



ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM

B.Sc. Honours Course Syllabus (Single Major)

(w.e.f:2023-24A.B)

B.Sc-Data Science

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

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

UNIT II: ESSENTIALS OF PHYSICS:

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



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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. Vasishta, 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



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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.



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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.



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3: Laboratory Experiments

Assign students laboratory experiments that demonstrate the practical applications of mathematics, physics, and chemistry.

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

.4: Mathematical Modeling

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

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

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



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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

COURSE – I ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICAL &
CHEMICAL SCIENCES

Time:3hrs

MAX MARKS: 70 M

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

1. If $\text{Arg}(Z) < 0$ the $\text{Arg}(-Z) - \text{arg}(Z) =$ []
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 $\text{Arg}(Z_1 Z_2) = 0$ 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) $\frac{1}{2}$ 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 $2\bar{i} + \lambda\bar{j} - \bar{k}$ and $4\bar{i} - 2\bar{j} + 2\bar{k}$ are perpendicular to each other, then
 $\lambda =$ _____ []
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 nucleons
c) Burning of nuclei d) Reflection of Solar Light
13. Organic chemistry is the study of _____. []
a) Nitrogen based compounds b) 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 disaccharide _____ []
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



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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 $\sqrt{3} \cos ec 20^\circ - \sec 20^\circ$ is _____.
2. The area of the parallelogram whose diagonals are $3i + j - 2k$ and $i - 3j + 4k$ 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 _____



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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 $\vec{a} = 3\vec{i} - 2\vec{j} + 6\vec{k}$ () a) Angular Momentum
B. Polar form $-1 + \sqrt{3}i$ () b) Glucose
C. Joule x Sec () c) $\frac{1}{7}(3\vec{i} - 2\vec{j} + 6\vec{k})$
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 \bar{Z} is a complex number then $Z\bar{Z}$ is purely real.
2. If Z is a complex number such that $Z^2 = (\bar{Z})^2$ 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, PHYSICAL AND CHEMICAL
SCIENCES

Theory

Credits: 4

5 hrs/week

Course Objective:

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

Learning outcomes:

1. Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used to model and solve real-world problems.
2. To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations.
3. Understand the different sources of renewable energy and their generation processes and advances in nanomaterials and their properties, with a focus on quantum dots. To study the emerging field of quantum communication and its potential applications. To gain an understanding of the principles of biophysics in studying biological systems. Explore the properties and applications of shape memory materials.
3. Understand the principles and techniques used in computer-aided drug design and drug delivery systems, to understand the fabrication techniques and working principles of nanosensors. Explore the effects of chemical pollutants on ecosystems and human health.
4. Understand the interplay and connections between mathematics, physics, and chemistry in various advanced applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.
- 5 Understand and convert between different number systems, such as binary, octal, decimal, and hexadecimal. Differentiate between analog and digital signals and understand their characteristics. Gain knowledge of different types of transmission media, such as wired (e.g., copper cables, fiber optics) and wireless (e.g., radio waves, microwave, satellite).

UNIT I: ADVANCES IN BASICS MATHEMATICS

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

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

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



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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.



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STUDENT ACTIVITIES

UNIT I: ADVANCES IN BASIC MATHEMATICS

1: Straight Lines Exploration

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

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

2: Limits and Differentiation Problem Solving

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

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

3: Integration Exploration

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

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

4: Matrices Manipulation

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

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

UNIT II: ADVANCES IN PHYSICS:

1: Case Studies

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

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

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

2: Experimental Design

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



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

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

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

3: Group Discussion and Debate

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

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

UNIT III: ADVANCES IN CHEMISTRY:

1. Experimental Design and Simulation

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

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

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

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

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

2. Case Studies and Discussion

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

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

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

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

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

3: Group Project

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

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



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

- 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) $y-x-2=0$
- $\lim_{x \rightarrow 0} \frac{1 - \cos 2x}{x^2}$ is equal to
[]
a) 0 b) 1 c) 2 d) 4
- 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) $1-x^2$
- $\int e^{\tan x} \sec^2 x \, dx =$
[]
a) $e^{\tan x}$ b) $e^{\sin x}$ c) $\tan x$ d) $\sin x$
- 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
- If $A = [a_{ij}]_{m \times n}$ such that $a_{ij} = 0$ for $i \neq j$ then A is
[]
a) a row matrix b) a column matrix
c) a diagonal matrix d) a scalar matrix
- Which of the following is an renewable energy source
[]
a) Coal b) Natural gas c) Solar d) Nuclear
- What is the main purpose of Photovoltaic cells in solar panels
[]
a) Heat generation b) Electricity generation c) Water purification d) Carbon capture
- Which renewable energy source is harnessed from the earth's Internal heat?
[]
a) Solar b) Wind c) Geothermal d) Hydro
- What is the fundamental principle behind quantum mechanics
[]
a) Classical Mechanics b) Quantum Superposition c) Newton law of motion d) Maxwell's equation
- 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)
- What is the primary advantage of using quantum dot in solar cells?
[]
a) Low cost b) High efficiency
c) Fast charging d) Large size
- The Binding capacity between the drug and target is known as
[]
a) Virtual Screening b) Docking Score c) ADMET d) None
- The Increased sensitivity of Nanosensors is due to
[]
a) High Surface-to-volume ratio b) Low surface-to-volume ratio
- The green pigment chlorophyll is affected by
[]
a) CO_2 b) NO_2 c) SO_2 d) CH_4



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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. $x \rightarrow 0 \lim \frac{ax + x \cos x}{b \sin x}$; 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 invasive 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. Fluorescence 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. 11110001 () d) Guided media
E. Ethernet cable () e) (secx)



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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. Data Science (w.e.f:2023-24A.B)

Programme: B.Sc. Honours Data Science (Major)
SEMESTER – II
COURSE STRUCTURE

Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	3	Introduction to Data Science and R Programming	3	3
		Introduction to Data Science and R Programming Practical Course	2	1
	4	Descriptive Statistics	3	3
		Descriptive Statistics Practical Course	2	1



SEMESTER-II

COURSE 3: INTRODUCTION TO DATA SCIENCE AND R PROGRAMMING

Theory

Credits: 3

3 hrs/week

Aim and objectives of Course :

Data Science is a fast-growing interdisciplinary field, focusing on the analysis of data to extract knowledge and insight. This course will introduce students to the collection, Preparation, analysis, modelling and visualization of data, covering both conceptual and practical issues. Examples and case studies from diverse fields will be presented, and hands- on use of statistical and data manipulation software will be included.

Learning outcomes of Course:

- Recognize the various discipline that contribute to a successful data science effort.
- Understand the processes of data science identifying the problem to be solved, data collection,preparation, modeling, evaluation and visualization.
- Be aware of the challenges that arise in Data Sciences.
- Be able to identify the application of the type of algorithm based on the type of the problem.
- Be comfortable using commercial and open source tools such as the R/Python language and its associated libraries for data analytics and Visualization.

UNIT I:

Defining Data Science and Big data, Benefits and Uses, facets of Data, Data Science Process. History and Overview of R, Getting Started with R, R Nuts and Bolts

UNIT II:

The Data Science Process: Overview of the Data Science Process-Setting the research goal, Retrieving Data, Data Preparation, Exploration, Modeling, data Presentation and Automation. Getting Data in and out of R, Using reader package, Interfaces to the outside world.

UNIT III:

Machine Learning: Understanding why data scientists use machine learning-What is machine learning and why we should care about, Applications of machine learning in data science, Where it is used in data science, The modeling process, Types of Machine Learning-Supervised and Unsupervised.

UNIT IV:

Handling large Data on a Single Computer: The problems we face when handling large data, General Techniques for handling large volumes of data, Generating programming tips for dealing with large datasets.



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UNIT V:

Sub setting R objects, Vectorised Operations, Managing Data Frames with the dplyr, Control structures, functions, Scoping rules of R, Coding Standards in R, Loop Functions, Debugging, Simulation. Case studies on preliminary data analysis.

TEXT BOOKS:

1. DavyCielen, Arno.D.B.Maysman, Mohamed Ali, “Introducing Data Science”ManningPublications, 2016.
2. Roger D. Peng, “R Programming for Data Science” Lean Publishing, 2015.

REFERENCE BOOKS:

1. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.
2. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, AbhijitDasgupta, “PracticalData Science Cookbook”, Packt Publishing Ltd., 2014.

WebReferences for case studies:

1. <https://www.kaggle.com/datasets>
2. <https://github.com/>



SEMESTER-II

COURSE 3: INTRODUCTION TO DATA SCIENCE AND R PROGRAMMING

Practical

Credits: 1

2 hrs/week

Lab/Practical/Experiments/Tutorials syllabus:

1. Installing R and R studio, with proper notes on version management, cosmetic settings and different libraries.
2. Basic operations in r with arithmetic and statistics.
3. Getting data into R, Basic data manipulation, Loading Data into R
4. Basic plotting
5. Loops and functions
6. Create Vectors, Lists, Arrays, Matrices, Data frames and operations on them.
7. Demonstrate the visualization and graphics using visualization packages like ggplot2.
8. Implement Loop functions with lapply(), sapply(), tapply(), apply(), mapply().
9. Explore data using Single Variables: Unimodal, Bimodal, Histograms, Density Plots, Barcharts
10. Explore data using two Variables: Line plots, Scatter Plots, smoothing cures, Bar charts
11. Explore and implement commands using dplyr package
12. Download a dataset and work on basic data manipulation followed by inferential statistics.

RECOMMENDED TEXT BOOKS:

1. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012.
 2. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013.
- Recommended Reference books:
3. The art of R Programming: A tour of Statistical Software design. Norman Matloff. Kindle Edition
 4. The book of R : The first course in Programming and Statistics by Tilman M. Davies.

Recommended Co-curricular activities: (Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

A. Measurable:

1. Assignments on:
2. Student seminars (Individual presentation of papers) on topics relating to:
3. Quiz Programmes on:
4. Individual Field Studies/projects:
5. Group discussion on:
6. Group/Team Projects on:



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

B. General

1. Collection of news reports and maintaining a record of paper-cuttings relating to topics covered in syllabus
2. Group Discussions on:
3. Watching TV discussions and preparing summary points recording personal observations etc., under guidance from the Lecturers
4. Any similar activities with imaginative thinking.
5. Recommended Continuous Assessment methods:



SEMESTER-II

COURSE 4: DESCRIPTIVE STATISTICS

Theory

Credits: 3

3 hrs/week

Course Learning Outcomes: Students will acquire:

- knowledge of Statistics and its implementation through practical understanding for various domains related to data science.
- knowledge of various types of data, their organization and evaluation of summary measures such as measures of central tendency and dispersion etc.
- knowledge of other types of data reflecting quality characteristics including concepts of independence and association between two attributes,
- insights into preliminary exploration of different types of data.
- Knowledge of correlation, regression analysis, regression diagnostics, partial and multiple correlations.

UNIT I:

Introduction to Statistics: Importance of Statistics. Scope of Statistics in different fields. Concepts of primary and secondary data. Diagrammatic and graphical representation of data: Histogram, frequency polygon, Pie. Measures of Central Tendency: Mean, Median, Mode, Geometric Mean and Harmonic Mean. Median and Mode through graph.

UNIT II:

Measures of Dispersion: Range, Quartile Deviation, Mean Deviation and Standard Deviation, Variance. Central and Non-Central moments and their interrelationship. Skewness and kurtosis.

UNIT III:

Curve fitting: Bi- variate data, Principle of least squares, fitting of degree polynomial. Fitting of straight line, Fitting of Second degree polynomial or parabola, Fitting of power curve and exponential curves.

Correlation: Meaning, Types of Correlation, Measures of Correlation: Scatter diagram, Karl Pearson's Coefficient of Correlation, Rank Correlation Coefficient (with and without ties), Bi-variate frequency distribution, correlation coefficient for bi-variate data and simple problems. Concept of multiple and partial correlation coefficients (three variables only) and properties

UNIT IV:

Regression: Concept of Regression, Linear Regression: Regression lines, Regression coefficients and its properties, Regressions lines for bi-variate data and simple problems. Correlation vs regression, sigmoid curve, derivation from linear regression to logistic regression.



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UNIT-V

Attributes : Notations, Class, Order of class frequencies, Ultimate class frequencies, Consistency of data, Conditions for consistency of data for 2 and 3 attributes only, Independence of attributes, Association of attributes and its measures, Relationship between association and colligation of attributes, Contingency table: Square contingency, Mean square contingency, Coefficient of mean square contingency,

TEXT BOOKS:

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. BA/BSc I year statistics - descriptive statistics, probability distribution - Telugu Academy - Dr M. Jaganmohan Rao, Dr N. Srinivasa Rao, Dr P. Tirupathi Rao, Smt. D. Vijayalakshmi.
3. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC. PHI

REFERENCE BOOKS:

1. Willam Feller: Introduction to Probability theory and its applications. Volume –I, Wiley
2. Goon AM, Gupta MK, Das Gupta B : Fundamentals of Statistics , Vol-I, the World Press Pvt.Ltd., Kolakota.
3. Hoel P.G: Introduction to mathematical statistics, Asia Publishinghouse.
4. M. JaganMohan Rao and Papa Rao: A Text book of Statistics Paper-I.
5. Sanjay Arora and Bansi Lal: New Mathematical Statistics: Satya Prakashan , New Delhi



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

SEMESTER-II

COURSE 4: DESCRIPTIVE STATISTICS

Practical

Credits: 1

2 hrs/week

List of the experiments:

1. Graphical presentation of data (Histogram, frequency polygon).
2. Diagrammatic presentation of data (Bar and Pie).
3. Computation of measures of central tendency (Mean, Median and Mode)
4. Computation of measures of dispersion (Q.D, M.D and S.D)
5. Computation of non-central, central moments, μ_1 and μ_2 for ungrouped data.
6. Computation of Karl Pearson's coefficients of Skewness and Bowley's coefficients of Skewness.
7. Fitting of straight line by the method of leastsquares
8. Fitting of parabola by the method of leastsquares
9. Fitting of power curve of the type by the method of leastsquares.
10. Fitting of exponential curve of the type and by the method of leastsquares.
11. Computation of correlation coefficient and regression lines for ungrouped data.
12. Computation of correlation coefficient, forming regression lines for grouped data



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

Single Major
Model Question Paper
SEMESTER-II
B.Sc. Data Science
Introduction to Data Science and R Programming

Time:3hrs

MAX MARKS: 70 M

SECTION – A

Answer any 5 questions. Each question carries 4 marks

(5 X 4 = 20M)

1. What are the uses of data science and big data in r programming?
2. What is meant by data presentation and automation?
3. Write few applications of machine learning in data science?
4. What are the Generating programming tips for dealing with large datasets?
5. Write a short note on loop functions?
6. Write about Control structures, functions, Scoping rules of R?
7. What are the problems we face when handling large data?
8. What is meant reader package? write it uses?

SECTION – B

Answer all the questions. Each question carries 10 marks.

(5 X 10 = 50M)

- 9.a) Explain briefly about Data Science Process?
(OR)
b) Write about history and Overview of R?
10. a) Explain about Data Science Process?
(OR)
b) Write an essay on getting Data in and out of R, Using reader package?
11. a) What is machine learning? Explain it's types?
(OR)
b) What are the uses of machine learning in data science and write it's applications?
12. a) What are the techniques used to handle the large amount of data on a single computer?
(OR)
b) Generating programming tips for dealing with large datasets.?
13. Write about coding Standards in R, Loop Functions, Debugging, Simulation?
(OR)
Explain briefly about Vectorised Operations?



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

Single Major
Model Question Paper
SEMESTER-II
B.Sc. Data Science
Descriptive Statistics

Time:3hrs

MAX MARKS: 70 M

SECTION – A

Answer any 5 questions. Each question carries 4 marks

(5 X 4 = 20M)

1. What is the scope of Statistics in different fields?
2. Skewness and kurtosis of measures of depression?
3. What is meant by fitting of power curve and exponential curve?
4. Difference between correlation and regression?
5. Relationship between association and colligation of attributes?
6. Central and Non-Central moments and their interrelationship?
7. Explain about correlation coefficient for bi-variate data and simple problems?
8. Write about the Association of attributes and its measures?

SECTION – B

Answer all the questions. Each question carries 10 marks.

(5 X 10 = 50M)

9. a) Write about Concepts of primary and secondary data?

(OR)

- b) What is meant by measures of tendency ? Explain it's types ?

10. a) Define Range, Quartile Deviation, Mean Deviation and Standard Deviation, Variance?

(OR)

- b) Explain about Central and Non-Central moments and their interrelationship?

11. a) What are the principles of least squares?

(OR)

- b) Explain about fitting of degree polynomial and fitting of straight line?

12. a) Write about Regression lines, Regression coefficients and it's property?

(OR)

- b) Write a derivation from linear regression to logistic regression?

13. a) Write an essay on relationship between association and colligation of attributes?

(OR)

- b) Explain about Square contingency, Mean square contingency, Coefficient of mean square contingency?