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

B.Sc-Mathematics

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	3+2	4
	I	2	Advances in Mathematical, Physical and Chemical Sciences	3+2	4

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B.Sc. Honours Course Syllabus (Single Major)
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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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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)

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B.Sc. Honours Course Syllabus (Single Major)
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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) $2^{7}\left[\cos\left(\frac{2\pi}{3}\right) + i\sin\left(\frac{2\pi}{3}\right)\right]$
   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.

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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)

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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
B.Sc. Honours Course Syllabus (Single Major)
(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. $\overset{Lt}{x \to 0} \frac{ax + x\cos x}{b\sin x}$; 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)

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

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.

Programme: B.Sc Mathematics (Major)

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
	II	3	Differential Equations & Problem Solving Sessions	3	3
			Differential Equations & Problem Solving Sessions Practical Course	2	1
		4	Analytical Solid Geometry & Problem Solving Sessions	3	3
			Analytical Solid Geometry & Problem Solving Sessions Practical Course	2	1

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 $y^2 \log y = xpy + p^2$

UNIVERSITY MODEL PAPER

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.

UNIVERSITY MODEL PAPER

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 $2x - y + 2z + 2 = 0$..

UNIVERSITY MODEL PAPER

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.