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

# B.Sc-Physics

## 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 |

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

## 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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**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) $\pi$ 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
   $\lambda$ = _____ [ ]
   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 nucles
    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 disacchanide _____ [ ]
    a) Sucrose b) Glucose c) Fructose d) Ribose
16. The Monomers present in proteins are _____ [ ]
    a) Alcohols b) Acids c) Amino acids d) Esters
17. Lipids composed mainly of _____ [ ]
    a) C, H, N b) C, H, O c) O, N, S d) N, S, Cl

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

## SECTION – B

## II Fill in the Blanks 10x1=10M

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

## SECTION – C

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

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

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

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

## SECTION – D

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

1. A. Unit Vector in the direction $\bar{a} = 3\bar{i} - 2\bar{j} + 6\bar{k}$ ( ) a) Angular Momentum
   B. Polar form $-1+\sqrt{3}i$ ( ) b) Glucose
   C. Joule x Sec ( ) c) $\frac{1}{7}\left(3\bar{i} - 2\bar{j} + 6\bar{k}\right)$
   D. Mass of a proton ( ) d) $2\left[\cos\left(\frac{2\pi}{3}\right) + i\sin\left(\frac{2\pi}{3}\right)\right]$
   E. Reducing Sugar ( ) e) 1.676 x $10^{-24}$ 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 $\overline{Z}$ is a complex number then $Z\overline{Z}$ is purely real.
2. If Z is a complex number such that $Z^2 = \left(\overline{Z}\right)^2$ 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. $\underset{x \to 0}{Lt} \frac{1-\cos 2x}{x^2}$ 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)

## 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. Honours in Physics (Major)
## SEMESTER – II
## COURSE STRUCTURE

| Year | Semester | Course | Title of the Course | No. of Hrs /Week | No. of Credits |
|---|---|---|---|---|---|
| | II | 3 | Mechanics and Properties of Matter | 3 | 3 |
| | | | Mechanics and Properties of Matter Practical Course | 2 | 1 |
| | | 4 | Waves and Oscillations | 3 | 3 |
| | | | Waves and Oscillations Practical Course | 2 | 1 |

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

**SEMESTER-II**
**COURSE 3: MECHANICS AND PROPERTIES OF MATTER**

Theory Credits: 3 3 hrs/week

## COURSE OBJECTIVE:

The course on Mechanics and Properties of Matter aims to provide students with a fundamental understanding of the behaviour of physical systems, both in terms of mechanical motion and in terms of the properties of matter

## LEARNING OUTCOMES:

1. Students will be able to understand and apply the concepts of scalar and vector fields, calculate the gradient of a scalar field, determine the divergence and curl of a vector field.
2. Students will be able to apply the laws of motion, solve equations of motion for variable mass systems
3. Students will be able to define a rigid body and comprehend rotational kinematic relations, derive equations of motion for rotating bodies, analyze the precession of a top and gyroscope, understand the precession of the equinoxes
4. Students will be able to define central forces and provide examples, understand the characteristics and conservative nature of central forces, derive equations of motion under central forces.
5. Students will be able to differentiate between Galilean relativity and the concept of absolute frames, comprehend the postulates of the special theory of relativity, apply Lorentz transformations, understand and solve problems

## UNIT-I VECTOR ANALYSIS

Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. Vector integration (line, surface and volume), Statement and proof of Gauss and Stokes theorems.

## UNIT-II MECHANICS OF PARTICLES

Laws of motion, motion of variable mass system, Equation of motion of a rocket. Conservation of energy and momentum, Collisions in two and three dimensions, Concept of impact parameter, scattering cross-section, Rutherford scattering-derivation.

## UNIT-III MECHANICS OF RIGID BODIES AND CONTINUOUS MEDIA

Definition of rigid body, rotational kinematic relations, equation of motion for a rotating body, Precession of a top, Gyroscope, Precession of the equinoxes. Elastic constants of isotropic solids and their relations, Poisson's ratio and expression for Poisson's ratio. Classification of beams, types of bending, point load, distributed load.

## UNIT-IV CENTRAL FORCES

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, conservative force as a negative gradient of potential energy, equations of motion under a . Derivation of Kepler's laws. Motion of satellites

## UNIT-V SPECIAL THEORY OF RELATIVITY

Galilean relativity, Absolute frames. Michelson-Morley experiment, The negative result. Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation.

**REFERENCE BOOKS:**

1. BSc Physics -Telugu Akademy, Hyderabad
2. Mechanics - D.S. Mathur, Sulthan Chand & Co, New Delhi
3. Mechanics - J.C. Upadhyaya, Ramprasad & Co., Agra
4. Properties of Matter - D.S. Mathur, S.Chand & Co, New Delhi ,11th Edn., 2000
5. Physics Vol. I - Resnick-Halliday-Krane ,Wiley, 2001
6. Properties of Matter – Brijlal & Subrmanyam, S. Chand &Co. 1982
7. Dynamics of Particles and Rigid bodies– Anil Rao, Cambridge Univ Press, 2006
8. Mechanics-EM Purcell, Mc Graw Hill
9. University Physics-FW Sears, MW Zemansky & HD Young, Narosa Publications, Delhi
10. College Physics-I. T. Bhima sankaram and G. Prasad. Himalaya Publishing House.
11. Mechanics, S. G. Venkata chalapathy, Margham Publication, 2003.

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

## SEMESTER-II
## COURSE 3: MECHANICS AND PROPERTIES OF MATTER

Practical Credits: 1 2hrs/week

### COURSE OBJECTIVE:

To develop practical skills in the use of laboratory equipment and experimental techniques for measuring properties of matter and analyzing mechanical systems.

### LEARNING OUTCOMES:

1. Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques to measure properties of matter and analyze mechanical systems.
2. Application of theory to practice: Students should be able to apply theoretical concepts learned in lectures to real-world situations, and understand the limitations of theoretical models.
3. Accurate recording and analysis of data: Students should be able to accurately record and analyze experimental data, including understanding the significance of error analysis and statistical methods.
4. Critical thinking and problem solving: Students should be able to identify sources of error, troubleshoot experimental problems, and develop critical thinking skills in experimental design and analysis.
5. Understanding of physical principles: Students should develop an understanding of the physical principles governing mechanical systems and the properties of matter, including elasticity, viscosity, and thermal expansion.

**Minimum of 6 experiments to be done and recorded**

1. Viscosity of liquid by the flow method (Poiseuille's method)
2. Young's modulus of the material of a bar (scale) by uniform bending
3. Young's modulus of the material a bar (scale) by non- uniform bending
4. Surface tension of a liquid by capillary rise method
5. Determination of radius of capillary tube by Hg thread method
6. Viscosity of liquid by Searle's viscometer method
7. Bifilar suspension –moment of inertia of a regular rectangular body.
8. Determination of moment of inertia using Fly-wheel
9. Determination of the height of a building using a sextant.
10. Rigidity modulus of material of a wire-dynamic method (torsional pendulum)

## STUDENT ACTIVITIES

Unit I: Vector Analysis
Activity: Field Mapping

Students can choose a physical field (e.g., temperature, magnetic field) and create a field map by taking measurements at different points. They can then calculate the gradient of the field and analyse the variations. This activity helps them understand the concept of gradient in a scalar field.

Unit II: Mechanics of Particles
Activity: Collision Experiments

Students can set up simple collision experiments using marbles, carts, or other objects. They can measure the initial and final velocities, masses, and analyze the momentum conservation. By varying the conditions (e.g., masses, initial velocities), they can observe the effects on the collision outcomes.

Unit III: Mechanics of Rigid Bodies and Continuous Media
Activity: Balancing Act

Students can experiment with balancing various objects (e.g., rulers, books) on different points to understand the concept of center of mass and stability. They can analyse the equilibrium conditions and explore how the position of the center of mass affects the stability.

Unit IV: Central Forces
Activity: Pendulum Motion

Students can investigate the motion of a simple pendulum by varying its length and measuring the time period. They can analyze the relationship between the period and the length, and discuss the concept of centripetal force and its role in circular motion.

Unit V: Special Theory of Relativity
Activity: Time Measurement

Students can perform a time measurement experiment using simple devices like water clocks or sand timers. They can compare the measured time between two events at different relative speeds and discuss the concept of time dilation

## SEMESTER-II
## COURSE 4: WAVES AND OSCILLATIONS

Theory Credits: 3 3hrs/week

**COURSE OBJECTIVE:**

This course provides students with a broad understanding of the physical principles of the oscillations, to help them develop critical thinking and quantitative reasoning skills, to empower them to think creatively and critically about scientific problems and experiments.

**LEARNING OUTCOMES:**

The student should be able

1. To describe the basic characteristics of waves such as frequency, wavelength, amplitude, period, and speed.
2. To utilize mathematical relationships related to wave characteristics.
3. To compare particle motion and wave motion in different types of waves.
4. To distinguish between Longitudinal and Transverse waves.
5. To get the knowledge about how to construct and analysis the square waves, saw tooth waves, etc. from Fourier analysis

**UNIT-I Simple Harmonic oscillations**

Simple harmonic oscillator and solution of the differential equation-Physical characteristics of SHM, torsion pendulum-measurements of rigidity modulus, compound pendulum- measurement of 'g', Principle of superposition, beats, combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies. Lissajous figures.

**UNIT-II Damped and forced oscillations**

Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, comparison with un-damped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance and velocity resonance.

**UNIT-III Complex vibrations** **9hr**

Fourier theorem and evaluation of the Fourier coefficients, analysis of periodic wave functions-square wave, triangular wave, saw tooth wave, simple problems on evolution of Fourier coefficients.

**UNIT-IV Vibrating Strings and Bars**

Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones and harmonics. Energy transport and transverse impedance. Longitudinal vibrations in bars-wave equation and its general solution. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end. Tuning fork.

**UNIT-V Ultrasonics:**

Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and magneto strictive methods, detection of ultrasonics, determination of wavelength of ultrasonic waves. Applications and uses of ultrasonic waves.

**REFERENCE BOOKS:**

1. BSc Physics Vol.1, Telugu Academy, Hyderabad.
2. Fundamentals of Physics. Halliday/Resnick/Walker ,Wiley India Edition 2007.
3. Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy, Orient Longman.
4. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
5. Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004
6. Introduction to Physics for Scientists and Engineers. F.J. Buche. McGraw Hill.

## SEMESTER-II
## COURSE 4: WAVES AND OSCILLATIONS

Practical Credits: 1 2hrs/week

**COURSE OBJECTIVE:**

This course provides students with a broad understanding of the physical principles of the oscillations, to help them develop critical thinking and quantitative reasoning skills, to empower them to think creatively and critically about scientific problems and experiments.

**LEARNING OUTCOMES:**

1. Students are made to determine the unknown frequency of tuning fork by volume resonator experiment
2. Students are made to determine 'g' by compound/bar pendulum
3. Students are made to determine the force constant of a spring by static and dynamic method.
4. Students are made to determine the elastic constants of the material of a flat spiral spring.
5. Students are made to verify the laws of vibrations of stretched string –sonometer
6. Students are made to determine the frequency of a bar –Melde's experiment.
7. Students are made to study the damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.
8. Students are made to form Lissajous figures using CRO.

**Minimum of 6 experiments to be done and recorded**

**Experiments**

1. Volume resonator experiment
2. Determination of 'g' by compound/bar pendulum
3. Simple pendulum normal distribution of errors-estimation of time period and the error of the mean by statistical analysis
4. Determination of the force constant of a spring by static and dynamic method.
5. Determination of the elastic constants of the material of a flat spiral spring.
6. Coupled oscillators
7. Verification of laws of vibrations of stretched string –sonometer
8. Determination of frequency of a bar –Melde's experiment.
9. Study of a damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.
10. Formation of Lissajous figures using CRO.

## STUDENT ACTIVITIES

Unit-I Simple Harmonic oscillations:

Activity: Measuring the period of a simple pendulum and verifying the relationship between the period and the length of the pendulum. Students can use a stopwatch and a ruler to measure the time for a fixed number of oscillations and calculate the period.

Unit-II Damped and forced oscillations:

Activity: Measuring the damping coefficient of a mass-spring system and calculating the quality factor. Students can measure the amplitude of the system as it undergoes damped oscillations and use the logarithmic decrement formula to calculate the damping coefficient. They can then use the formula for the quality factor to evaluate the quality of the system.

Unit-III Complex vibrations:

Activity: Constructing a square wave using Fourier series and analyzing its Fourier coefficients. Students can use a software tool or a programming language to generate a square wave and then compute the Fourier coefficients. They can then plot the magnitude spectrum of the waveform and observe the harmonic components.

Unit-IV Vibrating Strings and Bars:

Activity: Measuring the speed of sound in a metal rod and comparing it with the theoretical value. Students can use a microphone and an oscilloscope to measure the time delay between two reflections of a sound pulse in the rod. They can then use the formula for the speed of sound in a solid to calculate the speed and compare it with the theoretical value.

Unit-V Ultrasonics:

Activity: Measuring the wavelength of ultrasonic waves using the diffraction of light. Students can use a laser and a diffraction grating to create a diffraction pattern of an ultrasonic wave. They can then measure the distance between the diffraction fringes and use the formula for the diffraction of light to calculate the wavelength of the ultrasonic wave.

**ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM**
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**Single Major**
**Model Question Paper**
**SEMESTER-II**
**Physics**
**Paper: 3- Mechanics and Properties of Matter**

*Time:3hrs* *MAX MARKS: 70 M*

## SECTION – A

Answer any Five questions. Each question carries 4 marks 5 X 4 = 20 M

1. Define the gradient of scalar field. Write its physical significance.
2. Explain the conservation of energy and momentum.
3. Write a short note on classification of beams.
4. Write the characteristics of central forces.
5. Derive Einstein's mass-energy relation.
6. Find the divergence of A at point (1, -1, 1) when $A = x^2z\ i - 2y^3z^2\ j + xy^2z\ k$.
7. Describe the working of Gyroscope.
8. If the earth be one-half of its present distance from the Sun, what will be the number of days in a year?

## SECTION – B

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

9. (A) Define curl of a vector and derive its expression. Give the physical significance of curl.

(OR)

(B) State and prove Gauss's divergence theorem.

10. (A) Derive an expression for the velocity of a rocket at any given time.

(OR)

(B) Derive an expression for Rutherford's scattering angle.

11. (A) Obtain an expression for precessional velocity of a symmetric top.

(OR)

(B) Derive relation between y, n, k and σ.

12. (A) Define central force. Give two examples. Show that central forces are conservative.

(OR)

(B) State and prove Kepler's first law.

13. (A) Describe Michelson-Morley experiment with necessary theory? Explain the negative result.

(OR)

(B) Write the postulates of special theory of relativity? Derive Lorentz transformation equations.

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**Single Major**
**Model Question Paper**
**SEMESTER-II**
**Physics**
**Paper: 4- Waves & Oscillations**

***Time:3hrs*** ***MAX MARKS: 70 M***

## SECTION – A

Answer any Five questions. Each question carries 4 marks 5 X 4 = 20 M

1. What are Lissajous figures? Write any two applications of Lissajous figures?
2. Write a short note on velocity resonance.
3. List the applications and the limitations of Fourier theorem?
4. State and explain Fourier theorem.
5. Write a short note on tuning fork.
6. What are overtones and harmonics?
7. Write the applications of Ultrasonic waves.
8. Write any 5 characteristics of SHM.

## SECTION – B

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

9. (A) Define compound pendulum. Explain how you determine acceleration due to gravity using compound pendulum.

(OR)

(B) Explain the combination of two mutually perpendicular simple harmonic vibrations with 2:1 frequency?

10. (A) What are damped harmonic oscillations? Derive the equation of motion of damped harmonic oscillator and find its general solution?

(OR)

(B) What are forced oscillations? Discuss the differential equation of a forced damped oscillator and obtain its general solution?

11. (A) State and explain Fourier theorem? Derive the expressions for Fourier coefficients?

(OR)

(B) State Fourier theorem? Analyse a square wave using Fourier theorem?

12. (A) Derive the expression for the velocity of transverse wave along a stretched string. State the laws of transverse vibrations in strings?

(OR)

(B) Discuss the modes of vibrations of stretched string clamped at ends.

13. (A) What are ultrasonic waves? Describe how ultrasonic waves are produced by the method of Piezo electric method.

(OR)

(B) What are ultrasonic waves? Describe how ultrasonic waves are produced by the method of magnetostriction method.