

**SRI VENKATESWARA UNIVERSITY**

**B.Sc COURSE IN PHYSICS**

**IV SEMESTER**

**(CBCS) REVISED SYLLABUS – 2021-22**

**For Mathematics Combinations**

**Course-IV: ELECTRICITY, MAGNETISM AND ELECTRONICS**

**Work load:60 hrs per semester**

**4 hrs/week**

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**Course outcomes:**

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

- ❖ *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.*
- ❖ *Distinguish between the magnetic effect of electric current and electromagnetic induction and apply the related laws in appropriate circumstances.*
- ❖ *Understand Biot and Savart's law and Ampere's circuital law to describe and explain the generation of magnetic fields by electrical currents.*
- ❖ *Develop an understanding on the unification of electric and magnetic fields and Maxwell's equations governing electromagnetic waves.*
- ❖ *Phenomenon of resonance in LCR AC-circuits, sharpness of resonance, Q- factor, Power factor and the comparative study of series and parallel resonant circuits.*
- ❖ *Describe the operation of p-n junction diodes, zener diodes, light emitting diodes and transistors*
- ❖ *Understand the operation of basic logic gates and universal gates and their truth tables.*

## UNIT-I

### 1. Electrostatics: (6hrs)

*Gauss's law-Statement and its proof, Electric field intensity due to (i) uniformly charged solid sphere and (ii) an infinite conducting sheet of charge, Deduction of Coulomb's law from Gauss law, Electrical potential-Equipotential surfaces, Potential due to a (i) dipole (ii) uniformly charged sphere.*

### 2. Dielectrics: (6 hrs)

*Dielectrics-Polar and Non-polar dielectrics- Effect of electric field on dielectrics, Dielectric strength, Capacitance of a parallel plate condenser with dielectric slab between the plates, Electric displacement  $D$ , electric polarization  $P$ , Relation between  $D$ ,  $E$  and  $P$ , Dielectric constant and electric susceptibility.*

## UNIT-II

### 3. Magnetostatics: (6 hrs)

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

### 4. Electromagnetic Induction: (6 hrs)

*Faraday's laws of electromagnetic induction, Lenz's law, Self induction and Mutual induction, Self inductance of a long solenoid, Mutual inductance of two coils, Energy stored in magnetic field, Eddy currents and Electromagnetic damping*

## UNIT-III

### 5. Alternating currents: (6 hrs)

*Alternating current - 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.*

### 6. Electromagnetic waves-Maxwell's equations: (6 hrs)

*Idea of displacement current, Maxwell's equations-Derivation, Maxwell's wave equation (with derivation), Transverse nature of electromagnetic waves, Poynting theorem (Statement and proof)*

## UNIT-IV

### 7. Basic Electronic devices:

(12 hrs)

*PN junction diode, Zener diode and Light Emitting Diode (LED) and their I-V characteristics, Zener diode as a regulator- Transistors and its operation, CB, CE and CC configurations, Input and output characteristics of a transistor in CE mode, Relation between  $\alpha$ ,  $\beta$  and  $\gamma$ ; Hybrid parameters, Determination of hybrid parameters from transistor characteristics; Transistor as an amplifier.*

## UNIT-V:

### 8. Digital Electronics:

(12 hrs)

*Number systems, Conversion of binary to decimal system and vice versa, Binary addition & Binary subtraction (1's and 2's complement methods), Laws of Boolean algebra, DeMorgan's laws-Statements and Proofs, Basic logic gates, NAND and NOR as universal gates, Exclusive-OR gate, Half adder and Full adder circuits.*

## REFERENCE BOOKS

- ❖ *BSc Physics, Vol.3, Telugu Academy, Hyderabad.*
- ❖ *Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.*
- ❖ *Electricity and Magnetism, B.D.Duggal and C.L.Chhabra. Shobanlal & Co.*
- ❖ *Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand & Co.,*
- ❖ *Electricity and Magnetism, R.Murugesan, S. Chand & Co.*
- ❖ *Principles of Electronics, V.K. Mehta, S.Chand & Co.,*
- ❖ *Digital Principles and Applications, A.P. Malvino and D.P.Leach, McGrawHill Edition.*

**SRI VENKATESWARA UNIVERSITY**

**B.Sc COURSE IN PHYSICS**

**IV SEMESTER – W.E.F. 2021-22**

**For Mathematics Combinations**

**Practical Course IV: Electricity, Magnetism and Electronics**

**Work load: 30 hrs**

**2 hrs/week**

**Course outcomes (Practical's):**

*On successful completion of this practical course the student will be able to;*

- *Measure the current sensitivity and figure of merit of a moving coil galvanometer.*
- *Observe the resonance condition in LCR series and parallel circuit*
- *Learn how a sonometer can be used to determine the frequency of AC-supply.*
- *Observe the variation of magnetic field along the axis of a circular coil carrying current using Stewart and Gee's apparatus.*
- *Understand the operation of PN junction diode, Zener diode and a transistor and their V-I characteristics.*
- *Construct the basic logic gates, half adder and full adder and verify their truth tables. Further, the student will understand how NAND and NOR gates can be used as universal building blocks.*

**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 Kirchoff's laws and Maximum Power Transfer theorem.*
5. *Field along the axis of a circular coil carrying current-Stewart & Gee's apparatus.*
6. *PN Junction Diode Characteristics*
7. *Zener Diode –V-I Characteristics*
8. *Zener Diode as a voltage regulator*
9. *Transistor CE Characteristics- Determination of hybrid parameters*
10. *Logic Gates- OR,AND,NOT and NAND gates. Verification of Truth Tables.*
11. *Verification of De Morgan's Theorems.*
12. *Construction of Half adder and Full adders-Verification of truth tables*

## **RECOMMENDED CO-CURRICULAR ACTIVITIES:**

### *MEASURABLE*

- ❖ *Assignments (in writing and doing forms on the aspects of syllabus content and outside the syllabus content. Shall be individual and challenging)*
- ❖ *Student seminars (on topics of the syllabus and related aspects (individual activity))*
- ❖ *Quiz (on topics where the content can be compiled by smaller aspects and data (Individuals or groups as teams))*
- ❖ *Field studies (individual observations and recordings as per syllabus content and related areas (Individual or team activity))*
- ❖ *Study projects (by very small groups of students on selected local real-time problems pertaining to syllabus or related areas. The individual participation and contribution of students shall be ensured (team activity))*

### *GENERAL*

- ❖ *Group Discussion*
- ❖ *Visit to Research Stations/laboratories and related industries*
- ❖ *Others*

## **RECOMMENDED ASSESSMENT METHODS**

*Some of the following suggested assessment methodologies could be adopted;*

- ❖ *The oral and written examinations (Scheduled and surprise tests),*
- ❖ *Practical assignments and laboratory reports,*
- ❖ *Observation of practical skills,*
- ❖ *Efficient delivery using seminar presentations,*
- ❖ *Viva voce interviews.*

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**IV SEMESTER**  
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**For Mathematics Combinations**  
**Course V: MODERN PHYSICS**

**Work load: 60hrs per semester**

**4 hrs/week**

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**Course outcomes:**

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

- ❖ *Develop an understanding on the concepts of Atomic and Modern Physics, basic elementary quantum mechanics and nuclear physics.*
- ❖ *Develop critical understanding of concept of Matter waves and Uncertainty principle.*
- ❖ *Get familiarized with the principles of quantum mechanics and the formulation of Schrodinger wave equation and its applications.*
- ❖ *Examine the basic properties of nuclei, characteristics of Nuclear forces, salient features of Nuclear models and different nuclear radiation detectors.*
- ❖ *Classify Elementary particles based on their mass, charge, spin, half life and interaction.*
- ❖ *Get familiarized with the nano materials, their unique properties and applications.*
- ❖ *Increase the awareness and appreciation of superconductors and their practical applications.*

## **UNIT-I :**

### **1.Atomic and Molecular Physics:(12 hrs)**

*Vector atom model and Stern-Gerlach experiment, Quantum numbers associated with it, Angular momentum of the atom, Coupling schemes, Spectral terms and spectral notations, Selection rules, Intensity rules, Fine structure of Sodium D-lines, Zeeman effect, Experimental arrangement to study Zeeman effect; Raman effect, Characteristics of Raman effect, Experimental arrangement to study Raman effect, Quantum theory of Raman effect, Applications of Raman effect.*

## **UNIT-II:**

### **2.Matter waves & Uncertainty Principle: (12 hrs)**

*Matter waves, de Broglie's hypothesis, Wave length of matter waves, Properties of matter waves, Davisson and Germer's experiment, Phase and group velocities, 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),Bohr's principle of complementarity.*

## **UNIT-III:**

### **3.Quantum (Wave) Mechanics: (12 hrs)**

*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 (i) one dimensional potential box of infinite height(Infinite Potential Well) and (ii) one dimensional harmonic oscillator*

## **UNIT-IV:**

### **4.Nuclear Physics: (12 hrs)**

*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, The Shell model, Magic numbers; Nuclear Radiation detectors: G.M. Counter, Cloud chamber, Solid State detector; Elementary Particles: Elementary Particles and their classification*

## **UNIT-V:**

### **5.Nano materials: (7hrs)**

*Nanomaterials – Introduction, Electron confinement, Size effect, Surface to volume ratio, Classification of nano materials– (0D, 1D, 2D); Quantum dots, Nano wires, Fullerene, CNT, Graphene(Mention of structures and properties),Distinct properties of nano materials (Mention-mechanical,optical, electrical, and magnetic properties); Mention of applications of nano materials: (Fuel cells,Phosphors for HD TV, Next Generation Computer chips, elimination of pollutants, sensors).*

## **6.Superconductivity:**

**(5 hrs)**

*Introduction to Superconductivity, Experimental results-critical temperature, critical magnetic field, Meissner effect , Isotope effect,Type I and Type II superconductors, BCS theory (elementary ideas only),Applications of superconductors*

## **REFERENCE BOOKS**

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