

Unit I
Real Function Theory

Essential concepts from Real Function Theory – The basic problem -The fundamental existence and uniqueness theorem –examples to demonstrate the theory- continuation of solutions (Sections 10.1, 10.2 of the prescribed text book)

Unit II
Existence and Uniqueness

Dependence of solutions on initial conditions – dependence of solutions on parameters (causal function f) - Existence and Uniqueness theorems for systems – existence and uniqueness theorems for Higher order equations – examples (Sections 10.3, 10.4 of the prescribed text book)

Unit III
Linear differential systems

Introduction to the theory of Linear differential systems – Theory and properties of Homogeneous linear systems (Sections 11.1 - 11.3 of the prescribed text book)

Unit IV
Homogeneous and Non-homogeneous Systems

Theory of non-homogeneous linear systems – Theory and properties of the nth order homogeneous linear differential equations (Sections 11.4 - 11.6 of the prescribed text book)

Unit V
Higher order non-homogeneous Linear Equations

Theory of nth order Non homogeneous Linear equations – Sturm theory – Sturm Liouville Boundary value problems (Sections 11.7, 11.8, 12.1 of the prescribed text book)

Activities

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

Text Book

Differential Equations by Shepley L. Ross, Wiley India

Reference books

1. Differential Equations with Applications and Historical Notes by George F. Simmons,(3rd edition). CRC Press. Taylor & Francis.
2. An Introduction to Ordinary Differential Equations by Earl A. Coddington, Prentice-Hall of India

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)
SEMESTER-VIII

COURSE 24: APPLICATIONS OF ALGEBRA

Theory Credits: 4 5 hrs/week

Course Outcomes

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

1. understand Boolean polynomials and Boolean functions
2. understand designing and simplification of circuits
3. understand incidence matrix of a BIBD and construction of BIBD from finite fields
4. know the concept of coding theory
5. generating Functions for non-isomorphic Graphs

Unit – I

Boolean algebra and Swathing Circuits

Boolean Algebras; Switches and Logic Gates; Laws of Boolean algebra; Boolean Polynomials and Boolean Functions; Switching Circuits and Gate Networks; Simplification of Circuits; Designing Circuits (1.1 to 1.7 of Chapter 1)

Unit – II

Balanced Incomplete Block Designs(BIBD)

Basic Definitions and Results; Incidence Matrix of a BIBD; Construction of BIBDs from Difference Sets; construction of BIBD using quadratic residues; Difference set families, construction of BIBD from finite fields. (2.1 to 2.6 of Chapter 2)

Unit – III

Coding Theory

Introduction to Error - Correcting Codes, Linear Codes, Generator and Parity - Check Matrices, Minimum Distance, Hamming Codes, Decoding, Cyclic Codes. (4.1 to 4.3 of Chapter 4)

Unit - IV

Symmetry Groups and Color Patterns

Permutation Groups, Groups of Symmetries; Colouring and Colouring Patterns, Polya Theorem and Pattern Inventory, Generating Functions for non-isomorphic Graphs

(5.1 to 5.3, 5.6 to 5.7 of Chapter 5)

Unit – V

Wallpaper Pattern Groups

Group of Symmetries of a Plane; Wallpaper Pattern Groups; Change of Basis in R2 (6.1 to 6.3 of Chapter 6)

Activities

Seminar/ Quiz/ Assignments/ /Problem Solving.

Text Book

Topics in Applied Abstract Algebra by S. R. Nagpaul and S. K. Jain, Thomson Brooks and Cole, Belmont, 2005

Reference Book

Applications of Abstract Algebra with Maple by Richard E. Klima, Neil Sigmon, Ernest Stitzinger, CRC Press LLC, Boca Raton, 2000.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)
SEMESTER-VIII

COURSE 25: OPERATIONS RESEARCH

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. study on LPP enables to arrive at an optimal decision/solutions in difficult decision making.
2. study on LPP applied to problems pertaining to both profit making and low cost related real world situation.
3. study on Post optimal analysis enables into manage and control resource allocation.
4. study of Transportation problem and Assignment problem introduces to implementing simplex procedure for more variables using Modi method stepping stone method and hungary method
5. study on games and strategies helps in decision making for problems with competitive situations like candidates for elections, marketing campaigns by different companies etc.

UNIT-I
Linear Programming: Simplex Method

Introduction-Fundamental properties of solutions-The computational procedure-Use of artificial variables. 12 hours (Sections 4.1 to 4.4 of the Chapter 4 in the Prescribed Text Book)

UNIT-II
Duality in Linear Programing

Introduction-General Primal-Dual pair-Formulating a Dual problem-Prime-Dual Pair in matrix form-Duality theorems-Complementary slackness theoremDuality and simplex method. 12 hours (Sections 5.1 to 5.7 of the Chapter 5 in the Prescribed Text Book)

UNIT-III
Duality in Linear Programing

Economic Interpretation of Duality, Dual Simplex method Post-optimal Analysis : Introduction-Variation in the cost vector-Variation in the requirement vector-variation in the coefficient matrix-Structural variations- Applications of Post-optimal Analysis. 12 hours (Sections 5.8, 5.9 and 6.1 to 6.6 of the Chapters 5 and 6 in the Text Prescribed Book)

UNIT-IV
Transportation Problem and Assignment Problem

Introduction-General transportation problem-The transportation table-Solution of a transportation problem-Finding an initial basic feasible solution-Test for optimality-Degeneracy in Transportation problem-Transportation Algorithm (MODI Method)- Introduction -Mathematical formulation of the problem-The Assignment method-Special cases in Assignment problem-A typical Assignment problem. 12 hours (Sections 10.1 to 10.3 and 10.8 to 10.11 of the Chapter 10 in the Prescribed Text Book.) (Sections 11.1 to 11.5 of the Chapter 11 in the Prescribed Text Book)

UNIT-V
Games and Strategies

Introduction-Two-person zero-sum games-some basic terms-The maximin-minimax principle-Games without saddle points-Mixed strategies-Graphic solution of 2xn and mx2 games. 12 hours (Sections 17.1 to 17.6 of the Chapter 17)

Activities

Seminar/ Quiz/ Assignments/ Applications of Operations Research to Real life Problem /Problem Solving

Text Book

Operations Research byKantiSwarup, P.K. Gupta and Man Mohan Sultan Chand & Sons, New Delhi, 2006.

Reference Books

1. Operations Research, An Introduction byHamdy A Taha, Maxwell Macmillan International Edition, New York, 1992.

2. Operations Research Theory, methods and Applications by S.D. Sarma, kedarnathRamnath publications, 2008.

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ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc Mathematics (w.e.f:2023-24A.B)

SEMESTER-VIII

COURSE 25: MATHEMATICAL MODELLING

Theory Credits: 4 5 hrs/week

Learning Outcomes

After successful completion of the course, students will be able to

1. understand concept of modelling and simulation
2. construct mathematical models of real world problems
3. solve the mathematical models using mathematical techniques
4. know the need for mathematical modelling through difference equations
5. to know Harrod Model and cobweb application model to Actuarial science

Unit–1

Mathematical Modeling

Simple situations requiring mathematical modeling, characteristics of mathematical model.(Chapter 1 Sections 1.1-1.5 of the Text Book)

Unit – 2

Mathematical Modeling through ordinary differential equations of first order

Linear Growth and Decay Models.Non-Linear growth and decay models, Compartment models. (Chapter 2 Sections 2.1- 2.4 of the Text Book)

Unit – 3

Mathematical Modeling through system of Ordinary differential equations of first order

Prey-predator models, Competition models, Model with removal and model with immigrations.Epidemics: simple epidemic model, Susceptible-infected-susceptible(SIS) model, SIS model with constant number of carriers.Medicine : Model for Diabetes Mellitus. (Chapter 3 Sections 3.11, 3.12, 3.2 of the Text Book)

Unit – 4

Mathematical Modeling through difference equations Introduction to difference equations

The need for mathematical modelling through difference equations : some simple models, basic theory of linear difference equations with constant coefficients (Chapter 5 Sections 5.1 and 5.2 of the Text Book)

Unit - 5

Mathematical Modeling through difference equations Introduction to difference equations (continued…)

Harrod Model, cobweb model application to Actuarial Science (Chapter 5 Sections 5.3 (5.3.3 not included))

Activities

Seminar/ Quiz/ Assignments/ Applications of Mathematical Modelling to Real life Problem /Problem Solving

Text book

Mathematical Modeling by J N Kapur, New Age International publishers.(2009)

Reference Books

1. Mathematical Modelling with Case Studies by Barnes, B., Fulford, G. R., CRC Press, 2008.
2. An introduction to mathematical modeling by Bender, E. A. (2012), Courier Corporation.
3. Mathematical Modelling by Meerschaert, M. M., (2013) Academic Press.

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