Paper V: Electricity, Magnetism& Electronics
(For Maths Combinations)

V Semester

Work load: 60 hrs per semester **4 hrs/week**

UNIT-I (12 hrs)

1. **Electric field intensity and potential:**
   Gauss's law statement and its proof- Electric field intensity due to Uniformly charged sphere.Electrical potential – equipotential surfaces- potential due to i) a point charge, ii) uniformly charged sphere.
2. **Dielectrics:**
   Electric dipolemoment and molecular polarizability- Electric displacement D, electric polarization P – relation between D, E and P- Dielectric constant and susceptibility.

UNIT-II (12 hrs)

3. **Electric and magnetic fields**
   Biot-Savart's law, explanation and calculation of B due to long straight wire, a circular current loop and solenoid
4. **Electromagnetic induction**
   Faraday's law-Lenz's law- Self and mutual inductance, coefficient of coupling, calculation of self inductance of a long solenoid, energy stored in magnetic field.

UNIT-III (12 hrs)

5. **Alternating currents and electromagnetic waves**
   Alternating current - Relation between current and voltage in LR and CR circuits, vector diagrams, LCR series and parallel resonant circuit, Q –factor, power in ac circuits.
6. **Maxwell's equations**
   Idea of displacement current - Maxwell's equations (integral and differential forms) (no derivation), Maxwell's wave equation (with derivation).

UNIT-IV (12 hrs)

7. **Basic electronics:**
   PN juction diode, Zener diode, I-V characteristics, PNP and NPN transistors, CB, CE and CC configurations – Relation betweena, b and g - transistor (CE) characteristics - Determination of hybrid parameters.

UNIT-V: (12 hrs)

8. **Digital electronics**
   Number systems - Conversion of binary to decimal system and vice versa. Binary addition and subtraction (1's and 2's complement methods).Laws of Boolean algebra - De Morgan's laws-statement and proof, Basic logic gates, NAND and NOR as universal gates, exclusive-OR gate, Half adder and Full adder.

REFERENCE BOOKS

1. BSc Physics, Vol.3, Telugu Akademy, Hyderabad.
2. Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
3. Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand& Co.,
4. Principles of Electronics, V.K. Mehta, S.Chand& Co.,
5. Digital Principles and Applications, A.P. Malvino and D.P.Leach, Mc GrawHill Edition.

Practical Paper V: Electricity, Magnetism & Electronics

Work load: 30 hrs **2 hrs/week**

Minimum of 6 experiments to be done and recorded

1. Figure of merit of a moving coil galvonometer.
2. LCR circuit series/parallel resonance, Q factor.
3. Determination of ac-frequency –sonometer.
4. Verification of Kirchoff's laws and maximum power transfer theorem.
5. Field along the axis of a circular coil carrying current.
6. PN Junction Diode Characteristics
7. Zener Diode Characteristics
8. Transistor CE Characteristics- Determination of hybrid parameters
9. Logic Gates- OR,AND,NOT and NAND gates. Verification of Truth Tables.
10. Verification of De Morgan's Theorems.

Scheme of Valuation

Practicals	**50 marks**
Formula & Explanation	6
Tabular form +graph +circuit diagram	6
Observations	12
Calculation, graph, precautions & Result	6
Viva-Voce	10
Record	10

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

Seminars - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.

Group discussion - A topic from one of the units is given to a group of students and asked to discuss and debate on it.
Assignment - Few problems may be given to the students from the different units and asked them to solve.
Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
Study project - Web based study of different satellites and applications.

QUESTION BANK

UNIT – I (Electric field intensity and potential)

Essay Questions(10M)

1. State and prove Gauss theorem in electrostatics. Derive an expression for the electric field due to uniformly charged sphere.

2. State and prove Gauss theorem in electrostatics. Derive an expression for the electric field due to uniformly charged sphere(non-conducting)at points (i)Outside the sphere (ii)at the surface of the sphere and (iii)inside the sphere

3. Use Gauss's law to find electric intensity at a point near the infinite plane sheet of charge.

4. Derive an expression for the force on the surface of charged conductor.

5. Define electric potential. Derive an expression for potential due to a charged spherical conductor.

Short Answer (5M)

1. State and prove Gauss theorem in electrostatics.

2. State and prove Gauss law in differential form.

3. Derive and explain Gauss law in electrostatics and write any two applications.

4. What do you mean by electric potential difference and electric potential?

5. Explain equipotential surfaces.

6. Obtain an expression for potential due to a point charge.

Dielectrics

Essay Questions(10M)

1.Define D,P, and E and deduce relation between them. Hence derive the relationship between dielectric constant and susceptibility .

Short Answer (5M)

1. Explain polarization and polarizability.

2. Define polarization and show that it is equal to the surface density.

3. What is electric displacement? How it is related to electric intensity?

4. Define D,P and E and deduce relation between them.

5. Define electric constant and susceptibility. Derive a relationship between dielectric constant and susceptibility.

6. State and prove the boundary conditions at the dielectric surface.

UNIT-II(Electric and magnetic fields)

Essay Questions(10M)

1.state and explain biot and savarts law. derive an expression for magnetic induction at a point due to

an infinite straight conductor carrying current.

2.state and explain biot and savarts law. derive an expression for magnetic induction at a point due to

a circular wire carrying current.

3. state and explain biot and savarts law. Derive an expression for magnetic induction at a point due to a long solenoid.

Short Answer (5M)

1. What is hall effect and mention its application.

2. write a short note on hall effect

3. state and explain biot and savarts law.

UNIT-III (Electromagnetic induction)

Essay Questions(10M)

1.What is self induction and define coefficient of self induction and obtain an expression for the selfinductance of solenoid.

2.define self inductance. Calculate the self inductance due to a long solenoid.

3.Define mutual inductance, coefficient of coupling and arrive at an expression for coefficient of coupling between two coils separated by a distance d.

Short Answer (5M)

1.State faraday's law of electric magnetic induction .derive the differential and integral forms of Faraday's law

2.State and explain lenz's law. Does it contradict the lae of conservation of energy?

3.What is self inductance? In what units is it expressed?

4.What is mutual inductance? what are the units in which the coefficient of mutual inductance is expressed?

5. (a) state and explain faraday's law and lenz's law of induction

(b) derive an expression for mutual inductance between two coils.

6.explain the principle of transformer

UNIT-IV(Varying and Alternating currents)

Essay Questions(10M)

1.Derive an expression for the growth and decay of current in an inductance- resistance circuit.

2.discuss the nature of growth and decay of current in a capacitance –resistance circuit.

3.Discuss the growth and decay in a circuit containing resistance ,inductance and capacitance when direct e.m.f is applied.

Short Answer (5M)

1.Write a short note on power factor?

2.Write a short note on Q-factor?

3.Discuss the growth of charge in C-R Circuit.

4.Write about the growth and decay of current in L-R Circuit.

5.Derive the decay of charge in L-C-R Circuit.

6.Calculate the impedance of L,C, and R in series of an A.C.circuit

7.What is electric resonance? Distinguish between series and parallel resonance.

UNIT-V(Maxwell's equations)

Essay Questions(10M)

1.write Maxwell's equations in differential and integral forms. Derive an expression for energy flow by electromagnetic waves

2.Describe Hertz experiment for the production and detection of electromagnetic waves

3.what is pointing vector ? what is its significance?

4.write down maxwell's equation for electromagnetic fields and explain what each equation represents. Show that electromagnetic waves are transverse in nature.

Short Answer (5M)

1.write down the Maxwell's equation in differential form.

2.what is meant by Poynting vector? Discuss the use in electromagnetic principles.

3.Show that electromagnetic waves are transverse in nature.

Paper VI: Modern Physics
(For Maths Combinations)

V Semester

Work load: 60 hrs per semester **4 hrs/week**

UNIT-I (12 hrs)

1. **Atomic and molecular physics**

   Introduction –Vector atom model and Stern-Gerlach experiment - quantum numbers associated with it. L-S and j- j coupling schemes.Zeeman effect and its experimental arrangement.

   Raman effect, hypothesis, Stokes and Anti Stokes lines. Quantum theory of Raman effect. Experimental arrangement – Applications of Raman effect.

UNIT-II (12 hrs)

2. **Matter waves & Uncertainty Principle**

   Matter waves, de Broglie's hypothesis - wavelength of matter waves, Properties of matter waves - Davisson and Germer experiment – Phase and group velocities.

   Heisenberg's uncertainty principle for position and momentum (x and p), & energy and time (E and t). Experimental verification

UNIT-III (12 hrs)

3. **Quantum (wave) mechanics**

   Basic postulates of quantum mechanics-Schrodinger time independent and time dependent wave equations-derivations. Physical interpretation of wave function. Eigen functions, Eigen values. Application of Schrodinger wave equation to particle in one dimensional infinite box.

UNIT-IV(12 hrs)

4. **General Properties of Nuclei**

   Basic ideas of nucleus -size, mass, charge density (matter energy), binding energy, angular momentum, parity, magnetic moment, electric moments. Liquid drop model

5. **Radioactivity decay:**

   Alpha decay: basics of α-decay processes. Theory of α-decay, Gamow's theory, Geiger Nuttal law.β-decay, Energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.

UNIT-V (12 hrs)

6. **Crystal Structure**

   Amorphous and crystalline materials, unit cell, Miller indices, reciprocal lattice, types of lattices, diffraction of X-rays by crystals, Bragg's law.

7. **Superconductivity:**

   Introduction - experimental facts, critical temperature - critical field - Meissner effect – Isotope effect - Type I and type II superconductors - applications of superconductors.

REFERENCE BOOKS

1. BSc Physics, Vol.4, Telugu Akademy, Hyderabad
2. Molecular Structure and Spectroscopy by G. Aruldhas. Prentice Hall of India, New Delhi.

3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
4. Modern Physics by G. Aruldhas & P. Rajagopal. Eastern Economy Edition.
5. Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
6. Quantum Mechanics, Mahesh C Jain, Eastern Economy Edition.
7. Nuclear Physics, Irving Kaplan, Narosa publishing House.
8. Nuclear Physics, D.C.Tayal, Himalaya Publishing House.
9. Elements of Solid State Physics, J.P.Srivastava, Prentice Hall of India Pvt., Ltd.
10. Solid State Physics, A.J. Dekker, McMillan India.

Practical Paper VI:Modern Physics

Work load: 30 hrs **2 hrs/week**

Minimum of 6 experiments to be done and recorded

1. e/m of an electron by Thomson method.
2. Determination of Planck's Constant (photocell).
3. Verification of inverse square law of light using photovoltaic cell.
4. Study of absorption of α-rays.
5. Study of absorption of β-rays.
6. Determination of Range of β-particles.
7. Determination of M & H.
8. Analysis of powder X-ray diffraction pattern to determine properties of crystals.
9. Energy gap of a semiconductor using junction diode.
10. Energy gap of a semiconductor using thermister.
11. A.C Impedance and power factor.
12. Half adder and full adder.
13. Carry Foster, s Bridge-Determination of specific resistance of a given wire.
14. Bridge rectifier-Filters.

Note: For all the above 8 practical papers the book "B.Sc Practical Physics" by C.L. Arora Published by S.Chand & Co, New – Delhi may be followed.

Scheme of Valuation

Practical	**50 marks**
Formula & Explanation	6
Tabular form +graph +circuit diagram	6
Observations	12
Calculation, graph, precautions & Result	6
Viva-Voce	10
Record	10

NOTE: Problems should be solved at the end of every chapter of all units.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

Seminars - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.

Group discussion - A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment - Few problems may be given to the students from the different units and asked them to solve.

Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and

QUESTION BANK

UNIT – 1(Atomic and molecular physics)

Essay Questions(10M)

1. Describe Stern-Gerlach experiment with neat diagram and necessary theory.
2. Explain the quantum numbers associated with vector atom model.
3. What is Raman effect. Describe an experimental arrangement for the study of Raman efeect.

Short Answers (5M)

1. What are the drawbacks of Bohr atomic model?
2. Write a short note on Coupling schemes.
3. Write a short note on relativistic correction.
4. Explain the quantum theory of Raman effect.
5. What are the applications of Raman effect?

UNIT – 2(Quantum (wave) mechanics I)

Essay Questions(10M)

1. What are Matter waves? Explain de Broglie's hypothesis for matter waves. Derive expressions for wavelength of matter waves.
2. Describe Davisson and Germer experiment with a neat diagram and necessary theory.
3. Explain Heisenberg's uncertainty principle for position and momentum and extend it for energy and time.

Short Answers (5M)

1. What are the Properties of matter waves?
2. Describe γ_ ray microscope

UNIT – 3(Quantum (wave) mechanics II)

Essay Questions(10M)

1. Write the basic postulates of quantum mechanics and derive Schrodinger time independent wave equation.
2. Write the Physical interpretation of wave function. Derive Schrodinger time dependent wave equation.
3. Apply Schrodinger wave equation to particle in one dimensional infinite box.

Short Answers (5M)

1. Write the Physical interpretation of wave function.

UNIT – 4

Essay Questions(10M)

1. Explain the basic properties of nucleus
2. Explain the liquid drop model for nucleus. What are the drawbacks in this model. What are the drawbacks in this model?
3. What are magic numbers? How these are explained in shell model?
4. Explain Gamow's theory of α-decay.

Short Answers (5M)

1. Write a short note on binding energy.
2. Write a short note on β – decay.

UNIT – 4(Nuclear Physics)

Essay Questions(10M)

1. Derive Bragg's law. Describe the construction and working of Bragg's spectrometer.
2. Describe Laue's method to determine the crystal structure.
3. Describe powder method to determine the crystal structure.
4. What is Meissner effect? Write about Type I and type II superconductors.

Short Answers (5M)

1. Write a short note on Miller indices.
2. What is isotopic effect on super conductivity.

3. What are the applications of super conductors.

6.explain the principle of transformer

UNIT-IV(Varying and Alternating currents)

Essay Questions(10M)

1.Derive an expression for the growth and decay of current in an inductance- resistance circuit.

2.discuss the nature of growth and decay of current in a capacitance –resistance circuit.

3.Discuss the growth and decay in a circuit containing resistance ,inductance and capacitance when direct e.m.f is applied.

Short Answer (5M)

1.Write a short note on power factor?

2.Write a short note on Q-factor?

3.Discuss the growth of charge in C-R Circuit.

4.Write about the growth and decay of current in L-R Circuit.

5.Derive the decay of charge in L-C-R Circuit.

6.Calculate the impedance of L,C, and R in series of an A.C.circuit

7.What is electric resonance? Distinguish between series and parallel resonance.

UNIT-V(Maxwell's equations)

Essay Questions(10M)

1.write Maxwell's equations in differential and integral forms. Derive an expression for energy flow by electromagnetic waves

2.Describe Hertz experiment for the production and detection of electromagnetic waves

3.what is pointing vector? what is its significance?

4.write down maxwell's equation for electromagnetic fields and explain what each equation represents. Show that electromagnetic waves are transverse in nature.

Short Answer (5M)

1.write down the Maxwell's equation in differential form.

2.what is meant by Poynting vector? Discuss the use in electromagnetic principles.

3.Show that electromagnetic waves are transverse in nature.

hydroelectric power stations / Science Centres, any other such visit etc.

Study project - Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

Paper VI: Modern Physics
(For Maths Combinations)
V Semester

Work load: 60 hrs per semester **4 hrs/week**

UNIT-I (12 hrs)

8. Atomic and molecular physics

Introduction –Vector atom model and Stern-Gerlach experiment - quantum numbers associated with it. L-S and j- j coupling schemes.Zeeman effect and its experimental arrangement.

Raman effect, hypothesis, Stokes and Anti Stokes lines. Quantum theory of Raman effect. Experimental arrangement – Applications of Raman effect.

UNIT-II (12 hrs)

9. Matter waves & Uncertainty Principle

Matter waves, de Broglie's hypothesis - wavelength of matter waves, Properties of matter waves - Davisson and Germer experiment – Phase and group velocities.

Heisenberg's uncertainty principle for position and momentum (x and p), & energy and time (E and t). Experimental verification

UNIT-III (12 hrs)

10. Quantum (wave) mechanics

Basic postulates of quantum mechanics-Schrodinger time independent and time dependent wave equations-derivations. Physical interpretation of wave function. Eigen functions, Eigen values. Application of Schrodinger wave equation to particle in one dimensional infinite box.

UNIT-IV(12 hrs)

11. General Properties of Nuclei

Basic ideas of nucleus -size, mass, charge density (matter energy), binding energy, angular momentum, parity, magnetic moment, electric moments. Liquid drop model

12. Radioactivity decay:

Alpha decay: basics of α-decay processes. Theory of α-decay, Gamow's theory, Geiger Nuttal law.β-decay, Energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.

UNIT-V (12 hrs)

13. Crystal Structure

Amorphous and crystalline materials, unit cell, Miller indices, reciprocal lattice, types of lattices, diffraction of X-rays by crystals, Bragg's law.

14. Superconductivity:

Introduction - experimental facts, critical temperature - critical field - Meissner effect – Isotope effect - Type I and type II superconductors - applications of superconductors.

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16. Quantum Mechanics, Mahesh C Jain, Eastern Economy Edition.
17. Nuclear Physics, Irving Kaplan, Narosa publishing House.
18. Nuclear Physics, D.C.Tayal, Himalaya Publishing House.
19. Elements of Solid State Physics, J.P.Srivastava, Prentice Hall of India Pvt., Ltd.
20. Solid State Physics, A.J. Dekker, McMillan India.

Practical Paper VI:Modern Physics

Work load: 30 hrs **2 hrs/week**

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1. e/m of an electron by Thomson method.
2. Determination of Planck's Constant (photocell).
3. Verification of inverse square law of light using photovoltaic cell.
4. Study of absorption of α-rays.
5. Study of absorption of β-rays.
6. Determination of Range of β-particles.
7. Determination of M & H.
8. Analysis of powder X-ray diffraction pattern to determine properties of crystals.
9. Energy gap of a semiconductor using junction diode.
10. Energy gap of a semiconductor using thermister.
11. A.C Impedance and power factor.
12. Half adder and full adder.
13. Carry Foster, s Bridge-Determination of specific resistance of a given wire.
14. Bridge rectifier-Filters.

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Practical	**50 marks**
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QUESTION BANK

UNIT – 1(Atomic and molecular physics)

Essay Questions(10M)

1. Describe Stern-Gerlach experiment with neat diagram and necessary theory.
2. Explain the quantum numbers associated with vector atom model.
3. What is Raman effect. Describe an experimental arrangement for the study of Raman efeect.

Short Answers (5M)

1. What are the drawbacks of Bohr atomic model?
2. Write a short note on Coupling schemes.
3. Write a short note on relativistic correction.
4. Explain the quantum theory of Raman effect.
5. What are the applications of Raman effect?

UNIT – 2(Quantum (wave) mechanics I)

Essay Questions(10M)

1. What are Matter waves? Explain de Broglie's hypothesis for matter waves. Derive expressions for wavelength of matter waves.
2. Describe Davisson and Germer experiment with a neat diagram and necessary theory.
3. Explain Heisenberg's uncertainty principle for position and momentum and extend it for energy and time.

Short Answers (5M)

1. What are the Properties of matter waves?
2. Describe γ_ ray microscope

UNIT – 3(Quantum (wave) mechanics II)

Essay Questions(10M)

1. Write the basic postulates of quantum mechanics and derive Schrodinger time independent wave equation.
2. Write the Physical interpretation of wave function. Derive Schrodinger time dependent wave equation.
3. Apply Schrodinger wave equation to particle in one dimensional infinite box.

Short Answers (5M)

1. Write the Physical interpretation of wave function.

UNIT – 4

Essay Questions(10M)

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2. Explain the liquid drop model for nucleus. What are the drawbacks in this model. What are the drawbacks in this model?
3. What are magic numbers? How these are explained in shell model?
4. Explain Gamow's theory of α-decay.

Short Answers (5M)

1. Write a short note on binding energy.
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UNIT – 4(Nuclear Physics)

Essay Questions(10M)

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2. Describe Laue's method to determine the crystal structure.
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Short Answers (5M)

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2. What is isotopic effect on super conductivity.

3. What are the applications of super conductors.

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UNIT-IV(Varying and Alternating currents)

Essay Questions(10M)

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2.discuss the nature of growth and decay of current in a capacitance –resistance circuit.

3.Discuss the growth and decay in a circuit containing resistance ,inductance and capacitance when direct e.m.f is applied.

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UNIT-V(Maxwell's equations)

Essay Questions(10M)

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2.Describe Hertz experiment for the production and detection of electromagnetic waves

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hydroelectric power stations / Science Centres, any other such visit etc.

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