SRI VENKATESWARA UNIVERSITY – TIRUPATI

B.Sc., (Honours) in PHYSICS (SINGLE MAJOR)

(W.e.f. Academic Year 2024 - 25)

SECOND YEAR – IV SEMESTER - COURSE 9: ELECTRICITY AND MAGNETISM

Theory	Credits: 3	3 hrs./week

COURSE OBJECTIVE:

The course on Electricity and Magnetism aims to provide students with a fundamental understanding of the principles of electricity, magnetism, and their interactions

LEARNING OUTCOMES:

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

1. 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.
2. To learn the methods used to solve problems using loop analysis, Nodal analysis, Thvenin's theorem, Norton's theorem, and the Superposition theorem
3. Distinguish between the magnetic effect of electric current and electromagnetic induction and apply the related laws in appropriate circumstances.
4. Understand Biot and Savart's law and Ampere's circuital law to describe and explain the generation of magnetic fields by electrical currents.
5. Develop an understanding on the unification of electric, and magnetic fields and Maxwell's equations governing electromagnetic waves.
6. Phenomenon of resonance in LCR AC-circuits, sharpness of resonance, Q- factor, Power factor and the comparative study of series and parallel resonant circuits.

SYLLABUS

UNIT-I Electrostatics and Dielectrics

Gauss's law-Statement and its proof, Electric field intensity due to (i) uniformly charged solid sphere, Electrical potential–Equipotential surfaces, Potential due to a uniformly charged sphere. 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

Electrical conduction-drift velocity-current density, equation of continuity, ohms law and limitations, Kirchhoff's Law's, Wheatstone bridge-balancing condition - sensitivity. Branch current method, Nodal Analysis, star to delta & delta to star conversions. Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer theorem.

UNIT-III Magneto statics

Biot-Savart's law and its applications: (i) circular loop and (ii) solenoid, Ampere's Circuital Law and its application to Solenoid, Hall Effect, determination of Hall coefficient and applications.

Electromagnetic Induction:

Faraday's laws of electromagnetic induction, Lenz's law, Self-induction and Mutual induction, Self-inductance of a long solenoid, Magnetic Energy density. Mutual inductance of a pair of coils. Coefficient of Coupling.

UNIT-IV Electromagnetic waves-Maxwell's equations:

Basic laws of electricity and magnetism- Maxwell's equations- integral and differential forms Derivation, concept of displacement current. Plane electromagnetic wave equation, Hertz experiment- Transverse nature of electromagnetic waves. Electromagnetic wave equation in conducting media. Pointing vector and propagation of electromagnetic waves.

UNIT-V Varying and alternating currents:

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. Relation between current and voltage in LR and CR circuits, Phasor and Vector diagrams, 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 R. Murugeshan, Kiruthiga Siva prasath, and M. Saravanapandian

6. "Electricity and Magnetism: Theory and Applications" by Ajoy Ghatak and S. Lokanathan

7. Electricity and Magnetism: Problems and Solutions" by Ashok Kumar and Rajesh Kumar

8. Electricity and Magnetism, R.Murugeshan, S. Chand & Co.

SECOND YEAR – IV SEMESTER - COURSE 9: ELECTRICITY AND MAGNETISM

Practical **Credits: 1** **2hrs/week**

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:

Demonstrate a thorough understanding of the fundamental concepts and principles of electricity and magnetism.

Apply the laws and principles of electricity and magnetism to analyze and solve electrical and magnetic problems.

Design, construct, and test electrical circuits using various components and measuring instruments.

Measure and analyze electrical quantities such as voltage, current, resistance, capacitance, and inductance using appropriate instruments.

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. Figure of merit of a moving coil galvanometer.
2. LCR circuit series/parallel resonance, Q factor.
3. Determination of ac-frequency –Sonometer.
4. Verification of Kirchhoff's laws and Maximum Power Transfer theorem.
5. Verification of Thevenin's and Norton's theorem
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.

Scheme of valuation for Practical

1.	Formula, Units and Modal Graph	= 5 M
2.	Tabular Column	= 5 M
3.	Observations	= 15 M
4.	Calculations	= 10 M
5.	Viva	= 5 M
6.	Record	= 10 M

Total = 50 Marks

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.

MODEL QUESTION PAPER

SECOND YEAR – IV SEMESTER - COURSE 9: ELECTRICITY AND MAGNETISM

Time: 3 Hrs. **Max Marks: 75**

PART - A

Answer any five questions. Each one carries 5 marks **5 x 5 = 25 Marks**

1.
2
3.
4.
5.
6.
7.
8.

PART – B

Answer any Five Questions. Each one carries 10 marks **5x 10 = 50 Marks**

9. a) From unit-1
(OR)
b) From unit-1

10. a) From unit-2
(OR)
b) From unit-2

11. a) From unit-3
(OR)
b) From unit-3

12. a) From unit-4
(OR)
b) From unit-4

13. a) From unit-5
(OR)
b) From unit-5

BLUE PRINT FOR THE QUESTION PAPER SETTING

S. No.	Type of Question	To be given in the Question Paper			To be answered		
		No. of Questions	Marks allotted to each question	Total Marks	No. of Questions	Marks allotted to each question	Total Marks
1	Section – A (Short Questions)	8	5	40	5	5	25
2	Section - B (Essay Questions)	10	10	100	5	10	50
		Total Marks		140	**Total Marks**		**75**

SRI VENKATESWARA UNIVERSITY – TIRUPATI

B.Sc., (Honours) in PHYSICS (SINGLE MAJOR)

(W.e.f. Academic Year 2024 - 25)

SECOND YEAR – IV SEMESTER - COURSE 10: MODERN PHYSICS

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

COURSE OBJECTIVE:

The course on Modern Physics aims to provide students with an understanding of the principles of modern physics and their applications in various fields.

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 structure and spectroscopy
3. Develop critical understanding of concept of Matter waves and Uncertainty principle.
4. Get familiarized with the principles of quantum mechanics and the formulation of Schrodinger wave equation and its applications.
5. Increase the awareness and appreciation of superconductors and their practical applications

SYLLABUS

UNIT-I: Introduction to Atomic Structure and Spectroscopy:

Bohr's model of the hydrogen atom -Derivation for radius, energy and wave number - Hydrogen spectrum, Vector atom model – Stern and Gerlach experiment, Quantum numbers associated with it, Coupling schemes, Spectral terms and spectral notations, Selection rules. Zeeman effect, Experimental arrangement to study Zeeman effect.

UNIT-II: Molecular Structure and Spectroscopy

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, UV-Visible, and Raman spectroscopy

UNIT-III: Matter waves & Uncertainty Principle:

Matter waves, 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: Quantum 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 (one-dimensional potential box of infinite height (Infinite Potential Well)

UNIT-V: Superconductivity:

Introduction to Superconductivity, Experimental results-critical temperature, critical magnetic field, Meissner effect, London's Equation and Penetration Depth, Isotope effect, Type I and Type II superconductors, BCS theory, high Tc super conductors, Applications of superconductors.

REFERENCE BOOKS

1. BSc Physics, Vol.4, Telugu Akademy, Hyderabad
2. Atomic Physics by J.B. Rajam; S.Chand& Co.,
3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
4. Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
5. Nuclear Physics, D.C.Tayal, Himalaya Publishing House.
6. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publ.Co.)
7. K.K.Chattopadhyay&A.N.Banerjee, Introd.to Nanoscience and Technology(PHI Learning PLt.)
8. Nano materials, A K Bandopadhyay. New Age International Pvt Ltd (2007)
9. Textbook of Nanoscience and Nanotechnology, BS Murthy, P Shankar, Baldev Raj,BB Rath and J Murday-Universities Press-IIM.

SECOND YEAR – IV SEMESTER - COURSE 10: MODERN PHYSICS

Practical	Credits: 1	2hrs/week

COURSE OBJECTIVE:

The course objective for a practical course in Modern Physics may provide hands-on experience with experimental techniques and equipment used in modern physics experiments.

LEARNING OUTCOMES:

1. Apply experimental techniques and equipment to investigate and analyze phenomena related to modern physics, such as quantum mechanics, relativity, atomic physics, and nuclear physics.
2. Demonstrate a deep understanding of the principles and theories of modern physics through hands-on experimentation and data analysis.
3. Develop proficiency in using advanced laboratory instruments and techniques specific to modern physics experiments, such as spectroscopy, interferometry, particle detectors, and radiation measurement.
4. Analyze and interpret experimental data using statistical methods and error analysis, drawing meaningful conclusions and relating them to theoretical concepts.
5. Design and conduct independent experiments or investigations related to modern physics, demonstrating the ability to plan, execute, and analyze experimental procedures and results.

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. Determination of the Planck's constant using LEDs of at least 4 different colours.
5. Determination of work function of material of filament of directly heated vacuum diode.
6. Determination of M & H.
7. Energy gap of a semiconductor using junction diode.
8. Energy gap of a semiconductor using thermistor.

Scheme of valuation for Practical

1.	Formula, Units and Modal Graph	= 5 M
2.	Tabular Column	= 5 M
3.	Observations	= 15 M
4.	Calculations	= 10 M
5.	Viva	= 5 M
6.	Record	= 10 M

Total = 50 Marks

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 Structure and 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: Quantum Mechanics:

Begin the activity by providing an overview of quantum mechanics and its significance in understanding the behavior of particles on a microscopic scale. Discuss key concepts such as wave-particle duality, superposition, quantization, and the probabilistic nature of quantum systems

UNIT-V: Superconductivity:

Begin the activity by providing an overview of superconductivity, including its definition, properties, and significance in scientific and technological applications.

Discuss key concepts such as zero electrical resistance, Meissner effect, critical temperature, and type I and type II superconductors.

MODEL QUESTION PAPER

SECOND YEAR – IV SEMESTER - COURSE 10: MODERN PHYSICS

Time: 3 Hrs. **Max Marks: 75**

PART - A

Answer any five questions. Each one carries 5 marks **5 x 5 = 25 Marks**

1.
2
3.
4.
5.
6.
7.
8.

PART – B

Answer any Five Questions. Each one carries 10 marks **5x 10 = 50 Marks**

9. a) From unit-1
(OR)
b) From unit-1

10. a) From unit-2
(OR)
b) From unit-2

11. a) From unit-3
(OR)
b) From unit-3

12. a) From unit-4
(OR)
b) From unit-4

13. a) From unit-5
(OR)
b) From unit-5

BLUE PRINT FOR THE QUESTION PAPER SETTING

S. No.	Type of Question	To be given in the Question Paper			To be answered		
		No. of Questions	Marks allotted to each question	Total Marks	No. of Questions	Marks allotted to each question	Total Marks
1	Section – A (Short Questions)	8	5	40	5	5	25
2	Section - B (Essay Questions)	10	10	100	5	10	50
		Total Marks		140	**Total Marks**		**75**

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B.Sc., (Honours) in PHYSICS (SINGLE MAJOR)

(W.e.f. Academic Year 2024 - 25)

SECOND YEAR–IV SEMESTER -COURSE11: INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

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

COURSE OBJECTIVE:

The course aims to provide students with an understanding of the principles of Nuclear and Particle physics and their applications in various fields.

LEARNING OUTCOMES

By successful completion of the course, students will be able to

1. Know about high energy particles and their applications which prepares them for further study and research in nuclear physics
2. Students can explain important concepts on nucleon-nucleon interaction, such as its short-range, spin dependence, isospin, and tensors.
3. Students can show the potential shapes from nucleon- nucleon interactions.
4. Students can explain the single particle model, its strengths, and weaknesses
5. Students can explain magic numbers based on this model

SYLLABUS

UNIT-I: Introduction to Nuclear Physics

Nuclear Structure: General Properties of Nuclei, Mass defect, Binding energy; Nuclear forces: Characteristics of nuclear forces- Yukawa's meson theory; Nuclear Models- Liquid drop model- Semi empirical mass formula, nuclear shell model.

UNIT-II: Elementary Particles And Interactions

Discovery and classification of elementary particles, properties of leptons, mesons and baryons; Types of interactions- strong, electromagnetic and weak interactions; Conservation laws – Isospin, parity, charge conjugation

UNIT-III: Nuclear Reactions and Nuclear Detectors

Nuclear Reactions: Types of reactions, Conservation Laws in nuclear reactions, Reaction energetic, Threshold energy, nuclear cross-section; Nuclear detectors: Geiger- Muller counter, Scintillation counter, Cloud chamber

UNIT-IV: Nuclear Decays and Nuclear Accelerators

Nuclear Decays: Gamow's theory of alpha decay, Fermi's theory of Beta- decay, Energy release in Beta- decay, selection rules. Nuclear Accelerators: Types- Electrostatic and electrodynamics accelerators; Cyclotron-construction, working and applications; Synchrocyclotron-construction, working and applications.

UNIT-V: Applications of Nuclear and Particle Physics

Medical Applications: Radiation therapy and imaging techniques, nuclear energy: nuclear reactors and power generation, Particle physics in high-energy Astro Physics

Reference Books:

1. **Nuclear Physics, Irving Kaplan, Narosa Pub. (1998).**
2. **Nuclear Physics, Theory and experiment – P.R. Roy and B.P. Nigam, New Age Int.1997.**
3. **Atomic and Nuclear Physics (Vol.2), S.N. Ghoshal, S. Chand & Co. (1994).**
4. **Nuclear Physics, D.C. Tayal, Himalaya Pub. (1997).**
5. **Atomic and Nuclear Physics, R.C. Sharma, K. Nath& Co., Meerut.**
6. **Nuclei and Particles, E. Segre.**
7. **Introduction to Nuclear Physics, H.A. Enge, Addison Wesley (1975).**

SECOND YEAR – IV SEMESTER - COURSE 11: ITRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

Practical	Credits: 1	2hrs/week

COURSE OBJECTIVE:

To familiarize students with experimental techniques and methodologies used in nuclear and particle physics.

To provide hands-on experience in conducting experiments related to nuclear and particle physics

LEARNING OUTCOMES:

1. Gain a solid understanding of fundamental concepts in nuclear and particle physics.
2. Acquire knowledge of experimental techniques and methodologies used in the field.
3. Understand the principles and operation of laboratory equipment and instruments specific to nuclear and particle physics experiments.
4. Develop proficiency in conducting experiments related to nuclear and particle physics.
5. Acquire skills in data acquisition, analysis, and interpretation using appropriate software and techniques.
6. Learn to design and perform experiments, including calibration, measurement, and control of variables.

Minimum of 6 experiments to be done and recorded

1. GM counter – Determination of dead time
2. Study and characteristic curve of GM counter and estimation of its operating voltage
3. Estimation of efficiency for a gamma source of the GM counter
4. To verify inverse square law using GM counter
5. Production and attenuation of bremsstrahlung
6. Estimation of efficiency for a beta source of the GM counter
7. Study of back scattering of beta particles

Scheme of valuation for Practical

1.	Formula, Units and Modal Graph	= 5 M
2.	Tabular Column	= 5 M
3.	Observations	= 15 M
4.	Calculations	= 10 M
5.	Viva	= 5 M
6.	Record	= 10 M

Total = 50 Marks

STUDENT ACTIVITIES

UNIT-I: 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-II: ELEMENTARY PARTICLES AND INTERACTIONS

Divide students into small groups and assign each group a specific elementary particle (e.g., proton, electron, neutrino, quark).

Instruct students to create a poster showcasing their assigned particle, including its properties, classification, and interactions.

Encourage creativity in the presentation of information, such as diagrams, illustrations, and concise explanations.

Have each group present their posters to the class, promoting discussion and comparisons between different particles

UNIT-III: NUCLEAR REACTIONS AND NUCLEAR DETECTORS

Divide students into small groups and assign each group a specific scenario that requires radiation shielding, such as a nuclear power plant, a medical facility, or a space mission.

Instruct students to research and design an effective radiation shielding system for their assigned scenario, considering factors such as the type of radiation, the intensity of radiation, and the materials available for shielding.

Encourage students to calculate and compare the attenuation properties of different materials and discuss the trade-offs between effectiveness, cost, and practicality in their designs.

Have each group present their shielding design to the class, explaining their rationale and addressing potential challenges or limitations

UNIT-IV: NUCLEAR DECAYS AND NUCLEAR ACCELERATORS

Provide students with a radioactive decay chain involving multiple decays, such as alpha decay, beta decay, and gamma decay.

Instruct students to analyze the decay chain and determine the sequence of decays, including the types of particles emitted and the resulting daughter nuclei.

Ask students to calculate the half-lives of the parent and daughter nuclei based on the decay data and explore the concept of radioactive equilibrium.

Encourage students to discuss the practical applications and significance of decay chains in fields such as radiometric dating or medical imaging

UNIT-V: APPLICATIONS OF NUCLEAR AND PARTICLE PHYSICS

Assign students specific medical imaging techniques based on nuclear and particle physics, such as positron emission tomography (PET), single-photon emission computed tomography (SPECT), or computed tomography (CT).

Instruct students to research and present on the principles behind their assigned imaging technique, including the interaction of particles or radiation with matter, detector technology, and image reconstruction methods. Ask students to discuss the advantages, limitations, and specific medical applications of their assigned imaging technique.

MODEL QUESTION PAPER

SECOND YEAR – IV SEMESTER - COURSE 11: INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

Time: 3 Hrs. **Max Marks: 75**

PART - A

Answer any five questions. Each one carries 5 marks **5 x 5 = 25 Marks**

1.
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3.
4.
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7.
8.

PART – B

Answer any Five Questions. Each one carries 10 marks **5x 10 = 50 Marks**

9. a) From unit-1
(OR)
b) From unit-1

10. a) From unit-2
(OR)
b) From unit-2

11. a) From unit-3
(OR)
b) From unit-3

12. a) From unit-4
(OR)
b) From unit-4

13. a) From unit-5
(OR)
b) From unit-5

BLUE PRINT FOR THE QUESTION PAPER SETTING

S. No.	Type of Question	To be given in the Question Paper			To be answered		
		No. of Questions	Marks allotted to each question	Total Marks	No. of Questions	Marks allotted to each question	Total Marks
1	Section – A (Short Questions)	8	5	40	5	5	25
2	Section - B (Essay Questions)	10	10	100	5	10	50
		Total Marks		140	**Total Marks**		**75**