



S.R.R. & C.V.R. GOVT. DEGREE COLLEGE (A)

VIJAYAWADA, N.T.R. DT.

(NAAC Accredited with 'A' Grade-IV Cycle)

AFFILIATED TO KRISHNA UNIVERSITY, MACHILIPATNAM

DEPARTMENT OF PHYSICS & ELECTRONICS

ACADEMIC YEAR 2025-26

Composition of the Board of Studies (BoS) of PHYSICS as Per UGC Guidelines

Members of Board of studies

Members of the Board of Studies of Department of Electronics met on **30-06-2026** at 2.00 PM in the Department of Physics & Electronics staff room.

S.No	Name of the faculty	Designation
1	Smt.P.Sailaja, In- Charge, Department of Physics & Electronics SRR & CVR GDC (A), Vijayawada	Board of studies chairperson
2	Dr.Ch.Srinivasa Rao, Andhra Loyola College (A), Vijayawada	University Nominee
3	Sri T.V.Rambabu, Lecturer in Physics CSTS Govt. Kalasala, Jangareddygudem, Eluru Dist. Mob:9490823654	Subject Expert
4	Dr.P. Gopi Krishna, Asst. Professor, Dept of ECM K.L. Education Foundation, Vaddeswaram, Guntur Ph:9963696066	Subject Expert
5	N. Vara Prasad, CEO, ARETE IT Services Pvt. Ltd Mob:8885591199	Industrialist
6	T.Pujitha, M.Sc Mob:7799467493	Alumni
7	Smt. T.V.Vakula Priya, Lecturer in Physics& Electronics Dr. J.Nageswara Rao , Lecturer in Physics& Electronics Dr. A. Asirvadam, Lecturer in Physics& Electronics Sri G.V.Gangadhara Rao, Lecturer in Physics& Electronics Smt. Sk.Jubeda, Lecturer in Physics& Electronics Smt.S.Kiranmayi, Lecturer in Physics& Electronics	Members of the Department
8	Mr. R. Abhishek II B.Sc Physics (Honours) Mr. K. Manoj Kumar Sri II B.Sc Electronics (Honours)	Students



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DEPARTMENT OF PHYSICS & ELECTRONICS

ACADEMIC YEAR 2025-26

Members of the Board of Studies of Department of Electronics met on 30 -06-2026 at 2.00 PM in the Department of Physics & Electronics staff room Under chairmanship of Smt. P.Sailaja, In-charge of the Department, with the following agenda.

AGENDA:

1. Review of minutes of BOS.
2. To apprise and approve Departmental Vision and mission.
3. To discuss and approve curriculum structure suggested by APSCHE and from feedback of students and different stakeholders with modifications not exceeding 20% on demand of local needs and to be implemented from the year 2026-27.
4. To approve blue print and Model Question paper for theory and practical examinations.
5. Review of evaluation of Internal and External Examinations.
6. To Suggest Methodologies and innovative teaching practices.
7. To discuss and approve panel of Examiners.
8. To suggest and approve student study projects, Extension activities curricular, co-curricular activities and to discuss about certificate course.
9. Any other with the permission of the chairperson.

COURSE STRUCTURE (for Semester III to IV)
PHYSICS MAJOR Courses

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	5	Atomic, Molecular & Nuclear physics	3	3
			Atomic, Molecular & Nuclear physics-Practical	2	1
		6	Basic Electronics	3	3
			Basic Electronics-Practical	2	1
		7	Applied Optics	3	3
			Applied Optics-Practical	2	1
	IV	8	Electricity, Magnetism and Electromagnetic Theory	3	3
			Electricity, Magnetism and Electromagnetic Theory-Practical	2	1
		9	Analog Electronics	3	3
			Analog Electronics-Practical	2	1
		10	Advances in Physics	3	3
			Advances in Physics-Practical	2	1

Multidisciplinary Course Structure-INTRODUCTION TO NANOTECHNOLOGY

COURSE STRUCTURE (for Semester III to IV)
PHYSICS MINOR Courses

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	1	Mechanics and Properties of Matter	3	3
			Mechanics and Properties of Matter-Practical	2	1
	IV	2	Waves and Applied Optics	3	3
			Waves and Applied Optics-Practical	2	1

COURSE STRUCTURE (for Semester III to IV)
Quantum Technologies Minor Courses

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	1	Mathematical Physical and Computing Foundations of Quantum Computing	5	4
	IV	2	Quantum Technologies: Principles and Applications	5	4



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DEPARTMENT OF PHYSICS & ELECTRONICS

ACADEMIC YEAR 2025-26

SEMESTER-III

COURSE 5: ATOMIC, MOLECULAR AND NUCLEAR PHYSICS

Theory	Credits: 3	3hrs/week
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COURSE OBJECTIVE:

The course aims to introduce students to the principles of atomic structure, molecular spectroscopy, and fundamental nuclear physics. It covers key experimental methods and theoretical models, helping students understand how microscopic interactions lead to observable physical phenomena in atoms, molecules, and nuclei.

LEARNING OUTCOMES:

On successful completion of this course, the students will be able to:

1. Understand the principles of atomic structure and spectroscopy.
2. Understand the principles of molecular spectroscopy.
3. Develop critical understanding of concept to of Matter waves and Uncertainty principle.
4. Describe nuclear properties, binding energy, and nuclear models such as the liquid drop and shell model.
5. Explain the working of nuclear detectors and accelerators and classify elementary particles and their interactions.

UNIT-I: INTRODUCTION TO ATOMIC STRUCTURE AND SPECTROSCOPY

(9hrs.)

Limitations of Bohr's model, Vector atom model and Quantum numbers associated with it, Stern and Gerlach experiment, Coupling Schemes (LS & JJ), Spectral terms and spectral notations, Selection rules, Zeeman effect, Experimental arrangement to study Zeeman effect and expression for Zeeman shift.

UNIT-II: MOLECULAR SPECTROSCOPY

(9 hrs.)

Molecular rotational and vibrational spectra, electronic energy levels and electronic transitions, Raman effect, Characteristics of Raman effect, Experimental arrangement to study Raman effect, Quantum theory of Raman effect, Applications of Raman effect. Spectroscopic techniques: IR and UV-Visible.

UNIT-III: MATTER WAVES & UNCERTAINTY PRINCIPLE

(9 hrs.)

de Broglie's hypothesis, Properties of matter waves, Davisson and Germer's experiment, Heisenberg's uncertainty principle for position and momentum & energy and time, Illustration of uncertainty principle using diffraction of beam of electrons (Diffraction by a single slit) and photons (Gamma ray microscope).

UNIT-IV: INTRODUCTION TO NUCLEAR PHYSICS

(9 hrs.)

Nucleus: Properties of nucleus, Mass defect, Binding energy – binding energy curve; Nuclear forces: Characteristics of nuclear forces, Yukawa's meson theory; Nuclear Models- Liquid drop model, Shell model, magic numbers, nuclear stability.

UNIT-V: NUCLEAR DETECTORS AND NUCLEAR ACCELERATORS (9 hrs.)

Nuclear detectors: Geiger- Muller counter, Scintillation counter. Nuclear Accelerators: Cyclotron-construction, working and applications; Synchrocyclotron-construction, working and applications. Classification of elementary particles, Types of interactions- strong, electromagnetic and weak interactions.

REFERENCE BOOKS:

1. BSc Physics, Vol.4, Telugu Academy, Hyderabad
2. Atomic Physics by J.B. Rajam; S. Chand & Co.,
3. Modern Physics by R. Murugesan and Kiruthiga Siva Prasath. S. Chand & Co.
4. Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
5. Nuclear Physics, Irving Kaplan, Narosa Pub. (1998).
6. Nuclear Physics, Theory and experiment – P.R. Roy and B.P. Nigam, New Age Int.1997.
7. Atomic and Nuclear Physics (Vol.2), S.N. Ghoshal, S. Chand & Co. (1994).
8. Nuclear Physics, D.C. Tayal, Himalaya Pub. (1997).

SEMESTER-III
COURSE 5: ATOMIC, MOLECULAR AND NUCLEAR PHYSICS

Practical

Credits: 1

2hrs/week

COURSE OBJECTIVE:

To develop practical skills and experimental understanding in atomic and nuclear physics, including spectral line measurements, particle detection, and verification of quantum and nuclear models.

LEARNING OUTCOMES:

1. Demonstrate a deep understanding of the principles and theories of modern physics through hands-on experimentation and data analysis.
2. Analyze and interpret experimental data using statistical methods and error analysis, drawing meaningful conclusions and relating them to theoretical concepts.
3. Design and conduct independent experiments or investigations related to modern physics, demonstrating the ability to plan, execute, and analyze experimental procedures and results.
4. Gain a solid understanding of fundamental concepts in nuclear physics.
5. Understand the principles and operation of laboratory equipment and instruments specific to nuclear physics experiments.
6. Develop proficiency in conducting experiments related to nuclear physics.

Minimum of 6 experiments to be done and recorded

1. e/m of an electron by Thomson method
2. Determination of Planck's constant using a photocell
3. Verification of inverse square law of light using photovoltaic cell
4. Determination of work function of the filament material using directly heated vacuum diode
5. GM counter – Determination of dead time
6. Study of characteristic curve of GM counter and estimation of its operating voltage
7. Estimation of efficiency for a gamma source using GM counter
8. Estimation of efficiency for a beta source using GM counter
9. Study of sodium doublet using a diffraction grating
10. IR or UV-Vis spectroscopy of samples using a portable spectrometer
11. Single slit diffraction of laser beam to illustrate uncertainty principle
12. Study of absorption of beta particles in aluminum sheets
13. Study of Compton scattering (demo or simulation)
14. Study of counting statistics using GM counter
15. Study of plateau region and dead time using a counting system

STUDENT ACTIVITIES

UNIT-I: Introduction to Atomic Structure and Spectroscopy

Spectroscopy Experiment

Divide the students into small groups and provide each group with a spectrometer or spectroscope, a light source, and different samples or elements for analysis.

Instruct the students to carefully observe the spectra produced by the samples using the spectrometer. Encourage them to note the presence of specific spectral lines or patterns.

Data Collection

Have the students record their observations in their lab notebooks or worksheets. They should note the wavelengths or colors of the observed spectral lines and any patterns they observe.

Analysis and Discussion: Guide a class discussion on the observed spectra and their significance. Discuss how the observed spectral lines correspond to specific energy transitions in the atoms. Ask students to compare the spectra of different samples or elements and identify any similarities or differences.

Discuss the concept of energy levels and how electrons transition between them, emitting or absorbing photons of specific wavelengths.

UNIT-II: Molecular Spectroscopy

Begin the activity with a brief introduction to molecular structure, discussing concepts such as chemical bonds, molecular geometry, and the importance of molecular structure in determining the properties and behavior of substances. Explain the principles of spectroscopy, focusing on vibrational and rotational spectra and how they relate to molecular vibrations and rotations.

UNIT-III: Matter waves & Uncertainty Principle

Begin the activity by introducing the concept of matter waves and the uncertainty principle. Discuss how the wave-particle duality of matter is a fundamental principle in quantum mechanics. Provide a brief overview of the historical development of the uncertainty principle and its implications for our understanding of the behavior of particles on a microscopic scale.

UNIT-IV: Introduction to Nuclear Physics

Provide students with a computer simulation or interactive app that allows them to explore radioactive decay processes. Ask students to observe and analyze the decay patterns of different isotopes, including the concept of half-life. Guide students to make connections between the simulation results and the fundamental principles of nuclear physics.

UNIT-V: Nuclear Detectors and Nuclear Accelerators

Activity: Detector Comparison Chart – Students create a comparative table of detector types, operation principles, advantages, and use-cases.

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B. Sc Physics Honours
SEMESTER-III
COURSE 5: ATOMIC, MOLECULAR AND NUCLEAR PHYSICS

Time:3 hours

Max marks: 60M

COURSE 5: BLUE PRINT

	Essay answer questions	Short answer questions	Numerical problems
Unit I	2 (with internal choice)	2	0
Unit II	2 (with internal choice)	2	0
Unit III	2 (with internal choice)	1	1
Unit IV	2 (with internal choice)	1	1
Unit V	2 (with internal choice)	2	0

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B.Sc Physics Honours
SEMESTER-III
COURSE 5: ATOMIC, MOLECULAR AND NUCLEAR PHYSICS
Model Question Paper

Time: 3 hours

Max marks: 60M

SECTION-A

Answer any Five of the following questions

5x 4M = 20M

1. State the limitations of Bohr's atomic model.
2. Differentiate between LS coupling and JJ coupling.
3. Describe electronic energy levels in molecules
4. Write the applications of Raman effect.
5. An electron is accelerated through a potential difference of 150 V. Calculate its de Broglie wavelength.
6. List the important properties of matter waves.
7. Calculate the mass defect of ${}^4\text{He}$. Given: Mass of proton = 1.00728 u, Mass of neutron = 1.00866 u and Mass of helium nucleus = 4.00150 u
8. List the important characteristics of nuclear forces.
9. Explain the principle and working of a scintillation counter.
10. Classify elementary particles with suitable examples.

SECTION-B

Answer all the following questions.

5x8M = 40M

11. Explain the Stern–Gerlach experiment and discuss its importance in understanding the space quantization of angular momentum.
OR
12. Explain the Zeeman effect. Describe the experimental arrangement for studying the Zeeman effect and derive the expression for Zeeman shift.
13. Explain molecular rotational and vibrational spectra. Discuss the energy levels involved and the conditions for rotational and vibrational transitions.
OR
14. Explain the Raman effect. Describe the experimental arrangement for studying Raman effect and explain the quantum theory of Raman scattering.
15. State and explain Heisenberg's uncertainty principle for position–momentum and energy–time. Discuss its significance in quantum mechanics.
OR
16. Explain the illustration of Heisenberg's uncertainty principle using electron diffraction through a single slit and the gamma-ray microscope experiment.
17. Describe the characteristics of nuclear forces. Explain Yukawa's meson theory for the origin of nuclear forces.
OR
18. Explain the liquid drop model of the nucleus. Discuss its assumptions, features, and applications.
19. Describe the construction and working of a cyclotron. Explain its principle and applications in nuclear physics.
OR
20. Explain the construction and working of a synchrocyclotron. Compare it with a cyclotron and discuss its applications.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA

B.Sc Physics Honours

SEMESTER-III

COURSE 5: ATOMIC, MOLECULAR AND NUCLEAR PHYSICS

QUESTION BANK

Unit-1

Long answer questions:

1. Describe the vector atom model and explain the quantum numbers associated with it. Discuss the significance of each quantum number.
2. Explain the Stern–Gerlach experiment and discuss its importance in understanding the space quantization of angular momentum.
3. Explain the Zeeman effect. Describe the experimental arrangement for studying the Zeeman effect and derive the expression for Zeeman shift.

Short answer questions:

1. State the limitations of Bohr's atomic model.
2. Differentiate between LS coupling and JJ coupling.
3. State the selection rules for electronic transitions and explain their significance.

Unit-2

Long answer questions:

1. Explain molecular rotational and vibrational spectra. Discuss the energy levels involved and the conditions for rotational and vibrational transitions.
2. Explain the Raman effect. Describe the experimental arrangement for studying Raman effect and explain the quantum theory of Raman scattering.
3. Discuss the characteristics and applications of Raman effect. Explain the principles and applications of IR and UV-Visible spectroscopic techniques.

Short answer questions:

1. Describe electronic energy levels in molecules
2. Write the applications of Raman effect.
3. Explain Stokes and anti-Stokes lines.

Unit-3

Long answer questions:

1. Describe the Davisson and Germer experiment. Explain how the experiment proves the wave nature of electrons.
2. State and explain Heisenberg's uncertainty principle for position–momentum and energy–time. Discuss its significance in quantum mechanics.
3. Explain the illustration of Heisenberg's uncertainty principle using electron diffraction through a single slit and the gamma-ray microscope experiment.

Short answer questions:

1. State de Broglie's hypothesis and write the expression for the wavelength of matter waves.
2. List the important properties of matter waves.
3. State Heisenberg's uncertainty principle for position and momentum.

Unit-4

Long answer questions:

1. Describe the characteristics of nuclear forces. Explain Yukawa's meson theory for the

- origin of nuclear forces.
2. Explain the liquid drop model of the nucleus. Discuss its assumptions, features, and applications.
 3. Describe the shell model of the nucleus. Explain magic numbers and discuss their role in nuclear stability.

Short answer questions:

1. Define mass defect and binding energy of a nucleus.
2. List the important characteristics of nuclear forces.
3. What are magic numbers? Mention their significance in nuclear structure.
4. Explain the concept of nuclear stability briefly.

Unit-5

Long answer Questions:

1. Explain the construction and working principle of a Geiger–Müller counter. Discuss its applications in nuclear radiation detection.
2. Describe the construction and working of a cyclotron. Explain its principle and applications in nuclear physics.
3. Explain the construction and working of a synchrocyclotron. Compare it with a cyclotron and discuss its applications.

Short answer questions:

1. Explain the principle and working of a scintillation counter.
2. Classify elementary particles with suitable examples.
3. List the different types of fundamental interactions and mention their characteristics.

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SRR & CVR GDC (A), VIJAYAWADA, NTR DT.
AFFILIATED TO KRISHNA UNIVERSITY, MACHILIPATNAM
DEPARTMENT OF PHYSICS & ELECTRONICS
BOARD OF STUDIES OF PHYSICS (2026-2027)

SEMESTER-III
COURSE 6: BASIC ELECTRONICS

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVES

This course aims to introduce undergraduate physics students to the fundamental principles of electronics. It covers passive components, semiconductor physics, diode and transistor operation, DC power supplies, and the basics of digital logic. The goal is to build a solid foundation in circuit analysis and electronic devices for students with minimal prior background.

LEARNING OUTCOMES:

By the end of the course, students will be able to:

- CO 1: Identify and explain the function and types of resistors, capacitors, and inductors.
- CO 2: Understand the basic concepts of semiconductors and diode characteristics.
- CO 3: Analyze simple transistor circuits and their applications.
- CO 4: Describe the functioning of rectifiers, filters, and voltage regulators.
- CO 5: Perform basic binary arithmetic and construct simple digital logic circuits.

UNIT I: PASSIVE COMPONENTS AND CIRCUIT FUNDAMENTALS
(9 hrs)

PART A: Resistors: Types (carbon, wire-wound, metal film), color coding, tolerance, power ratings – Parallel and series combination.

Capacitors: Types (ceramic, electrolytic, film), applications, charge/discharge behavior –

PART B: Inductors: Basic structure and applications, Self-induction and Mutual induction, Series and parallel combinations: Equivalent resistance/capacitance/inductance - Basic laws: Ohm's Law, Kirchhoff's Voltage and Current Laws (KVL, KCL) with simple applications.

UNIT II: SEMICONDUCTOR PHYSICS AND DIODES **(9 hrs)**

PART A: Intrinsic vs extrinsic semiconductors - Doping, energy band diagrams, charge carriers - PN junction diode: Construction, working, forward/reverse biasing, I-V characteristics –

PART B: Special diodes: Zener diode, LED, photodiode, solar cell – construction, characteristics and uses.

UNIT III: TRANSISTORS AND THEIR OPERATION **(9 hrs)**

PART A: BJT: Structure, current components, working of NPN/PNP - Configurations: CB, CE, – input/output characteristics

PART B: Configuration: CC- input/output characteristics – Applications: Transistor as switch and amplifier (qualitative understanding)

UNIT IV: POWER SUPPLIES AND REGULATION (9 hrs)

PART A: Need for DC power supply: Block diagram - Rectifiers: Half-wave, full-wave, bridge with wave forms.

PART B: Filter circuits: RC, LC, and π filters – working principle- Voltage regulation: Zener diode regulation, IC regulators (brief introduction)

UNIT V: INTRODUCTION TO DIGITAL ELECTRONICS (9 hrs)

PART A: Analog vs Digital signals - Number systems: Binary, decimal, hexadecimal – conversions, binary arithmetic – Complements (1's, 2's)

PART B: Logic gates: AND, OR, NOT – symbols, truth tables, simple logic circuits, Universal gates (NAND, NOR) – brief introduction. De-Morgan's Theorems.

Textbooks / References:

1. V.K. Mehta & Rohit Mehta – *Principles of Electronics*, S. Chand
2. R.S. Sedha – *A Textbook of Applied Electronics*, S. Chand
3. D. Chattopadhyay & P.C. Rakshit – *Electronics: Fundamental Concepts*, New Central
4. Malvino & Leach – *Digital Principles and Applications*, McGraw-Hill
5. A.K. Maini – *Digital Electronics*, Wiley India

Student Activities

1. Component Hunt

- Task: Identify and collect physical samples of resistors, capacitors, diodes, and transistors from old circuit boards.
- Outcome: Visual and tactile understanding of component shapes, labels, and ratings.

2. Poster Presentation

- Topic examples: “Types of Diodes and Their Applications” or “Power Supply Block Diagram.”
- Outcome: Encourages concise technical communication and peer learning.

3. Group Demonstration

- Task: Simulate or build a basic rectifier or transistor switch circuit using breadboard or simulation software.
- Outcome: Team collaboration and hands-on understanding.

4. Number System Puzzle or Quiz

- Task: Convert between binary, decimal, and hexadecimal; perform binary addition/subtraction.
- Outcome: Reinforces digital electronics basics through gamified learning.

5. Mini Project (Optional)

- Task: Build a simple LED flasher or night lamp circuit using transistors and passive components.
- Outcome: Design thinking and real-world application.

6. Circuit Debugging Challenge

- Task: Find and correct errors in a faulty circuit diagram provided by the teacher.
- Outcome: Improves analytical and practical troubleshooting skills.

7. Logic Gate Simulation

- Task: Use a free simulator (like Falstad, Tinkercad, or Logic.ly) to create logic circuits.
- Outcome: Concept reinforcement through virtual labs.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA

B.Sc Physics Honours

SEMESTER-III

COURSE 6: BASIC ELECTRONICS

Time:3 hours

Max marks: 60M

COURSE 6: BLUE PRINT

UNIT		LONG	SHORT	PROBLEM
I	A	1	1	-
	B	1	-	1
II	A	1	1	-
	B	1	1	-
III	A	1	1	-
	B	1	-	1
IV	A	1	1	-
	B	1	1	-
V	A	1	-	1
	B	1	1	

SEMESTER-III
COURSE 6: BASIC ELECTRONICS

Practical

Credits: 1

2 hrs/week

COURSE OBJECTIVE:

To develop practical skills in handling basic electronic components and circuits by constructing, testing, and analyzing simple electronic systems such as rectifiers, filters, diode/transistor configurations, and digital logic gates using fundamental measurement tools.

Learning Outcomes

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

1. Measure and verify the behavior of passive components in circuits.
2. Construct and test diode and transistor-based circuits.
3. Analyze rectifier output and filter performance using basic instruments.
4. Build and verify logic gate circuits using ICs or trainer kits.
5. Practice circuit debugging, use of multimeters, and interpretation of waveforms using a CRO.

Minimum of 6 experiments to be done and recorded Experiments (Practical List)

1. Verification of Ohm's Law using resistive networks (series and parallel combinations).
2. Series and Parallel Combination of Capacitors and Inductors
3. Capacitor charging and discharging curves using RC circuits and a stopwatch /multimeter.
4. V-I characteristics of a PN junction diode (forward and reverse bias)
5. Temperature Dependence of Resistance (Using Thermistor).
6. Zener diode characteristics and voltage regulation behavior.
7. Study of LED and photodiode characteristics under different light conditions.
8. BJT transistor as a switch: ON/OFF control of an LED.
9. Construction of half-wave and full-wave rectifiers and measurement of output voltage.
10. Design and analysis of simple π -filtered power supply circuits.
11. Verification of logic gates (AND, OR, NOT, NAND, NOR) using digital ICs or simulation.
12. Verification of DE Morgan's theorems.

SEMESTER-III

COURSE 6: BASIC ELECTRONICS

QUESTION BANK

Unit - I: Passive Components and Circuit Fundamentals

Essay Questions

PART A

1. What is a Resistor and what are the types of resistors? Explain.
2. What is color code of resistor and how can calculate resistance with color code?
3. What are the types of Capacitors?
4. Explain Charging and Discharging of a Capacitor.

PART B

5. What is an inductor and give its basic structure?
6. State Ohm's law and give its limitations. State and Explain Kirchoff's laws of current and voltage with examples.

Short Answer Questions

1. Derive formula for Resistors are connected in Series.
2. Derive formula for Resistors are connected in Parallel.
3. What are the applications of Capacitors?
4. Derive formula for Capacitors are connected in Series.
5. Derive formula for Capacitors are connected in Parallel.
6. What are the Functions of an Inductor?
7. Derive formula for inductors are connected in series.
8. Derive formula for inductors are connected in Parallel.
9. What are the applications of an inductor?

Unit II: Semiconductor Physics and Diodes

Essay Questions

PART A

1. What are the types of semi-conductors? Explain Energy band Diagram.
2. Explain the working of PN junction diode. Draw its V-I Characteristics.

PART B

4. Explain about Zener diode and its V-I Characteristics.
5. What is Light emitting Diode and explain its Construction and working?
6. What is photodiode and explain its Construction and Working?
7. Explain construction and working of Solar cell.

Short Answer Questions

1. Differentiate between intrinsic and extrinsic semiconductors.
2. What is Doping?
3. Explain the characteristics of semiconductor Diode.
5. What is difference between a Diode and LED?
6. Explain I-V Characteristics of LED.
7. What are the Applications of LED?

9. What are the types of photodiode?
10. What are the advantages and disadvantages of LED?
11. What are the applications of Photodiode?
12. What is the V-I Characteristics of Photodiode?
13. What are the Advantages, Disadvantages, and Uses of Solar cell.

Unit III: Transistors and Their Operation

Essay Questions

Part A

1. Explain the mechanism of current flow in n-p-n and p-n-p transistors.
2. Define α , β and γ for a transistor and derive relation between them.
3. What is BJT Biasing and explain different types of biasing.
4. What is a transistor? Describe the input and output characteristics of a transistor in common-emitter (CE) configuration.
5. Describe the input and output characteristics of a transistor in common Base (CB) Configuration.

PART B:

6. Describe the input and output characteristics of a transistor in common Base (CC) configuration.
7. How Transistor worked as an amplifier? Explain.

Short Answer Questions

1. What is the difference between p-n-p and n-p-n transistor?
2. Write a short note on hybrid parameters of a transistor.
3. Explain Transistor biasing.
4. Compare the characteristics of CE, CB and CC Transistors.
5. Write a note on transistor as a switch.

Unit - IV: Power Supplies and Regulation

Essay Questions

PART A:

1. Explain DC Power supply with block diagram.
2. What is Half Wave Rectifier? Explain its construction and working.
3. What is a Full Wave Rectifier? Explain its construction and working.

PART B

4. What is a Filter Circuit? Explain RC, LC and PI filters.
5. Explain about three terminal fixed voltage IC regulators with examples.

Short Answer Questions

1. What is the need of DC power supply?
2. What are the applications of half wave rectifier?
3. What is the Difference between Full Wave Rectifier and Half Wave Rectifier?

4. What are the applications of full wave rectifier.
5. Explain how Zener worked as voltage regulator.
7. What are the advantages and disadvantages of PI filter?

Unit V: Introduction to Digital Electronics

Essay Questions

PART A

1. What is a Number System? Explain different number systems with examples.
2. Convert binary numbers a) (11110.101) b) 1011101 c) 100111011001 in to decimal.

PART B

3. Draw and Explain Logic gates AND, OR, NOT symbols with truth tables.
4. Explain laws Boolean algebra with examples.
5. How NAND and NOR gates are called Universal gates? Explain.

Short Answer Questions.

1. Convert the following decimal numbers into binary: (a) 35.6; (b) 10.25.
2. Convert decimal no. 189 into octal system
3. Convert the decimal no.365 to hexadecimal number.
4. Add binary numbers 110,111 and 101.
5. Subtract 6 from 9 by using one's complement method.
6. State and explain De Morgan's theorems.

SRR & CVR GOVT DEGREE COLLEGE (A), VIJAYAWADA

Model Question Paper

B.Sc. Physics (Major)

Semester-III

Basic Electronics

Time: 3 Hours

Max: 60 Marks

Section A

(5x4=20 Marks)

Answer any Five of the following questions.

1. Derive formula for Resistors are connected in Series.
2. Two cells of e.m.f. 1.5 volts and 2 volts having internal resistances 1 ohm and 2 ohm respectively are connected in parallel to an external resistance 5 ohms. Find the current in each part of the circuit.
3. What is difference between a Diode and LED?
4. What are the Advantages, Disadvantages, and Uses of Solar cell.
5. Explain Transistor biasing.
6. An NPN transistor in a common collector configuration has a load resistor (R_L) of 500 ohm and input voltage (V_{in}) of 5V. The base emitter voltage (V_{BE}) is 0.7 V. Calculate the output Voltage V_{out} .
7. What are the applications of half wave rectifier?
8. What are the advantages and disadvantages of PI filter?
9. Convert (11110.101), into decimal number.
10. Subtraction using one's complement method.
Given: Minuend: 1101 (binary), Subtrahend: 1010 (binary).

Section B

(5x8=40 Marks)

Answer all the questions given below

11. A) What is a Resistor and what are the types of resistors? Explain.
(Or)
B) State Ohm's law and give its limitations. State and Explain Kirchhoff's laws of current and voltage with examples.
12. A) Explain the working of PN junction diode. Draw its V-I Characteristics
(Or)
B) What is Light emitting Diode and explain its Construction and working?
- 13A) Explain the mechanism of current flow in n-p-n and p-n-p transistors.
(OR)
B) How transistor working as an Amplifier?
14. A) What is Half Wave Rectifier? Explain its construction and working with neat diagram.
(OR)
B) Explain about three terminal fixed voltage IC regulators with examples.
- 15 A) Convert binary numbers a) (11110.101) b) 1011101 c) 100111011001 in to decimal.
(OR)
B) Explain laws Boolean algebra with examples.

SEMESTER-III
COURSE 7: APPLIED OPTICS

Theory

Credits: 3

3 hrs/week

COURSE OBJECTIVE:

This course aims to introduce students to the core principles of optics and the functioning of various optical instruments. The objective is to provide a clear understanding of ray optics, aberrations, lasers, optical fibers, holography, and their applications in modern optical systems such as microscopes and telescopes.

LEARNING OUTCOMES:

On successful completion of this course, the students will be able to:

1. Understand the fundamentals of geometrical optics using ray matrices and apply them to complex lens systems.
2. Analyze and distinguish various types of optical aberrations and methods to minimize them.
3. Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields.
4. Understand the basic principles of fibre optic communication and explore the field of Holography and Nonlinear optics and their applications.
5. Gain knowledge of various optical instruments including microscopes and telescopes, their types, and real-world applications

UNIT-I: GEOMETRICAL OPTICS

(9 hrs.)

Fermat principle, Translation matrix, Reflection matrix, Refraction matrix, Cardinal points of an Optical System, ABCD matrices system matrix, thick lens formula, thin lens formula, Ramsden eyepiece, Huygens eyepiece, two lens formula - (i) separated by a distance and (ii) in contact.

UNIT-II: ABERRATIONS

(9 hrs.)

Monochromatic aberrations, Spherical aberration, Methods of minimizing spherical aberration, Coma, Astigmatism and Curvature of field, Distortion; Chromatic aberration-the achromatic doublet; Achromatism for two lenses (i) in contact and (ii) separated by a distance, Anti-Reflection coatings

UNIT-III: LASERS

(9 hrs.)

Lasers: Introduction, Spontaneous emission, Stimulated emission, Population Inversion, Laser principle, Types of lasers: He-Ne laser, Ruby laser, Semiconductor laser, Applications of laser, Laser Safety.

UNIT-IV: OPTICAL FIBERS AND HOLOGRAPHY

(9 hrs.)

Principle of Optical fibers, Acceptance angle, Acceptance cone, Numerical aperture, Types of optical fibers - Graded and Stepped index, Types of Signal attenuation mechanisms in optical fibers, Applications of Optical fibers - Sensors, Imaging, Communication.

Holography: Basic principle of holography-Gabor hologram and its limitations, Applications of holography.

UNIT-V: APPLICATIONS OF OPTICAL INSTRUMENTS**(9 hrs.)**

Introductory ideas and applications of various microscopes viz., (i) Optical microscopes (Compound microscope, Confocal microscope) (ii) Electron microscopes – SEM, Introductory ideas and applications of various telescopes viz., (i) Optical telescopes (ii) Radio telescopes (iii) Solar telescopes (iv) Infrared telescope, CCE Camera and Image Sensors

REFERENCE BOOKS:

1. BSc Physics, Vol.2, Telugu Academy, Hyderabad.
2. Optics - principles and applications Kailash K. Sharma
3. An introduction to Lasers M N Avadhanulu
4. Lasers Tyagarajan Ghatak 2nd Ed.
5. Introduction to Fiber Optics Tyagarajan Ghatak
6. Principles of Laser material processing Elijah Kannatey Asibu
7. Quantum optics an introduction Mark Fox

SEMESTER-III
COURSE 7: APPLIED OPTICS

Practical

Credits: 1

2 hrs/week

COURSE OBJECTIVE:

To provide hands-on experience with optical components and instruments, and to reinforce theoretical concepts through practical applications involving lasers, optical fibers, microscopes, and ray optics techniques.

LEARNING OUTCOMES:

1. Understand and apply geometrical optics principles through practical experiments involving lens combinations, matrix methods, and measurement of focal lengths using systems like the two-lens setup.
2. Demonstrate hands-on understanding of monochromatic and chromatic aberrations by working with diffraction gratings and measuring resolving powers of optical components like gratings and telescopes.
3. Explore the operational principles and characteristics of lasers, including wavelength measurement using diffraction gratings and analysis of laser beam behavior through reflection and refraction experiments.
4. Operate and analyze optical fiber systems by determining the numerical aperture, acceptance angle, and exploring their applications in communication and light guiding.
5. Investigate holographic concepts by understanding the role of laser light in interference-based techniques and identifying the limitations of basic holographic setups.
6. Examine and interpret the working of various optical instruments such as microscopes and telescopes by studying resolution, power, and optical limitations through practical experiments and simulations.

Minimum of 6 experiments to be done and recorded

1. Wavelength of laser using Diffraction grating
2. Refractive index of liquid using Hollow prism
3. Resolving power of telescope
4. Resolving power of grating
5. Spectrometer: i-d curve
6. Laser Reflection grating using metal scale
7. Optical fiber - Numerical Aperture
8. Rabi Oscillations Octave program
9. Two lens system power pairs plot (Python/Octave)
10. Focal length and verification of matrix method for thick and thin lenses
11. Achromatic combination of two lenses – in contact and at a distance
12. Measurement of beam divergence and spot size of a laser
13. Verification of Malus' Law using a laser and polarizers
14. Study of diffraction pattern from circular aperture (Airy disk) – resolving limit
15. Young's double-slit experiment using laser – interference fringes and fringe width
16. Study of bending losses in optical fiber

STUDENT ACTIVITIES

Unit-I: Geometrical Optics

Activity: Lens Matrix Simulation and Eyepiece Comparison

Students can use Python or Octave to simulate the behavior of optical systems using ABCD matrices. They can plot system matrices for single and double-lens setups and analyze the effective focal length. Additionally, students may perform a comparative analysis between Ramsden and Huygens eyepieces using ray diagrams and matrix methods, presenting their findings through short presentations or lab reports

Unit-II: Aberrations

Ask students to observe and sketch the different images produced by the lens at different distances. Build a simple optical system with two lenses in contact and ask students to calculate the focal length and magnification of the system. Then, introduce a thin glass plate between the lenses to simulate the effects of chromatic aberration and ask students to observe and discuss the changes in the image produced.

Unit-III: Lasers

Activity: Laser Communication Demo – Group project to transmit voice using a laser beam and photodiode.

Unit-IV: Optical fibers and Holography

Demonstrate the principle of holography using a laser beam, a beam splitter, and a photographic plate. Ask students to record a hologram of a simple object and then reconstruct the image using a laser beam.

UNIT-V: Applications of Optical Instruments

Activity: Comparative Analysis of Optical and Electron Microscopes and Telescope Technologies Students will form groups to study various microscopes (compound, confocal, SEM) and telescopes (radio, solar, UV, IR). Each group will create a model or infographic that illustrates the working principles, resolution limits, and applications of these instruments. Presentations will focus on how optics is tailored to different wavelength regimes.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA
B. Sc Physics Honours
SEMESTER-III
COURSE 7: APPLIED OPTICS

Time: 3 hours

Max marks: 60M

COURSE 7: BLUE PRINT

	Essay answer questions	Short answer questions	Numerical problems
Unit I	2 (with internal choice)	2	0
Unit II	2 (with internal choice)	2	0
Unit III	2 (with internal choice)	2	0
Unit IV	2 (with internal choice)	2	0
Unit V	2 (with internal choice)	2	0

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B.Sc Physics Honours
SEMESTER-III
COURSE 7: APPLIED OPTICS

Model Question Paper

Time: 3 hours

Max marks: 60M

SECTION-A

Answer any FIVE questions.

(5 × 4 = 20)

1. What is Fermat's Principle in ray Optics?
2. Explain cardinal points of an optical system.
3. Define Coma? How it is eliminated.
4. State the advantages of anti-reflection coatings.
5. Distinguish between spontaneous and stimulated emission.
6. List the applications of semiconductor lasers.
7. What are the advantages of Communication with optical fibre.
8. Explain the applications of holography.
9. Differentiate between optical microscope and SEM.
10. What is the importance Microscopes and telescopes.

SECTION-B

Answer ALL questions.

(5 × 8 = 40)

11. Derive system matrix for two thin lenses separated by a distance. OR
12. Derive Translation Matrix.
13. What is chromatic aberration? Derive the condition for achromatism when two lenses are (a) in contact and (b) separated by a distance? OR
14. What is spherical aberration? Explain spherical aberration by a plane refracting surface?
15. Explain the construction, working and applications of the He-Ne laser. OR
16. What is Ruby laser? Describe the construction and working of Ruby laser.
17. Derive expression for acceptance angle and numerical aperture. OR
18. What is Gabor hologram and explain the basic principle of holography.
19. Explain the construction and working of compound microscope and confocal microscope. OR
20. Explain different types of telescopes and their applications.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA

B.Sc Physics Honours

SEMESTER-III

COURSE 7: APPLIED OPTICS

QUESTION BANK

Unit-1

Long Answer Questions

1. Derive system matrix for two thin lenses separated by a distance.
2. Derive Translational Matrix
3. Derive Refraction Matrix.

Short Answer Questions

1. What is Fermat's Principle in ray Optics?
2. Explain the ABCD matrix method
3. Explain cardinal points.
4. Distinguish between Ramsden and Huygens eyepieces.

UNIT-II

Long Answer Questions

1. What is spherical aberration? Explain spherical aberration by a plane refracting surface?
2. What is chromatic aberration? Derive the condition for achromatism when two lenses are (a) in contact and (b) separated by a distance?
3. Discuss the various methods to minimise the spherical aberration?

Short Answer Questions

1. Define astigmatism? How it is eliminated
2. Define Coma? How it is eliminated.
3. Explain the aberrations Curvature and Distortion.
4. State the advantages of anti-reflection coatings.

UNIT-III

Long Answer Questions

1. Explain the principle and working of He-Ne laser.
2. What is Ruby laser? Describe the construction and working of Ruby laser.
3. Explain construction and working of semiconductor laser. What are the applications, advantages and limitations.

Short Answer Questions

1. Define population inversion.
2. Distinguish between spontaneous and stimulated emission.
3. Write short a note on Laser safety
4. List four applications of lasers.

UNIT-IV

Long Answer Questions

1. Derive expression for acceptance angle and numerical aperture.
2. Classify optical fibers based on number of modes and refractive index.
3. What is Gabor hologram and explain the basic principle of holography.

Short Answer Questions

1. What are the advantages of Communication with optical fibre.

2. Differentiate between step-index and graded-index fibers.
3. State causes of signal attenuation.
4. Mention four applications of holography.

UNIT-V

Long Answer Questions

1. Explain the construction and working of compound and confocal microscopes.
2. Explain different types of telescopes and their applications.
3. Explain CCD cameras and image sensors and their role in modern optical instruments.

Short Answer Questions

1. What is the importance Microscopes and telescopes.
2. Distinguish between SEM and optical microscope.
3. State the applications of radio telescopes.
4. What is solar telescope and give its applications.

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SRR & CVR GDC (A), VIJAYAWADA, NTR DT.
AFFILIATED TO KRISHNA UNIVERSITY, MACHILIPATNAM
DEPARTMENT OF PHYSICS & ELECTRONICS
BOARD of STUDIES OF PHYSICS (2026-2027)
SEMESTER-IV

COURSE 8: ELECTRICITY, MAGNETISM AND ELECTROMAGNETIC THEORY

Theory	Credits: 3	3 hrs/week
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COURSE OBJECTIVE

The course on Electricity, Magnetism and Electromagnetic theory aims to provide students with a fundamental understanding of the principles of electricity, magnetism, and electromagnetic theory.

LEARNING OUTCOMES:

On successful completion of this course, the students will be able to:

CO1: Understand the Gauss law and its application to obtain electric field in different cases and formulate the relationship between electric displacement vector, electric polarization, Susceptibility, Permittivity and Dielectric constant.

CO2: To learn the methods used to solve problems using loop analysis, Nodal analysis, Thevenin's theorem, Norton's theorem, and the Superposition theorem

CO3: Distinguish between the magnetic effect of electric current and electromagnetic induction and apply the related laws in appropriate circumstances.

CO4: Understand Biot and Savart's law and Ampere's circuital law to describe and explain the generation of magnetic fields by electrical currents.

CO5: Develop an understanding on the unification of electric, and magnetic fields and Maxwell's equations governing electromagnetic waves.

CO6: Phenomenon of resonance in LCR AC-circuits, sharpness of resonance, Q- factor, Power factor and the comparative study of series and parallel resonant circuits

UNIT-I: ELECTROSTATICS AND DIELECTRICS (9 hrs)

PART A: Gauss's law - Statement and its proof, Electric field intensity due to uniformly charged solid sphere, Electrical potential–Equipotential surfaces.

PART B: Dielectrics-Polar and Non-polar dielectrics - Effect of electric field on dielectrics, Dielectric strength, Electric displacement D, electric polarization Relation between D, E and P, Dielectric constant and electric susceptibility.

UNIT-II: CURRENT ELECTRICITY (9 hrs)

PART A: Electrical conduction - drift velocity-current density, ohms law and limitations, Kirchhoff's Law's, Branch current method, Nodal Analysis, Star to Delta & Delta to Star conversions. Superposition Theorem (Concept only).

PART B: Thevenin's Theorem (included Numerical Problem based on the circuit), Norton's Theorem.

UNIT-III: MAGNETOSTATICS AND ELECTROMAGNETIC INDUCTION (9 hrs)

PART A: Magneto statics: Biot-Savart's law and its applications: (i) long straight wire and (ii) circular loop, Hall Effect, determination of Hall coefficient and applications, magnetic charge, concept of vector potential.

PART B: Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, Self- inductance of a long solenoid, Magnetic Energy density, mutual inductance of a pair of coils.

UNIT-IV ELECTROMAGNETIC WAVES-MAXWELL'S EQUATIONS (9 hrs)

PART A: Maxwell's equations: integral and differential forms (No derivation), Concept of displacement current. Plane electromagnetic wave equation, Hertz experiment - Transverse nature of electromagnetic waves,

PART B: Electromagnetic wave equation in conducting media, Skin depth, Poynting theorem-Pointing vector, Wave equations for E & B, Maxwell's equations in matter.

UNIT-V VARYING AND ALTERNATING CURRENTS (9 hrs)

PART A: Growth and decay of currents in LR, CR, LCR circuits-Critical damping, alternating current - A.C. fundamentals, and A.C through pure R, L and C.

PART B: Relation between current and voltage in LR and CR circuits, LCR series and parallel resonant circuit, Q - factor, Power in ac circuits, Power factor.

REFERENCE BOOKS:

1. BSc Physics, Vol.3, Telugu Academy, Hyderabad.
2. Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
3. Electricity, Magnetism with Electronics, K.K. Tewari, R. Chand & Co.,
4. "Electricity and Magnetism" by Brijlal and Subramanyam Ratan Prakashan Mandir, 1966
5. "Electricity and Magnetism: Fundamentals, Theory, and Applications" by Murugesan, Kiruthiga Siva prasath, and M. Saravanapandian
6. "Electricity and Magnetism: Theory and Applications" by Ajoy Ghatak and Lokanathan
7. Electricity and Magnetism: Problems and Solutions" by Ashok Kumar and Rajesh Kumar
8. Electricity and Magnetism, R.Murugesan, S. Chand & Co.

SEMESTER-IV
COURSE 8: ELECTRICITY, MAGNETISM AND ELECTROMAGNETIC THEORY

Practical	Credits: 1	2 hrs/week
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COURSE OBJECTIVE:

The Course Objective for a practical course in electricity and magnetism may include to develop practical skills in handling electrical and electronic components, such as resistors, capacitors, inductors, transformers, and oscillators.

LEARNING OUTCOMES:

1. Demonstrate a thorough understanding of the fundamental concepts and principles of electricity and magnetism.
2. Apply the laws and principles of electricity and magnetism to analyze and solve electrical and magnetic problems.
3. Design, construct, and test electrical circuits using various components and measuring instruments.
4. Measure and analyze electrical quantities such as voltage, current, resistance, capacitance, and inductance using appropriate instruments.
5. Apply the principles of electromagnetism to understand and analyze the behavior of magnetic fields and their interactions with electric currents

Minimum of 6 experiments to be done and recorded

1. LCR circuit series resonance, Q factor.
2. LCR circuit parallel resonance, Q factor.
3. Determination of AC-frequency –Sonometer.
4. Verification of Kirchhoff's laws and
5. Maximum Power Transfer theorem. (splitted in to two practical's)
6. Field along the axis of a circular coil carrying current-Stewart & Gee's apparatus.
7. Charging and discharging of CR circuit-Determination of time constant
8. A.C Impedance and Power factor
9. Determination of specific resistance of wire by using Carey Foster's bridge.
10. Study of electric field and equipotential lines using conducting paper/Solution
11. Measurement of inductance using bridge method (Maxwell's or Anderson's bridge)
12. Demonstration of electromagnetic shielding (Faraday cage effect)
13. Study of skin effect using high-frequency AC and measuring resistance variation
14. Simulation of electromagnetic wave propagation using MATLAB/Python
15. Q factor and resonance frequency using CRO in LCR circuits (with variable frequency AC generator)

STUDENT ACTIVITIES

UNIT-I Electrostatics and Dielectrics

Conduct a simulation to visualize equipotential surfaces for a given charge distribution.

Conduct a group discussion on the significance of electric field lines and how they can be used to predict the motion of charged particles in electric fields.

UNIT-II Current electricity

Conduct a Wheatstone bridge experiment in class and discuss the balancing condition and sensitivity. Conduct a group activity where students are divided into groups and assigned a different circuit analysis method (nodal analysis, mesh analysis, superposition theorem, etc.) and asked to present their findings to the class.

UNIT-III Magneto statics and Electromagnetic Induction

Conduct a demonstration to show the Hall Effect and measure the Hall coefficient of a given material. Conduct a group activity where students are divided into groups, and assigned a different application of Faraday's law (electromagnetic induction, transformers, etc.) and asked to present their findings to the class.

UNIT-IV Electromagnetic waves

Conduct a group activity where students are asked to research the history of the development of Maxwell's equations and present their findings to the class.

Conduct a simulation to visualize the propagation of electromagnetic waves in different media (vacuum, air, water, etc.) and discuss the differences in the behavior of waves in different media.

UNIT-V Varying and alternating currents

Conduct a demonstration to show the resonance in an LCR circuit and measure the Q-factor.

Conduct a group activity where students are divided into groups and assigned a different power factor correction method (capacitor banks, synchronous condensers, etc.) and asked to present their findings to the class.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA
B. Sc Physics Honours
SEMESTER-III
COURSE 8: ELECTRICITY, MAGNETISM AND ELECTROMAGNETIC THEORY

Time: 3 hours

Max marks: 60M

COURSE 8: BLUE PRINT

UNIT		LONG	SHORT	PROBLEM
I	A	1	-	1
	B	1	1	
II	A	1	1	-
	B	1	1	-
III	A	1	1	-
	B	1	-	1
IV	A	1	1	-
	B	1	1	-
V	A	1	-	1
	B	1	1	

SEMESTER-IV
SRR & CVR GOVT. DEGREE COLLEGE (A), VIJAYAWADA, NTR DT.
COURSE 8: ELECTRICITY, MAGNETISM AND ELECTROMAGNETIC THEORY
QUESTION BANK

UNIT-I: ELECTROSTATICS AND DIELECTRICS

Long answer questions

PART A

1. State and prove Gauss's law in electrostatics.
2. Define electric field intensity. Calculate the electric field intensity due to uniformly charged sphere.

PART B

3. Define D, E and P. Establish the relation between them.
4. Define the three electric vectors and deduce the relation between dielectric constant and susceptibility.

Short answer questions

5. Define electric potential. Explain equi-potential surfaces.
6. Write about Effect of electric field on dielectrics.
7. What are polar and non-polar dielectrics?
8. What is polarizability and electric susceptibility?

UNIT –II- CURRENT ELECTRICITY

Long answer questions

PART A

1. State and explain Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL) with examples.
2. State and prove Superposition Theorem.
3. Derive the mathematical formulas for transforming a resistive network from a Star to a Delta configuration and vice versa.

PART B

4. State and prove Thevenin's Theorem.
5. State and prove Norton's Theorem
6. State and prove Maximum power transfer theorem.

Short answer questions

7. State Ohm's Law and discuss at least four of its limitations.
8. Write a short note on drift velocity.
9. What do you understand by current density?
10. What is the fundamental principle of the Branch Current Method? Explain it.

UNIT-III: MAGNETOSTATICS AND ELECTROMAGNETIC INDUCTION

Long answer questions

PART A

1. State and Explain Biot –Savart law. Calculate the magnetic field due to long straight wire.
2. State and explain Biot – savart law. Calculate Magnetic field on the axis of a circular loop.
3. What is Hall Effect? Derive the equation of Hall coefficient.

PART B

4. Define self-inductance? Calculate the self-inductance due to a long solenoid.

5. Define mutual inductance. Derive an expression for the coefficient of mutual inductance between a pair of coils.

Short answer questions

1. State and explain Biot –savart law.
2. What is Hall effect? Mention its applications.
3. State and explain Faraday's laws.
4. State and explain Lenz's law.
5. Write about concept of vector potential.
6. Derive an expression for Energy density in magnetic field.

UNIT-IV ELECTROMAGNETIC WAVES-MAXWELL'S EQUATIONS

Long answer questions

PART A

1. Show that electromagnetic waves are transverse in nature.
2. Write down the Maxwell's equations in differential form. Derive expression for plane electromagnetic wave equation.
3. Discuss construction and production of electromagnetic waves (Hertz experiment)

PART B

4. What is Poynting vector? Obtain an expression for Poynting vector.
5. Discuss the propagation of Electromagnetic wave equation in conducting media.

Short answer questions

6. Write Maxwell's equations in integral and differential form.
7. Explain displacement current.
8. Write wave equations for E & B.
9. What is meant by Poynting vector? Write its significance.
10. Write about Maxwell's equations in matter.

UNIT-V VARYING AND ALTERNATING CURRENTS

Long answer questions

PART A:

1. Derive expression for the Growth and decay of currents in LR circuit.
2. Derive expression for the Growth and decay of currents in CR circuit.
3. Derive expression for the Growth and decay of currents in LCR circuit.
4. Give the theory of L-C-R series circuit carrying A.C and explain resonance condition.

PART B:

5. Draw relation between current and voltage in LR and CR circuits.
6. Discuss LCR parallel resonant circuit with necessary theory and obtain an expression for Q-value.
7. Discuss LCR series resonant circuit with necessary theory and obtain an expression for Q-value.

Short answer questions

1. Define alternating current and write its importance.
2. Write a short note on power factor in AC circuit.
3. Calculate the impedance of CR in series of an A.C circuit.
4. What is critical damping?

COURSE 9: ANALOG ELECTRONICS

Theory

Credits: 3

3hrs/week

COURSE OBJECTIVE:

To build on the understanding of transistor and op-amp-based analog circuits, enabling students to analyze and design amplifiers, oscillators, and basic analog signal processing systems for real-world applications.

LEARNING OUTCOMES:

By the end of the theory course, the student will be able to:

1. Analyze the design and performance of BJT amplifier circuits and multistage configurations.
2. Distinguish between different classes of power amplifiers and understand feedback principles.
3. Understand the internal operation and characteristics of operational amplifiers.
4. Design practical op-amp based analog circuits for mathematical operations and signal conditioning.
5. Explain the principles of sinusoidal oscillator circuits and their applications.

UNIT I: BJT AMPLIFIERS

(9hrs)

Review of transistor operation in CE configuration – DC Load line analysis, biasing concepts (fixed bias, voltage divider bias) - CE amplifier: Circuit, gain, input/output impedance - Frequency response, bandwidth - Multistage amplifiers (RC Coupled) and emitter follower (voltage follower)

UNIT II: POWER AND FEEDBACK AMPLIFIERS

(9hrs)

Classification of amplifiers: Class A, B, AB, C - Class A and Class B (Push-pull) power amplifiers – working and efficiency - Types of feedbacks (+ve, -ve) – Expressions for gain (+ve, -ve).

UNIT III: OPERATIONAL AMPLIFIERS–BASICS

(9hrs)

Characteristics of ideal and practical op-amp - Parameters: CMRR, slew rate, input offset voltage, bias current - Pin configuration and block diagram of IC 741 - Open loop and closed loop configuration

UNIT IV: APPLICATIONS OF OP-AMPS

(9hrs)

Inverting and non-inverting amplifiers – gain derivation and characteristics - Adder, subtractor circuits - Integrator and differentiator – design and applications, voltage regulator.

UNIT V: OSCILLATOR CIRCUITS

(9hrs)

Conditions for oscillations: Barkhausen criterion - RC oscillators: Phase shift oscillator, LC oscillators: Colpitts –basic theory and circuits - Crystal oscillator: Construction and applications.

Text books/ References:

1. Robert L. Boylestad – Electronic Devices and Circuit Theory, Pearson
2. Ramakant A. Gayakwad – Op-Amps and Linear Integrated Circuits, PHI
3. D. Roy Choudhury – Linear Integrated Circuits, New Age International

4. A.P. Malvino – Electronic Principles, Tata McGraw-Hill
5. Millman & Halkias – Integrated Electronics, McGraw-Hill

Student Activities List

1. **Waveform analysis:** Record and interpret CRO traces from amplifier and oscillator outputs.
2. **Op-amp datasheet exploration:** Interpret specifications of IC 741 or similar.
3. **Mini project:** Build a tone generator or audio amplifier circuit.
4. **Simulation task:** Simulate CE amplifier or op-amp circuit using free tools like Falstad or Multisim Live.
5. **Classroom quiz:** Identify amplifier classes and feedback types based on circuit conditions.
6. **Group circuit-building challenge:** Design a multistage amplifier with given constraints.
7. **Poster presentation:** On “Power Amplifier Classes: Differences and Applications.”
8. **Function generator use:** Demonstrate square, triangle, and sine wave outputs and measure frequency.
9. **Lab oral viva:** Justify component selection in op-amp applications.
10. **Oscillator comparison chart:** Create a chart comparing Hartley, Colpitts, and Wein bridge oscillators.

SEMESTER-IV
COURSE 9: ANALOG ELECTRONICS

Practical

Credits: 1

2 hrs/week

COURSE OBJECTIVE:

To provide hands-on experience in constructing and analyzing analog circuits involving BJTs, operational amplifiers, and oscillator configurations using commonly available components and instruments.

LEARNING OUTCOMES:

By the end of the lab course, the student will be able to:

1. Design and analyze various transistor amplifier circuits.
2. Measure amplifier parameters such as voltage gain, bandwidth, and input/output impedance.
3. Implement analog signal processing circuits using op-amps.
4. Test sinusoidal oscillator circuits and identify working conditions.
5. Utilize function generators, power supplies, and CROs for analog circuit testing..

Minimum of 6 experiments to be done and recorded

1. CE amplifier design and performance: Measure voltage gain and bandwidth.
2. Transistor biasing circuits: Fixed bias and voltage divider bias—measurement of Q-point.
3. Class-B push-pull amplifier: Construction and efficiency estimation.
4. Negative feedback amplifier: Study gain variation with and without feedback.
5. Study of IC 741 op-amp parameters: Offset voltage, bias current, and CMRR.
6. Op-amp inverting and non-inverting amplifiers: Gain and phase comparison.
7. Op-amp adder and subtractor circuits: Build and verify output equations.
8. Op-amp integrator and differentiator: Observe and sketch output waveforms.
9. Wein bridge oscillator using op-amp or transistor: Frequency and waveform measurement.
10. Phase-shift oscillator using RC networks and op-amp.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA
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SEMESTER-IV
COURSE 9: ANALOG ELECTRONICS

Time:3 hours

Max marks: 60M

COURSE 9: BLUE PRINT

	Essay answer questions	Short answer questions	Numerical problems
Unit I	2 (with internal choice)	2	0
Unit II	2 (with internal choice)	2	0
Unit III	2 (with internal choice)	1	1
Unit IV	2 (with internal choice)	1	1
Unit V	2 (with internal choice)	2	0

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA
B.Sc Physics Honours
SEMESTER-IV
COURSE 9: ANALOG ELECTRONICS

Model Question Paper

Time: 3 hours

Max marks: 60M

SECTION-A

Answer any Five of the following questions

5x 4M = 20M

1. What is DC load line?
2. Define transistor biasing.
3. Define power amplifier.
4. What is the efficiency of Class A amplifier?
5. An op-amp integrator has $R=100\text{ k}\Omega$, $C=0.1\text{ }\mu\text{F}$ and the input voltage is $V_{in}=2\text{ V}$. Find the output after 5 ms.
6. Define operational amplifier.
7. The currents entering the two input terminals are $I_{B1}=120\text{ nA}$, and $I_{B2}=80\text{ nA}$. Find: (a) Input bias current (b) Input offset current.
8. Write a short note on voltage regulator.
9. State Barkhausen criterion.
10. What is the use of a crystal oscillator?

SECTION-B

Answer all the following questions.

5x8M = 40M

1. Explain the operation of a BJT in Common Emitter (CE) configuration with characteristics and DC load line analysis. **OR**
2. Describe the CE amplifier circuit and derive expressions for voltage gain, current gain, input impedance and output impedance.
3. Explain the push-pull amplifier with circuit diagram and waveforms. **OR**
4. Explain negative feedback in amplifiers and discuss its types, derive expressions for gain.
5. Explain important op-amp parameters: CMRR, slew rate, input offset voltage and bias current. **OR**
6. Draw and explain the block diagram and pin configuration of IC 741 op-amp.
7. Explain op-amp based adder and subtractor circuits with applications. **OR**
8. Explain integrator and differentiator circuits with working, equations and applications.
9. Explain the construction and working of RC phase shift oscillator. **OR**
10. Explain Colpitts LC oscillator with circuit and working

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA

B.Sc Physics Honours

SEMESTER-IV

COURSE 9: ANALOG ELECTRONICS

Question Bank

Time:3 hours

Max marks: 60M

UNIT I: BJT AMPLIFIERS

Essay Questions

1. Explain the operation of a BJT in Common Emitter (CE) configuration with characteristics and DC load line analysis.
2. Describe the CE amplifier circuit, derive expressions for voltage gain, current gain, input impedance and output impedance.
3. Explain multistage RC coupled amplifiers and emitter follower with circuit diagrams, working and applications.

Short Questions

1. What is DC load line?
2. Define transistor biasing.
3. What is frequency response of an amplifier?
4. Define bandwidth of an amplifier.

UNIT II: POWER AND FEEDBACK AMPLIFIERS

Essay Questions

1. Explain the classification of power amplifiers (Class A, B, AB, C) with characteristics and applications.
2. Explain the working, circuit and efficiency of Class A and Class B power amplifiers.
3. Explain the push-pull amplifier with circuit diagram and waveforms.
4. Explain negative feedback in amplifiers and discuss its types, derive expressions for gain.

Short Questions

1. Define power amplifier.
2. What is the efficiency of Class A amplifier?
3. Define positive and negative feedback.
4. List the types of feedback amplifiers.

UNIT III: OPERATIONAL AMPLIFIERS – BASICS

Essay Questions

1. Explain the characteristics of an ideal and practical operational amplifier.
2. Explain important op-amp parameters: CMRR, slew rate, input offset voltage and bias current.
3. Draw and explain the block diagram and pin configuration of IC 741 op-amp.
4. Explain open-loop and closed-loop configurations of an op-amp with characteristics.

Short Questions

1. Define operational amplifier.
2. What is CMRR?
3. Define slew rate.
4. What is input offset voltage?

UNIT IV: APPLICATIONS OF OP-AMPS

Essay Questions

1. Explain inverting and non-inverting op-amp amplifiers with circuit diagrams and gain derivations.
2. Explain op-amp based adder and subtractor circuits with applications.
3. Explain integrator and differentiator circuits with working, equations and applications.

Short Questions

1. Write the gain expression of an inverting amplifier.
2. Define op-amp integrator.
3. Write a short note on voltage regulator.

UNIT V: OSCILLATOR CIRCUITS

Essay Questions

1. Explain the Barkhausen criterion and conditions required for oscillations.
2. Explain the construction and working of RC phase shift oscillator.
3. Explain Colpitts LC oscillator with circuit and working.
4. Explain the construction, working and applications of a crystal oscillator.

Short Questions

1. State Barkhausen criterion.
2. What is an oscillator?
3. Define frequency of oscillation.
4. What is the use of a crystal oscillator?

SEMESTER-IV
COURSE 10: ADVANCES IN PHYSICS

Theory

Credits: 3

3 hrs/week

Course Objectives

To introduce students to fundamental concepts of quantum mechanics, classical mechanics, and the evolution of computing with emphasis on quantum computing principles. To expose students to emerging areas in physics, including nanotechnology and renewable energy, and their practical applications in modern technology and sustainable development.

Learning Outcomes

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

1. Apply basic quantum mechanics concepts including the Schrödinger equation, quantum postulates, and Pauli matrices to simple physical systems.
2. Formulate and solve mechanical problems using Lagrangian and Hamiltonian formulations of classical mechanics.
3. Trace the historical and technological evolution of computers, and explain the significance of quantum algorithms and the concept of quantum supremacy.
4. Identify and describe types of nanomaterials and discuss their unique properties and applications in science and technology.
5. Compare various renewable energy sources and explain principles of energy generation, storage, and integration into modern power grids.

UNIT-I CONCEPTS OF QUANTUM MECHANICS

(9 hrs.)

Photoelectric effect (concept only), Compton Effect (concept only), de Broglie Matter Waves, Schrodinger's wave Equation time dependent, Time independent, Postulates of Quantum mechanics, Properties of wave function, Expectation values. One-dimensional problems - Particle in a box. Pauli spin matrices.

UNIT-II LAGRANGIAN MECHANICS

(9 hrs.)

Conservation laws, Constraints, Generalized coordinates and velocities, virtual work, D'Alembert Principle, Lagranges equation of motion, Application-Simple pendulum, Atwood machine. Principle of least action, Hamiltonian equation of motion, Legendre transformation, Cyclic Coordinates.

UNIT III EVOLUTION OF COMPUTERS

(9 hrs.)

Computers: Mechanical to electronic evolution, Generations of computers: Vacuum tubes, transistors, ICs, microprocessors, Moore's Law and classical computing limitations, Need for a new paradigm: Introduction to quantum concepts, Key contributions from Feynman, Deutsch, and others, Quantum Bits (Qubits), Concept and implications of quantum supremacy

UNIT IV: FUNDAMENTALS OF NANOTECHNOLOGY

(9 hrs.)

Introduction to Nanoscience and Nanotechnology, Definition, and importance. Volume to Surface ratio, quantum effects, Types of Nanomaterials: Nanoparticles, nanowires, nanotubes, quantum dots. Applications of Nanotechnology: In electronics, medicine, energy, and environment, Carbon Nanotubes (CNTs)-structure and Applications.

UNIT V: RENEWABLE ENERGY

(9 hrs.)

Conventional and non-conventional energy sources. Renewable energy and its resources Solar

energy - Generation, energy storage. Grid Integration and Smart Grids, Hydrogen Energy and Hydrogen Economy
Green energies - Wind energy, Biomass energy, Tidal energy, Fuel cells, Hydrogen

Books and References

1. Quantum Mechanics: Concepts and Applications – Nouredine Zettili
2. Principles of Quantum Mechanics – R. Shankar
3. A Textbook of Quantum Mechanics – P.M. Mathews and K. Venkatesan (Indian Author)
4. Classical Mechanics – H. Goldstein, C. Poole, and J. Safko
5. Introduction to Classical Mechanics – R.G. Takwale and P.S. Puranik (Indian Author)
6. Classical Mechanics – J.C. Upadhyaya (Indian Author)
7. Computer Organization and Architecture – William Stallings
8. Quantum Computation and Quantum Information – Michael A. Nielsen and Isaac L. Chuang
9. Fundamentals of Computers – V. Rajaraman (Indian Author)
10. Quantum Mechanics and Path Integrals – Richard P. Feynman and A.R. Hibbs
11. Introduction to Nanotechnology – Charles P. Poole Jr. and Frank J. Owens
12. Nanoscience and Nanotechnology – M.A. Shah and Tokeer Ahmad (Indian Author)
13. Renewable Energy Resources – John Twidell and Tony Weir
14. Non-Conventional Energy Sources – G.D. Rai (Indian Author)
15. Solar Energy: Principles of Thermal Collection and Storage – S.P. Sukhatme and J.K. Nayak (Indian Author)

Student Activities

1. Solve numerical problems on particle in a box, harmonic oscillator, and quantum statistics to reinforce conceptual understanding.
2. Create a comparison chart of industrial materials highlighting their properties and specific applications across different industries.
3. Prepare a poster or presentation on types of nanomaterials and their real-life applications in healthcare, electronics, or energy.
4. Demonstrate or simulate the working of basic sensors and use a CRO or signal generator to observe and analyze waveforms.
5. Build a working model or give a seminar on a renewable energy system (e.g., mini solar panel setup or wind turbine model).

SEMESTER-IV
COURSE 10: ADVANCES IN PHYSICS

Practical

Credits: 1

2 hrs/week

Course Objective:

To provide students with hands-on experience and demonstrations of fundamental and emerging concepts in modern physics through physical and simulated experiments, focusing on quantum phenomena, material properties, energy technologies, and basic nanoscience.

Learning Outcomes

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

1. Demonstrate understanding of quantum and thermal physics principles through experiments such as photoelectric effect and Boltzmann constant determination.
2. Analyze electrical and magnetic properties of materials using real measurements (resistivity, magnetization, LDR, etc.).
3. Explore basic properties of nanomaterials and their synthesis through simple laboratory techniques like green synthesis of nanoparticles.
4. Develop awareness of renewable energy technologies and compare efficiencies of energy devices like solar panels, LEDs, and fuel cells.
5. Apply instrumentation skills in using sensors, CROs, and circuit components for measuring physical parameters.
6. Interpret results from simulated experiments and link theoretical physics models with practical outcomes (e.g., Maxwell-Boltzmann distribution, particle in a box).
7. Enhance scientific inquiry and experimental reporting skills through observations, data analysis, and interpretation.

A minimum of 6 experiments to be performed and recorded

1. Photoelectric Effect using UV LED and LDR
 - Demonstrates threshold frequency and energy quantization.
2. Determination of Boltzmann Constant from Diode Characteristics
 - Uses current–voltage relation of a diode.
3. Simple Pendulum – Time Period vs. Lagrangian Prediction
 - Validates theoretical dynamics.
4. Atwood Machine – Verification of Newton's Laws
 - Demonstrates conservation of energy and force analysis.
5. LCR Circuit and Impedance Measurement
 - Explores phase relations and resonance in AC circuits..
6. Synthesis of Iron Oxide Nanoparticles (Green Method)
 - Simple and safe wet-chemical synthesis using plant extracts.
7. Surface Area to Volume Ratio Demonstration Using Sugar Cubes/Sponge
 - Explains nanoscale effects visually.

8. Wind Energy Demonstration (Fan + Mini Turbine Setup)
 - Demonstrates wind-to-electricity conversion.
9. Hydrogen Generation via Electrolysis and Fuel Cell Demonstration
 - Produces H_2 and shows voltage from a fuel cell.
10. Efficiency Comparison Between LED and Incandescent Bulbs
 - Measures power consumption and light output.
11. Solar Panel Efficiency under Different Light and Load Conditions
 - Demonstrates photovoltaic energy conversion and optimization.
12. Battery/Fuel Cell Voltage Measurement with Varying Load
 - Observes how output voltage changes with load resistance.

Simulation-Based or Digital Experiments

13. 1D Particle in a Box – Simulation using PhET/Python
 - Visualizes quantum confinement and energy levels.
14. Rutherford Scattering Simulation
 - Models scattering patterns and cross-section concepts.
15. Spin- $\frac{1}{2}$ System and Pauli Matrices – Qiskit or QuTiP
 - Simulates spin operators and quantum states.
16. Visualization of Kepler's Laws and Satellite Orbits
 - Models elliptical motion and geostationary conditions.
17. Lagrangian and Hamiltonian Simulation (e.g., Double Pendulum)
 - Explores classical mechanics through dynamic systems..
18. Basic Quantum Circuit Simulation using IBM Quantum Lab (Qiskit)
 - Visualizes gates, superposition, and basic algorithms.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA

B.Sc Physics Honours

SEMESTER-IV

COURSE 10: ADVANCES IN PHYSICS

Time:3 hours

Max marks: 60M

COURSE 10: BLUE PRINT

	Essay answer questions	Short answer questions	Numerical problems
Unit I	2 (with internal choice)	2	0
Unit II	2 (with internal choice)	2	0
Unit III	2 (with internal choice)	2	0
Unit IV	2 (with internal choice)	2	0
Unit V	2 (with internal choice)	2	0

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA

B.Sc Physics Honours

SEMESTER-IV

COURSE 10: ADVANCES IN PHYSICS

Model Question Paper

Time: 3 hours

Max marks: 60M

SECTION-A

Answer any FIVE questions.

(5 × 4 = 20 Marks)

1. State the de Broglie hypothesis and write its significance.
2. Define expectation value in quantum mechanics.
3. What are generalized coordinates?
4. Explain cyclic coordinates.
5. What is a qubit? How does it differ from a classical bit?
6. State the significance of quantum supremacy.
7. Define nanotechnology and mention two applications.
8. Explain the properties of carbon nanotubes.
9. What are smart grids?
10. List four applications of hydrogen energy.

SECTION-B

Answer ALL questions.

(5 × 8 = 40 Marks)

11. Explain the particle in a one-dimensional box by using Schrodinger wave equation. **OR**
12. Derive Schrodinger time independent wave equation.
13. Derive Lagrange's equations of motion and explain their application to a simple pendulum. **OR**
14. Explain Hamilton's equations with examples
15. Discuss the evolution of computers from mechanical to quantum computers and explain the need for quantum computing. **OR**
16. Explain the concept of qubits, contributions of Feynman and Deutsch, and the significance of quantum supremacy.
17. Explain the types of nanomaterials and discuss their applications. **OR**
18. Explain the properties, structure, and applications of carbon nanotubes and quantum dots.
19. Explain renewable energy resources, solar energy generation, and energy storage. **OR**
20. Explain smart grids, fuel cells, and hydrogen energy with suitable applications.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA

B.Sc Physics Honours

SEMESTER-IV

COURSE 10: ADVANCES IN PHYSICS

Question Bank

Time:3 hours

Max marks: 60M

UNIT-I: Quantum Mechanics

Long Answer Questions

1. Explain the Schrödinger wave equation and derive the time-independent form.
2. Discuss the postulates of quantum mechanics. Derive the Schrödinger time dependent wave equations.
3. Explain the particle in a one-dimensional box by using Schrodinger wave equation.

Short Answer Questions

1. State the de Broglie wavelength.
2. Define expectation value.
3. Write the properties of a wave function.
4. What are Pauli spin matrices?

UNIT-II: Lagrangian Mechanics

Long Answer Questions

1. What is D'Alembert's principle and derive Lagrange's equation of motion D'Alembert's principle.
2. Explain Hamilton's equations with examples
3. Obtain Equation of motion for (i) simple pendulum (ii) Atwood's Machine by using Lagrange's equation.

Short Answer Questions

1. Define generalized coordinates.
2. Explain briefly Legendre transformation
3. Define cyclic coordinates.
4. State the principle of least action.
5. Explain about the term Virtual work.

UNIT-III: Evolution of Computers

Long Answer Questions

1. Discuss the evolution of computers from mechanical to quantum computers and explain the need for quantum computing.
2. Discuss Moore's law, the limitations of classical computing, and the need for quantum computing.
3. Explain the concepts of qubits, the contributions of Feynman and Deutsch, and the concept of quantum supremacy.

Short Answer Questions

1. What is a qubit? How does it differ from a classical bit?
2. State the significance of quantum supremacy.
3. Mention the contributions of Richard Feynman to quantum computing.

UNIT-IV: Fundamentals of Nanotechnology

Long Answer Questions

1. Explain the different types of nanomaterials and their properties.
2. Discuss carbon nanotubes, quantum dots, and their applications.
3. Explain the applications of nanotechnology in electronics, medicine, energy, and the environment.

Short Answer Questions

1. Define nanotechnology.
2. What is the significance of the surface-to-volume ratio?
3. Define carbon nanotubes.
4. State four applications of nanotechnology.

UNIT-V: Renewable Energy**Long Answer Questions**

1. Explain renewable energy resources and solar energy generation.
2. Discuss smart grids, energy storage systems, and grid integration.
3. Explain fuel cells and the hydrogen economy with suitable applications.

Short Answer Questions

1. Define renewable energy.
2. What is a smart grid?
3. Mention two advantages of fuel cells.
4. List four applications of hydrogen energy.

Multidisciplinary Course
w.e.f. AY 2025-26 SEMESTER-IV
INTRODUCTION TO NANOTECHNOLOGY

Credits: 2

2 hrs/week

Course Objective:

The objective of the course "Introduction to Nanotechnology" is to provide students with a comprehensive understanding of the principles, applications, and implications of nanotechnology from a multidisciplinary perspective.

Programme Outcomes:

By the end of the course, students will be able to:

1. Define and describe the fundamentals of nanotechnology: Students will develop a clear understanding of the basic concepts and principles of nanotechnology, including nanoscale materials, structures, and phenomena. They will grasp the unique properties and behavior of materials at the nanoscale and how they differ from macroscopic systems.
2. Understand the fabrication and characterization techniques in nanotechnology: Students will learn about the techniques and tools used to fabricate, manipulate, and characterize nanoscale materials and devices. They will explore techniques such as lithography, self-assembly, microscopy, spectroscopy, and nanofabrication methods.
3. Evaluate the ethical and societal implications of nanotechnology: Students will critically assess the ethical, social, and environmental implications of nanotechnology. They will explore issues related to privacy, health and safety, sustainability, and public perception, enabling them to make informed judgments and decisions regarding the responsible development and deployment of nanotechnology.

Syllabus:

Unit 1: Introduction to Nanotechnology

Overview of Nanotechnology: Definition, scope, and interdisciplinary nature of nanotechnology. Historical Development: Understanding the historical background and key milestones in the field of nanotechnology. Nanoscale Science: Introduction to the unique properties and phenomena at the nanoscale, including quantum effects and surface-to-volume ratio. Nanotechnology Applications: Exploring the diverse range of applications of nanotechnology in various fields such as medicine, electronics, energy, and materials science.

Unit 2: Nanomaterials and Fabrication Techniques

Nanomaterials: Introduction to different types of nanomaterials, including nanoparticles, nanotubes, and nanocomposites. Understanding their synthesis, characterization, and properties. Top-Down Fabrication: Exploring top-down fabrication techniques, such as lithography and etching, used to create nanostructures and devices. Bottom-Up Fabrication: Introduction to bottom-up fabrication techniques, such as self-assembly and molecular nanotechnology, for the creation of nanoscale structures. Characterization Techniques: Overview of characterization techniques used to analyse and measure nanomaterials, including microscopy, spectroscopy, and diffraction methods.

Unit 3: Implications and Ethics of Nanotechnology

Environmental and Health Impacts: Understanding the potential environmental and health impacts of nanotechnology, including the risks associated with nanoparticles and nanomaterials. Ethical Considerations: Exploring ethical considerations related to

nanotechnology, including privacy concerns, responsible research, and societal implications. Regulatory Framework: Introduction to the regulatory frameworks and safety standards for the development and commercialization of nanotechnology products. Future Perspectives: Discussing emerging trends, challenges, and future prospects in the field of nanotechnology, including advancements in nanomedicine, nanoelectronics, and nanomanufacturing.

Reference Books:

1. "Introduction to Nanotechnology" by Charles P. Poole Jr. and Frank J. Owens: This book provides a comprehensive introduction to the field of nanotechnology. It covers the basics of nanoscale science and engineering, fabrication techniques, nanomaterials, and various applications of nanotechnology.
2. "Nanotechnology: Principles and Applications" by Sulabha K. Kulkarni and Prakash C. Ghosh: This book offers an overview of the principles and applications of nanotechnology. It covers nanomaterials, nanofabrication methods, characterization techniques, and the role of nanotechnology in different sectors such as electronics, medicine, energy, and environmental remediation.
3. "Introduction to Nanoscience and Nanotechnology" by Gabor L. Hornyak, Joydeep Dutta, et al.: This textbook provides a comprehensive introduction to nanoscience and nanotechnology. It covers the fundamental concepts, fabrication techniques, characterization methods, and applications of nanotechnology. It also discusses societal and ethical considerations related to nanotechnology.
4. "Nanotechnology: Basic Science and Emerging Technologies" by Mick Wilson, Kamali Kannangara, et al.: This book presents the fundamental concepts and emerging technologies in nanotechnology. It covers nanoscale physics, chemistry, materials science, and engineering aspects of nanotechnology. It also explores the potential impact of nanotechnology on various fields, including medicine, electronics, and energy.
5. "Introduction to Nanotechnology" by Poole and Owens: This introductory textbook covers the basics of nanotechnology, including nanoscale phenomena, nanomaterials, fabrication techniques, and applications in electronics, medicine, and energy. It provides a solid foundation for understanding the principles and potential of nanotechnology.
6. Student Activity
7. Assign students to create a timeline that highlights the key milestones and discoveries in the field of nanotechnology. They should include significant events, breakthroughs, and contributions from different scientists and researchers. Encourage students to incorporate visuals and descriptions to depict the historical development of nanotechnology.
8. Organize a class discussion or debate where students compare and contrast top-down and bottom-up fabrication techniques for creating nanostructures and devices. Assign students to research and present the advantages, limitations, and real-world applications of each technique. Encourage students to critically analyze and discuss the suitability of each technique for different scenarios.
9. Assign students to research and prepare a report on the potential environmental and health impacts of nanotechnology. Students should explore the risks associated with nanoparticles and nanomaterials, such as their release into the environment, bioaccumulation, and potential toxicological effects. They should analyse case studies and scientific literature to assess the current understanding of these impacts and propose strategies for risk assessment and mitigation.

Multidisciplinary Course
w.e.f. AY 2025-26 SEMESTER-IV
INTRODUCTION TO NANOTECHNOLOGY

Credits: 2

2 hrs/week

BLUE PRINT

Unit	Essay answer questions
Unit I	3
Unit II	3
Unit III	4

QUESTION BANK

Unit 1: Introduction to Nanotechnology

Essay Questions:

1. Define nanotechnology and discuss its interdisciplinary nature. Highlight key historical milestones.
2. Discuss the applications of nanotechnology in textiles, fabrics, Agriculture, Food Industry, Construction and infrastructure.
3. Discuss applications of nanotechnology in medicine and healthcare with examples.
4. Discuss applications of nanotechnology in Electronics and Computing.
5. Describe nanotechnology's impact on energy and environmental remediation with specific examples.

Unit 2: Nanomaterials and Fabrication Techniques

Essay Questions:

1. Explain briefly different types of nanomaterials (nanoparticles, nanotubes, nanocomposites) and their properties.
2. Compare top-down and bottom-up fabrication techniques with examples.
3. Explain the significance of electron microscopy and scanning probe microscopy.
4. Discuss FTIR and Raman spectroscopy's role in analyzing nanomaterials.
5. Describe the process and importance of X-ray diffraction in studying nanomaterials.

Unit 3: Implications and Ethics of Nanotechnology

Essay Questions:

1. How do nanoparticles affect the environment and what are the potential health risks of nanomaterials.
2. Discuss ethical considerations of nanotechnology, focusing on privacy and security.
3. What are the key safety standards for nanotechnology products?
4. How can societal acceptance impact the growth of nano technology?
5. Describe a regulatory framework for nanotechnology.

Introduction to Nano Technology

Time:2 hours

Max marks: 50M

MODEL QUESTION PAPER

SECTION-A

Answer any FIVE Questions

5x10=50 Marks

1. Define nanotechnology and discuss its interdisciplinary nature. Highlight key historical milestones.
2. Discuss applications of nanotechnology in medicine and healthcare with examples.
3. Discuss applications of nanotechnology in Electronics and Computing.
4. Explain briefly different types of nanomaterials (nanoparticles, nanotubes, nanocomposites) and their properties.
5. Compare top-down and bottom-up fabrication techniques with examples.
6. Describe the process and importance of X-ray diffraction in studying nanomaterials.
7. How do nanoparticles affect the environment and what are the potential health risks of nanomaterials.
8. Discuss ethical considerations of nanotechnology, focusing on privacy and security.
9. How can societal acceptance impact the growth of nano technology?
10. Describe a regulatory framework for nanotechnology.

SEMESTER-III

COURSE 1: 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 behavior 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 apply the laws of motion, solve equations of motion for variable mass systems.
2. Students will be able to define central forces and provide examples, understand the characteristics and conservative nature of central forces, to derive equations of motion under central forces.
3. Students will be able to define and relate elastic constants, interpret stress-strain relationships, and analyze bending in beams.
4. Students will be able to apply the basic principles of fluid dynamics including Bernoulli's theorem, viscosity, and surface tension in practical contexts.
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 MECHANICS OF PARTICLES

(9 hrs)

Newton's Laws of motion, motion of variable mass system, Equation of motion of a rocket. Conservation of energy and momentum, Elastic and Inelastic collisions with examples, concept of impact parameter, scattering cross-section, Rutherford scattering-derivation of equation for scattering angle and scattering cross-section.

UNIT-II CENTRAL FORCES

(9 hrs)

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 central force, derivation of Kepler's laws, motion of satellites- Concept of Escape and Orbital velocity, Geo-stationary satellites.

UNIT III: ELASTICITY AND BENDING OF BEAMS

(9 hrs)

Stress and strain, Hooke's Law, Elastic moduli – Young's, bulk, and shear modulus, Poisson's ratio – Physical meaning, Beams-Definition and Examples, Types, point and distributed load, Cantilever and uniform bending – Qualitative treatment, Torsional pendulum – working principle and uses.

UNIT IV: FLUID MECHANICS

(9 hrs)

Fluids – Properties and classification, Streamline vs turbulent flow, Reynolds number, Bernoulli's theorem – Statement, simple derivation and applications (Venturimeter, airplane lift), Viscosity – Poiseuille's law (statement and qualitative explanation), Surface tension – Examples and qualitative ideas.

UNIT V: SPECIAL THEORY OF RELATIVITY

(9 hrs)

Galilean relativity, absolute frames, Michelson-Morley experiment, negative result, postulates of special theory of relativity, Lorentz transformation, time dilation, length contraction, relativistic addition of velocities, mass-energy relation-Derivation of the expression, Mass energy equivalence and examples.

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 & Subrmayam, S. Chand & Co. 1982
7. Mechanics-EM Purcell, Mc Graw Hill
8. University Physics-FW Sears, MW Zemansky & HD Young, Narosa Publications, Delhi
9. College Physics-I. T. Bhima sankaram and G. Prasad. Himalaya Publishing House.
10. Mechanics, S. G. Venkata chalapathy, Margham Publication, 2003.
11. Fluid Mechanics – Frank M. White, McGraw Hill.
12. Textbook of Fluid Dynamics – M. D. Raisinghania, S. Chand & Co.

SEMESTER-III

COURSE 1: MECHANICS AND PROPERTIES OF MATTER

Practical

Credits: 1

2 hrs/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. Young's modulus by uniform bending
2. Young's modulus by non-uniform bending
3. Rigidity modulus using torsional pendulum
4. Viscosity of liquid by Poiseuille's method
5. Surface tension by capillary rise method
6. Flywheel – Determination of moment of inertia
7. Viscosity of liquid by Searle's viscometer method
8. Bifilar suspension – moment of inertia of a rectangular body
9. Radius of capillary tube by Hg thread method
10. Optional Simulation-based activity: Time dilation or projectile simulation.

STUDENT ACTIVITIES

Unit I: 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 II: 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 III: Elasticity and Bending of Beams

Activity: Beam Bending Experiment

Use rulers or meter sticks on supports to apply loads and measure deflection. This hands-on demo helps visualize how elasticity and loading affect real-world structures.

Unit IV: Fluid Mechanics

Activity: Water Jet Speed Measurement

Students can measure the range and height of a water jet to relate fluid velocity with pressure (Bernoulli principle). They can also explore streamlines using ink in water.

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-III

COURSE 1: MECHANICS AND PROPERTIES OF MATTER

Theory

Credits: 3

3 hrs/week

BLUE PRINT

Unit	Essay answer questions	Short answer questions	Numerical problems
Unit I	2 (with internal choice)	2	0
Unit II	2 (with internal choice)	2	0
Unit III	2 (with internal choice)	1	1
Unit IV	2 (with internal choice)	2	0
Unit V	2 (with internal choice)	1	1

SEMESTER-III

COURSE 1: MECHANICS AND PROPERTIES OF MATTER MODEL QUESTION PAPER

Time: 3 Hours

Max. Marks: 60M

Section-A

Answer any FIVE of the following Questions 5X4=20 Marks

1. Define impact parameter and Scattering cross-section.
2. Write a short note on conservation of Energy and Momentum.
3. Write a short note on Geo-stationary satellites?
4. Show that conservative force as negative gradient of potential energy?
5. What is Hook's law? Explain it.
6. Calculate the Poisson's ratio of a material when it's Young's modulus $Y = 7.25 \times 10^{10} \frac{N}{m^2}$ and bulk modulus $K = 11 \times 10^{10} \frac{N}{m^2}$ are given.
7. What is Reynolds number? Explain it.
8. Write the differences between Streamline flow and turbulent flow?
9. If a rod travels with a speed of $V = 0.6C$ along its length, then calculate the percentage of contraction. (C is velocity of light)
10. What is Length contraction? Derive an equation for it.

Section-B

Answer ALL the questions 5X8=40 Marks

11. What is a variable mass system? Derive an expression for the motion of a rocket.
OR
12. Obtain the equation for the angle of Scattering of alpha particle in Rutherford scattering?
13. Define central force. Derive the equation of motion of a particle under the central force?
OR
14. State Kepler's laws and hence deduce Kepler's first law?
15. Define the three elastic moduli. Derive the relation among them.
OR
16. What is Torsional pendulum? Discuss working Principle and Uses?
17. State and derive the Bernoulli's theorem? Mention the applications of the theorem.
OR
18. What is Viscosity? Explain the Poiseuille's law with necessary theory?
19. Describe the construction and working of Michelson-Morley experiment.
OR
20. Derive an equation for Mass-Energy relation.

SEMESTER-III

COURSE 1: MECHANICS AND PROPERTIES OF MATTER QUESTION BANK

Time: 3 Hours

Max. Marks: 60M

UNIT-I: Essay Questions

1. What is a variable mass system? Derive an expression for the motion of a rocket.
2. Derive an equation for scattering cross section in Rutherford scattering?
3. Obtain the equation for the angle of scattering of alpha particle in Rutherford scattering.

Short Answer Questions

1. Define impact parameter and Scattering Cross-section.
2. Write a short note on conservation of Energy and Momentum.
3. Derive the equation for the motion of a variable mass system.
4. Distinguish between elastic and inelastic collisions. Give examples.

UNIT-II: Essay Questions

1. Define central force. Derive the equation of motion of a particle under the central force?
2. State Kepler's laws and hence deduce Kepler's first law?
3. What is Conservative Force? Show that central forces are conservative in nature?

Short Answer Questions

1. Derive Kepler's second law and third law?
2. Write a note on motion of a satellite?
3. Write a short note on Geo-stationary satellites?
4. Show that conservative force as negative gradient of potential energy?

UNIT-III: Essay Questions

1. Define the three elastic moduli. Derive the relation among them.
2. What is a beam? Explain different types of beams with examples?
3. What is Torsional pendulum? Discuss working Principle and Uses?

Short Answer Questions

1. What is Hook's law? Explain it.
2. Explain the Poisson's ratio?
3. Explain the Cantilever beam?
4. Discuss uniform bending with examples?

UNIT IV: Essay Questions

1. State and derive the Bernoulli's theorem? Mention the applications of the theorem.
2. What is Viscosity? Explain the Poiseuille's law with necessary theory?
3. What is Surface tension? Explain with examples.

Short Questions

1. Explain the Properties and classification of Fluids?
2. What is Reynolds number? Explain it.
3. Discuss about Equation of continuity?
4. Write the differences between Streamline flow and turbulent flow?

UNIT- V: Essay Questions

1. State the postulates of special theory of relativity. Derive Lorentz transformation equations?
2. Describe the construction and working of Michelson-Morley experiment.
3. Derive an equation for Mass-Energy relation.

Short Questions

1. What is absolute frame? Explain the negative result obtained in Michelson-Morley experiment.

2. What is Length contraction? Derive an equation for it.
3. Derive an equation for the Time dilation?
4. Write a short note on addition of velocities.

SEMESTER-III

COURSE 2: WAVES AND APPLIED OPTICS

Theory

Credits: 3

3 hrs/week

COURSE OBJECTIVE:

This course introduces the physical principles of oscillatory motion, interference, and polarization of light, and explores modern optical phenomena including lasers, optical fibers, and holography. The objective is to build a deep conceptual understanding of wave behavior in mechanical and optical systems and their technological applications.

LEARNING OUTCOMES:

On successful completion of this course, the students will be able to:

1. Describe the basic characteristics of waves such as frequency, wavelength, amplitude, period, and speed and utilize mathematical relationships related to wave characteristics.
2. Understand the phenomenon of interference of light and its formation in Thin films and Newton's rings and Distinguish between Fresnel's diffraction and Fraunhofer diffraction and observe the diffraction patterns in the case of single slit.
3. Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity.
4. Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields.
5. Understand the basic principles of fiber optic communication and explore the field of Holography and Nonlinear optics and their applications.

UNIT-I: SIMPLE HARMONIC, DAMPED & FORCED OSCILLATIONS (9hrs)

Part (a): Simple Harmonic Oscillator: Solution of differential equation, and physical characteristics, Principle of superposition, Combination of two mutually perpendicular SHMs (1:1 frequencies), Lissajous figures.

Part (b): Damping, Damped Harmonic Oscillator: Solution of differential equation, Energy considerations, Logarithmic decrement, relaxation time, quality factor, Forced Oscillations: Solution of differential equation. Amplitude resonance

UNIT-II: INTERFERENCE AND DIFFRACTION

(9 hrs)

Part (a): Interference: Principle of superposition – coherence Conditions for interference of light. Fresnel's biprism determination of wavelength of light, change of phase on reflection, Colors in Thin Films, Newton's rings in reflected light. Determination of wavelength of monochromatic light using Newton's rings.

Part (b): Diffraction: Introduction, distinction between Fresnel and Fraunhofer diffraction, Fraunhofer diffraction – Diffraction due to single slit, Difference between interference and diffraction.

UNIT-III: POLARIZATION

(9 hrs)

Part (a): Polarized light: methods of polarization by reflection, refraction, double refraction, Brewster's law, Maule's law, Nicol prism polarizer and analyser, Quarter wave plate, Half wave plate,

Part (b): optical activity - Determination of specific rotation by Laurent's half shade

Polarimeter. Idea of elliptical and circular polarization

UNIT-IV: LASERS

(9 hrs)

Part (a): Lasers: Introduction, Spontaneous emission, Stimulated emission, Population Inversion, Laser principle, Types of lasers: He-Ne laser, Ruby laser,

Part(b): Semiconductor laser, Applications of laser, Laser Safety and Classification

UNIT-V: OPTICAL FIBERS AND HOLOGRAPHY

(9 hrs)

Part (a): Principle of Optical fibers, Acceptance angle, Acceptance cone, Numerical aperture, Types of optical fibers - Graded and Stepped index, Types Signal attenuation mechanisms in optical fibers, Applications of Optical fibers - Sensors, Imaging, Communication.

Part (b): Holography: Basic principle of holography-Gabor hologram and its limitations, Applications of holography.

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. BSc Physics, Vol .2, Telugu Academy, Hyderabad
5. A Text Book of Optics-N Subramanyam, L Brijlal, S. Chand& Co.
6. Unified Physics Vol. II Optics & Thermodynamics – Jai Prakash Nath & Co. Ltd., Meerut
7. Optics, F.A. Jenkins and H.G. White, Mc Graw-Hill 5. Optics, Ajay Ghatak, Tata Mc Graw-Hill. Introduction of Lasers – Avadhanulu, S. Chand & Co.
8. Principles of Optics- BK Mathur, Gopala Printing Press, 1995

SEMESTER-III

COURSE 2: WAVES AND APPLIED OPTICS

Practical

Credits: 1

2 hrs/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 aims to provide students with a fundamental understanding of the behavior and properties of light and its interaction with matter.

LEARNING OUTCOMES:

1. Perform experiments to analyze oscillatory systems and visualize resonance and damping.
2. Use optical instruments to study interference and polarization.
3. Measure the wavelength of light using Newton's rings and biprism methods.
4. Understand laser characteristics and fiber optic transmission through practical demonstration.
5. Record, analyze, and interpret experimental data with precision.

Minimum of 6 experiments to be done and recorded

1. Determination of 'g' by compound/bar pendulum
2. Simple pendulum normal distribution of errors-estimation of time period and the error of the mean by statistical analysis Verification of inverse square law of light using photovoltaic cell.
3. Determination of radius of curvature of a given convex lens-Newton's rings.
4. Resolving power of grating.
5. Study of optical rotation – polarimeter.
6. Dispersive power of a prism.
7. Determination of wavelength of light using diffraction grating-minimum deviation method.
8. Determination of wavelength of light using diffraction grating-normal incidence method.
9. Determination of thickness of a thin wire by wedge method
10. Refractive index of liquid using laser and rectangular container
11. Optical fiber - Numerical Aperture

STUDENT ACTIVITIES

UNIT-I: Simple harmonic, damped & forced 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.

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-II: Interference and Diffraction

Ask students to measure the diameter of the central bright spot and the diameter of the n th ring for different values of n , and then calculate the wavelength of light.

Build a simple diffraction grating using a piece of cardboard and some sewing needles. Ask students to measure the distance between the needles, count the number of lines per unit length, and then calculate the grating spacing and the wavelength of light.

UNIT-III: Polarization

Ask students to measure the angle of rotation of the polarized light before and after passing through the sample, and then calculate the specific rotation of the sample.

Unit-IV: Lasers

Activity: Laser Communication Demo – Group project to transmit voice using a laser beam and photodiode.

Unit-V: Optical fibers and Holography

Demonstrate the principle of holography using a laser beam, a beam splitter, and a photographic plate. Ask students to record a hologram of a simple object and then reconstruct the image using a laser beam.

SEMESTER-III**COURSE 2: WAVES AND APPLIED OPTICS****Theory****Credits: 3****3 hrs/week****BLUE PRINT**

Unit	Essay answer questions	Short answer questions	Numerical problems
Unit I	1 essay from Part A & 1 essay from Part B (with internal choice)	2	0
Unit II	1 essay from Part A & 1 essay from Part B 2 (with internal choice)	2	0
Unit III	1 essay from Part A & 1 essay from Part B 2 (with internal choice)	1	1
Unit IV	1 essay from Part A & 1 essay from Part B 2 (with internal choice)	2	0
Unit V	1 essay from Part A & 1 essay from Part B 2 (with internal choice)	2	0

SEMESTER-III

COURSE 2: WAVES AND APPLIED OPTICS MODEL QUESTION PAPER

Time: 3 Hours

Max. Marks: 60M

Section-A

Answer any FIVE of the following Questions 5X4=20 Marks

1. Write a short note on Lissajous figures.
2. What is logarithmic decrement? Give its physical significance.
3. Explain colors of thin films.
4. Distinguish between the interference and diffraction.
5. Write a short note on optical cavity.
6. Two polaroids are kept with their transmission axes inclined at 30° . Unpolarised light of intensity I falls on the first polaroid. Find out the intensity of light emerging from the second polaroid.
7. Distinguish between spontaneous and stimulated emission.
8. List the applications of semiconductor lasers.
9. Define numerical aperture and derive its expression.
10. Explain the applications of holography.

Section-B

Answer ALL the questions

5X8=40 Marks

11. What is a simple harmonic oscillator? Derive the equation of motion of a simple harmonic oscillator and find its solution. (OR)
12. What are Forced Oscillations and also find the solution for it.
13. Describe Newton's rings method for measuring the wavelength of monochromatic light. Give necessary theory. (OR)
14. Discuss Fraunhofer Single Slit Diffraction
15. Explain the construction and working of Nicol's Prism. How Nicol prism works as a polarizer and an analyzer? (OR)
16. Explain the production and detection of circularly and elliptically polarized light?
17. Explain the construction, working and applications of the He-Ne laser. OR
18. Explain the construction, working and applications of Ruby laser.
19. Explain the principle, construction and applications of optical fibers. OR
20. Explain holography and describe the optical fiber communication system.

SEMESTER-III

COURSE 2: WAVES AND APPLIED OPTICS QUESTION BANK

Time: 3 Hours

Max. Marks: 60M

UNIT I: Long Answer Questions

1. What is a simple harmonic oscillator? Derive the equation of motion of a simple harmonic oscillator and find its solution.
2. Describe the resultant motion of the superposition of two mutually perpendicular SHMs with equal frequencies in various cases.
3. Explain the Damped Harmonic Oscillator with its solution
4. What are Forced Oscillations and also find the solution for it.

Short Answer Questions

1. Write a short note on Lissajous figures.
2. What is logarithmic decrement? Give its physical significance.
3. What is amplitude resonance in case of forced vibrations? State its condition.
4. Define the terms (i) relaxation time (ii) quality factor.

UNIT II: Long Answer Questions:

1. Determine wavelength of light using Fresnel's biprism
2. Describe Newton's rings method for measuring the wavelength of monochromatic light. Give necessary theory.
3. Discuss Fraunhofer Single Slit Diffraction
4. Distinguish between interference and diffraction

Short Answer Questions

1. Explain the concept of double refraction?
2. Explain Malus law and Brewster's law?
3. Explain the construction and working of Quarter wave plate?
4. Explain the construction and working of half wave plate?
5. Write a short note on optical cavity.

UNIT III: Long Answer Questions:

14. Analyse the construction and working of Laurent's half shade polarimeter. How would you use it to determine the specific rotation?
15. Explain the construction and working of Nicol's Prism. How Nicol prism works as a polarizer and an analyzer?
16. Explain the production and detection of circularly and elliptically polarized light?

UNIT-IV

Long Answer Questions

4. Explain the principle and working of He-Ne laser.
5. Explain the construction and working of Ruby laser.
6. Discuss semiconductor lasers, laser safety and applications.

Short Answer Questions

5. Define population inversion.

6. Distinguish between spontaneous and stimulated emission.
7. What is laser action?
8. List four applications of lasers.

UNIT-V

Long Answer Questions

4. Explain the principle and working of optical fibers.
5. Explain the optical fiber communication system with a block diagram.
6. Explain holography and its applications.

Short Answer Questions

5. Define numerical aperture.
6. Differentiate between step-index and graded-index fibers.
7. State causes of signal attenuation.

SEMESTER-III

COURSE 1: MATHEMATICAL PHYSICAL AND COMPUTING FOUNDATIONS OF QUANTUM COMPUTING

Theory

Credits: 4

5 hrs/week

Course Outcomes

At the end of the course, students will be able to

CO1: Students will be able to compute eigenvalues, eigenvectors, and perform diagonalization of matrices, and interpret these results in the context of quantum state representation.

CO2: Students will be able to model random experiments using probability distributions and apply the Central Limit Theorem to analyze data relevant to quantum mechanical systems.

CO3: Students will be able to apply Maxwell's equations to derive wave propagation characteristics in free space, conducting media, and optical fibers.

CO4: Students will be able to trace the instruction execution cycle in a microprocessor, including fetch, decode, and execute phases, and explain the role of memory hierarchy in system performance.

CO5: Students will be able to design optimized combinational circuits such as adders, multiplexers, and code converters using Boolean algebra and Karnaugh map simplification.

Unit 1. Linear Algebra

Vectors and Vector Spaces, Linear Transformations, Hermitian and Unitary Matrices, Eigenvalues and Eigenvectors, Inner Product Spaces, Orthogonality and Hilbert Spaces, Diagonalization, Applications to Quantum computing.

Unit 2. Probability, Statistics and basics of Quantum Mechanics

Introduction to Statistics, Descriptive Statistics, Probability, Random Variables and Probability Distributions, Bayes theorem, Specific Probability Distributions and the Central Limit Theorem

Classical Mechanics Overview, Lagrangian Formulation, Hamiltonian Mechanics, Applications to Quantum Mechanics, Introduction to Electromagnetic theory, Maxwell's equations.

Unit 3. Computer Architecture

Digital Number Representation: Number systems: binary, octal, decimal, hexadecimal., Conversion between number systems, Signed number representation: sign-magnitude, 1's complement, 2's complement, Gray code, Binary arithmetic (addition, subtraction, multiplication, division).

Computer Architecture Basics: Fundamentals of computer design, Functional units of a computer, Data path and control path, Input-Output organization

Instruction cycle: Fetch, Decode, Execute, Control unit.

Unit 4. Microprocessors and Memory

Microprocessor Fundamentals Evolution of microprocessors (8085, 8086, Pentium, ARM), CPU internal architecture (ALU, registers, buses)., Addressing modes and instruction formats, Instruction execution and timing, Interrupts (Introduction)

Memory Hierarchy: Need for memory hierarchy, Cache memory: mapping techniques and replacement policies, Main memory (RAM, ROM, DRAM, SRAM)., Virtual memory concepts (paging, segmentation), Secondary storage overview.

Unit 5. Digital Logic, Boolean Algebra, and Combinational Circuits

Introduction to Digital Logic Gates: Basic gates: AND, OR, NOT, Universal gates: NAND, NOR, XOR, XNOR functions, Truth tables and circuit symbols, Logic gate implementations using transistors. Demorgan's laws

Boolean Algebra and Simplification: Boolean postulates and theorems, Canonical forms (SOP, POS), Simplification techniques: Boolean identities, algebraic manipulation, Karnaugh maps (2, 3, 4 variables).

Combinational Circuits: Half adder and full adder, Subtractors, comparators, Multiplexers, demultiplexers, Encoders, decoders, Design examples: Arithmetic circuits, code converters.

Textbooks:

1. Bernard Kolman, David A Hill, Elementary Linear Algebra with Applications, Pearson New International Edition, 2013.
2. Ron Larson, Elementary Statistics: Picturing the World, 8th Edition, Pearson, 2023.
3. Herbert Goldstein, Classical Mechanics, 3rd Edition, Addisen Wesley Publisher, 2001
4. Griffiths D. J., Introduction to Electrodynamics, 4th Edition, Cambridge University Press, 2020.
5. Thomas L. Floyd, Digital Fundamentals, 11th Edition, Pearson Publication, 2014.

Reference Books:

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson Education, 2nd Edition, 2005.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India, 10th Edition, 2015.
3. David Morin, Introduction to Classical Mechanics, 1st Edition, Cambridge University, 2008.
4. William H. Hayt and John A. Buck, Engineering Electromagnetics, 8th Edition, McGraw-Hill Education, 2011.
5. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, 5th Edition, Morgan Kaufmann, 2013.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA

B.Sc Physics Honours

SEMESTER-IV

COURSE 1: MATHEMATICAL PHYSICAL AND COMPUTING

FOUNDATIONS OF QUANTUM COMPUTING

Time:3 hours

Max marks: 60M

COURSE 1: BLUE PRINT

	Essay answer questions	Short answer questions	Numerical problems
Unit I	2 (with internal choice)	1	1
Unit II	2 (with internal choice)	2	0
Unit III	2 (with internal choice)	1	1
Unit IV	2 (with internal choice)	2	0
Unit V	2 (with internal choice)	1	1

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B.Sc Physics Honours
SEMESTER-IV
COURSE 1: MATHEMATICAL PHYSICAL AND COMPUTING
FOUNDATIONS OF QUANTUM COMPUTING
Model Question Paper

Time: 3 hours

Max marks: 60M

SECTION-A

Answer any Five of the following questions

5x 4M = 20M

1. Define a vector space and give an example.
2. Find the eigenvalues of $\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$.
3. State Bayes' theorem.
4. Explain the Central Limit Theorem.
5. Convert $(101101)_2$ into decimal.
6. Write the steps in the instruction cycle.
7. Explain cache memory and its advantages.
8. Distinguish between RAM and ROM.
9. State De Morgan's laws.
10. Write the truth table of a XNOR gate.

SECTION-B

Answer all the following questions.

5x8M = 40M

11. Explain eigenvalues, eigenvectors and diagonalization with an example. (OR)
12. Explain inner product spaces, orthogonality and Hermitian matrices.
13. Explain probability distributions and the Central Limit Theorem. (OR)
14. Explain the applications to quantum mechanics and explain the electromagnetic theory of Maxwell's equations.
15. Explain number systems and binary arithmetic. (OR)
16. Explain computer architecture and the instruction cycle.
17. Explain the memory hierarchy with suitable diagrams. (OR)
18. Explain microprocessor architecture, addressing modes and interrupts.
19. Explain Boolean algebra and Karnaugh map simplification. (OR)
20. Explain Full Adder and Half Adder with truth tables.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA

B.Sc Physics Honours

SEMESTER-IV

COURSE 1: MATHEMATICAL PHYSICAL AND COMPUTING

FOUNDATIONS OF QUANTUM COMPUTING

QUESTION BANK

UNIT – I : Linear Algebra

Long Answer Questions

- Explain vector spaces and linear transformations.
- Explain eigenvalues, eigenvectors and diagonalization.
- Discuss Hermitian and Unitary matrices with suitable examples.

Short Answer Questions

- Define an inner product space.
- What is orthogonality?
- Find the eigenvalues of a 2×2 matrix. (Numerical)
- Define a Hermitian matrix.

UNIT – II : Probability & Statistics

Long Answer Questions

- Explain random variables and probability distributions.
- Explain the applications to quantum mechanics and explain the electromagnetic theory of Maxwell's equations.
- Explain the Central Limit Theorem and its significance.

Short Answer Questions

- Define a random variable.
- State Bayes' theorem.
- What is a normal distribution?
- A coin is tossed twice. Find the probability of two heads. (Numerical)

UNIT – III : Computer Architecture

Long Answer Questions

- Explain number systems and conversions.
- Explain binary arithmetic operations.
- Explain the instruction cycle of a computer.

Short Answer Questions

- Convert decimal 45 into binary. (Numerical)
- What is Gray code?
- Define control path.
- List the functional units of a computer.

UNIT – IV : Microprocessors & Memory

Long Answer Questions

- Explain CPU architecture and buses.
- Explain cache memory and mapping techniques.
- Explain virtual memory and memory hierarchy.

Short Answer Questions

- Define cache memory.
- Differentiate SRAM and DRAM.
- What is virtual memory?
- Explain interrupts.

UNIT – V : Digital Logic

Long Answer Questions

- Explain Boolean algebra and K-map simplification.
- Explain Half Adder and Full Adder with truth tables.
- Explain fundamental logic gates using transistors.

Short Answer Questions

- State De Morgan's laws.
- Draw the truth table of XNOR gate.
- Simplify a Boolean expression using K-map. (Numerical)
- Explain half subtractor with truth table

SEMESTER-IV

COURSE 2: QUANTUM TECHNOLOGIES: PRINCIPLES AND APPLICATIONS

Theory

Credits: 4

5 hrs/week

Course Outcomes

At the end of the course, students will be able to

CO1: Understand foundational principles governing quantum behavior and contrast them with classical systems, study and interpret evolution and measurement of simple systems.

CO2: Analyze various physical platforms proposed or used for realizing advanced computing technologies.

CO3: Understand the principles behind high-precision measurement techniques enabled by quantum effects.

CO4: Apply coherence and entanglement concepts to real-world sensing applications in navigation and metrology.

CO5: Analyze communication systems using non-classical principles to enhance security and information transfer.

Unit 1: Introduction to Quantum Physics and Quantum Technologies

Motivation for Quantum Technologies, Quantum States, Wave functions, Heisenberg uncertainty principle, Schrodinger equation (conceptual), distinction from classical physics, Heuristic description of Superposition, Tunnelling and entanglement, No cloning theorem, Simulating classical systems – Feynman's idea of a quantum simulator and the birth of the field.

Unit 2: Quantum Computation

Basics of Qubits, Measurement and Errors. Difference between a classical bit and quantum Qubits, Review of classical logic gates, Di Vincenzo criteria for realising Qubits, Basics of Qubit gates and quantum circuits Overview of applications and recent achievements: Shor's algorithm and Quantum Advantage.

Unit 3: Quantum Sensing

Basics of quantum sensing: Definition and scope, Classical vs. quantum sensing and Applications in precision measurements, navigation, and defense, Principles of single-photon generation, Sources of single photons, Generation of entangled photon pairs. Quantum materials and their properties.

Unit 4: Quantum Communications

Basics of digital communication: Introduction to classical communication systems, Analog vs. digital communication, Quantifying classical information: Definition and significance of entropy in communication and Shannon entropy; Quantum communication: Principles of quantum information transfer, Qubits in communication systems, Quantum superposition and entanglement in communication, Role of quantum states in secure information transfer. Secure communication.

Unit 5: Simulators and Security

Running quantum protocols in a quantum simulator, Implementing simple quantum algorithms

on cloud-based quantum computers.

Security: Quantum Security and Eavesdropping: Detection of eavesdropping using quantum principles.

Textbooks

1. R. Shankar, Principles of Quantum Mechanics, 2nd Edition, Springer, 2012.
2. Nouredine Zettili, Quantum Mechanics: Concepts and Applications, 2nd Edition, Wiley, 2009.
3. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, 10th Anniversary Edition, Cambridge University Press, 2010.
4. David J. Griffiths and Darrell F. Schroeter, Introduction to Quantum Mechanics, 3rd Edition, Cambridge University Press, 2018.
5. Robert Eisberg and Robert Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, 2nd Edition, Wiley, 1985.

Reference Books

1. J.J. Sakurai and Jim Napolitano, Modern Quantum Mechanics, 2nd Edition, Cambridge University Press, 2017.
2. Marlan O. Scully and M. Suhail Zubairy, Quantum Optics, 1st Edition, Cambridge University Press, 1997.
3. P. Hemmer, Quantum Technologies and Applications, 1st Edition, Springer, 2020.
4. Eleanor G. Rieffel and Wolfgang H. Polak, 1st Edition, MIT Press, 2011.
5. Mark M. Wilde, Quantum Information Theory, 2nd Edition, Cambridge University Press, 2017

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B.Sc Physics Honours
SEMESTER-IV
COURSE 2: QUANTUM TECHNOLOGIES: PRINCIPLES AND
APPLICATIONS

Time:3 hours

Max marks: 60M

COURSE 2: BLUE PRINT

	Essay answer questions	Short answer questions
Unit I	2 (with internal choice)	2
Unit II	2 (with internal choice)	2
Unit III	2 (with internal choice)	2
Unit IV	2 (with internal choice)	2
Unit V	2 (with internal choice)	2

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA

B.Sc Physics Honours

SEMESTER-IV

COURSE 2: QUANTUM TECHNOLOGIES: PRINCIPLES AND APPLICATIONS

Model Question Paper

Time:3 hours

Max marks: 60M

SECTION-A

Answer any Five of the following questions

5x 4M = 20M

1. Define a wave function and state its significance.
2. Write a short note on quantum states.
3. Define a qubit. How is it different from a classical bit?
4. Discuss Di Vincenzo criteria for realising Qubits
5. Define quantum sensing and give two examples.
6. What are the differences between classical and quantum sensing.
7. Explain the importance of quantum communication.
8. Write a short note on secure communication.
9. Analyze the concept of quantum security.
10. List any four cloud-based quantum computing platforms.

SECTION-B

Answer all the following questions.

5x8M = 40M

11. Explain the differences between classical physics and quantum physics with suitable examples.
12. Discuss the Heisenberg Uncertainty Principle and explain its importance in quantum physics.
13. Describe the basic quantum gates and explain how they are used to build quantum circuits.
14. Explain the process of quantum measurement and discuss the sources of quantum errors.
15. Discuss the principles of single-photon generation and their importance in quantum technologies.
16. Explain the generation of entangled photon pairs and discuss their applications.
17. Discuss the concept of Quantum Key Distribution (QKD) and explain its role in secure communication.
18. Discuss the applications, advantages, and challenges of quantum communication.
19. Explain the concept of a quantum simulator and discuss its importance in quantum computing research.
20. Describe the process of implementing simple quantum circuits using cloud-based quantum computing platforms.

S.R.R & C.V.R. GOVERNMENT DEGREE COLLEGE (A) VIJAYAWADA
B.Sc Physics Honours
SEMESTER-IV
COURSE 2: QUANTUM TECHNOLOGIES: PRINCIPLES AND APPLICATIONS

QUESTION BANK

Unit-1

Long answer questions:

1. Explain the differences between classical physics and quantum physics with suitable examples.
2. Discuss the Heisenberg Uncertainty Principle and explain its importance in quantum physics.
3. Explain the phenomenon of quantum tunnelling and discuss its applications in modern technology.

Short answer questions:

1. Define a wave function and state its significance.
2. Write a short note on quantum states.
3. Explain the no cloning theorem
4. List any four applications of quantum technologies.

Unit-2

Long answer questions:

1. Describe the basic quantum gates and explain how they are used to build quantum circuits.
2. Explain the process of quantum measurement and discuss the sources of quantum errors.
3. Discuss the working principle of Shor's algorithm and explain its significance in quantum computing.

Short answer questions:

1. Define a qubit. How is it different from a classical bit?
2. Discuss Di Vincenzo criteria for realizing Qubits
3. List the steps involved in a simple quantum circuit.
4. State any four applications of quantum computing.

Unit-3

Long answer questions:

1. Discuss the principles of single-photon generation and their importance in quantum technologies.
2. Explain the generation of entangled photon pairs and discuss their applications.
3. Describe the role of quantum sensing in healthcare, navigation, defence, and industrial applications.

Short answer questions:

1. Define quantum sensing and give two examples.
2. What are the differences between classical and quantum sensing.
3. Write the properties the quantum materials

Unit-4

Long answer questions:

1. Explain the principles of quantum information transfer.
2. Discuss the concept of Quantum Key Distribution (QKD) and explain its role in secure communication.
3. Discuss the applications, advantages, and challenges of quantum communication.

Short answer questions:

1. Explain the importance of quantum communication.
2. Write a short note on secure communication.
3. Distinguish between classical and quantum communication.
4. Outline the significance of entropy in communication.

Unit-5

Long answer Questions:

1. Explain the concept of a quantum simulator and discuss its importance in quantum computing research.
2. Describe the process of implementing simple quantum circuits using cloud-based quantum computing platforms.
3. Discuss the methods used to detect eavesdropping in quantum communication.

Short answer questions:

1. Analyze the concept of quantum security.
2. List any four cloud-based quantum computing platforms.

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