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| Course title : **Physics II** | Full marks : 100 (80T + 20P) |
| Course No. : Sc. Ed. 422 | Pass marks : 28T + 8P |
| Nature of the course : Theory & Practical  Level : B.Ed. (4 Year) | Periods per week : 9 (6T + 3P) ,  Practical ( 3P) : 3pds/day/Week/gr. |
| Year : Second | Total Periods : 150  Time per period : 45 minutes |
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1. **Course Description**

This course aims to develop advanced knowledge in Physics. It is divided into two parts: theory and practical. The first part deals with concepts, principles and laws. It includes Waves and Oscillation, Sound waves and Physical optics. The theory part also focuses on Electrostatics, Current Electricity and The Universe.

The second part deals with practical activities related to Wave and Sound, Physical Optics, Electrostatics, Current Electricity and the Universe.

The students are required to secure pass marks in theory as well as practical courses separately.

1. **General Objectives**

The general objectives of the course are as follows:

1. To acquaint the students with the basic properties of Wave motion and Sound waves.
2. To make the students familiar with the theoretical aspects of Electrostatics and Current Electricity.
3. To provide in-depth knowledge about the different phenomena related to Physical Optics and the Universe.
4. **Specific Objectives and Contents**

**Part I : Theory**

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| **Specific Objectives** | **Contents** |
| * Define the term wave, wave length, amplitude, time period and frequency. * Derive arelation between velocity, frequency and wavelength of wave. * Define path difference and phase difference and derive relation between them. * Define progressive wave and express it in different ways. * Discuss the characteristics of progressive wave. * Derive differential form of wave equation * State the principle of superposition. * Define stationary wave and derive equations of it (Mathematical treatment). * Discuss the characteristics of stationary wave. * Describe the stationary waves in open and closed boundaries. * Differentiate between progressive and stationary wave. * Derive equation of interference of waves and discuss the condition of constructive and destructive interference. * Discuss the phenomenon of reflection, refraction and diffraction of sound waves. * Explain free, damped, forced oscillations and resonance. * Give some examples of resonance. * Discuss the velocity of sound wave in liquid and solid. * Derive formula for velocity of sound in a gas by using dimensional method. * Describe Newton’s formula for velocity of sound in gas and discuss the Laplace correction for this. * Discuss factors like temperature, pressure, density, humidity, motion of wind which affects the velocity of sound in a gas. * Solve numerical examples related with the above topics. | **Units I : Basic properties of waves and**  **Oscillation (10)**   * 1. Introduction and definitions   2. Path difference and phase difference   3. Equation of progressive wave and its characteristics.   4. Differential form of wave equation   5. Principle of superposition   6. Equation of stationary wave and its characteristics   7. Stationary waves in boundary   8. Equation of interference of waves.   9. Reflection, refraction and diffraction of sound waves   10. Free and damped oscillation   11. Forced oscillations and resonance   12. Consequence of resonance   13. Velocity of sound wave in liquid and   solid.   * 1. Velocity of sound in a gas   2. Newton’s formula for velocity of sound   in gas and Laplace correction   * 1. Factors affecting the velocity of sound in   gas |
| * Define musical notes, noise, overtones and harmonics. * Differentiate between musical notes and noise. * Explain the term pitch loudness and quality (or Timber) of sound. * Explain the factor effecting pitch, loudness, quality of sound. * Define intensity of sound and derive an expression of it. * Derive the relation between intensity and loudness of sound. * Define the units of loudness: bel and decibel. * Define beats and derive the beat frequency with mathematical treatment. * Derive relation to measure the frequency by means of beats. * Define Doppler effect and discuss the change in apparent frequency in following conditions: * Observer at rest and source in motion * Source at rest and observer in motion * Both the source and observer are in motion. * Discuss the applications of Doppler Effect like red shift, RADAR and SONAR.etc. * Define Infrasonic and Ultrasonic waves and discuss the applications of ultrasonic waves. * Explain noise pollution and its causes and remedy. * Define reverberation and write down the acoustics of building. * Solve numerical examples related to in course. | **Units II : Acoustic Phenomena ( 10** )  2.1 musical notes  2.2 Overtones and harmonics  2.3 Pitch and loudness and quality of  Sound.  2.4 Intensity of sound  2.5 Intensity levels: Decibel  2.6 Beats  2.7 Doppler’s effect  2.8 Applications of Doppler effect ( concept of  red shift, RADAR, SONAR etc)  2.9 Infrasonic and Ultrasonic waves  2.10 Noise pollution  2.11 Acoustic of building and reverberation of  sound. |
| * Discuss various modes of vibrations in closed pipe and open end pipe and their properties. * Explain the end correction in pipes (In both open ends and closed ends) * Determine the speed of sound by resonance tube method. * Derive velocity of transverse wave along a stretched string by dimensional analysis. * Discuss various modes of vibration in stretched string. * Explain the laws of transverse vibration of string. * Verify laws of transverse vibration of strings. * Describe the process of determination of frequency of tuning fork by Sonometer. * Solve simple numerical examples related to above topics. | **Units III : Wave in pipe and string (10)**  3.1 Waves in pipes  3.1.1 Vibration in closed pipes  3.1.2 Vibration in open end pipes  3.1.3 End correction in pipes  3.1.4 Existence of nodes and antinodes  3.1.6 Determination of the speed of sound by  Resonance tube method.  3.2 Waves in string  3.2.1 Velocity of transverse wave along a  stretched string by dimensional analysis.  3.2.2 Modes of vibration of stretched string  3.2.3 Laws of Transverse vibration of string  3.2.4 Verification of laws of vibrating strings.  3.2.5 Determination of frequency of tuning  fork by Sonometer |
| * Define wave fronts and rays * Explain Huygens’s principle and prove the laws of reflection, refraction and total internal reflection by using its principle. | **Unit IV : Huygens’s construction (5)**  4.1 Wave fronts and rays  4.2 Huygens’s principle  4.3 Applications ofHuygens’s principle  4.3.1 Laws of reflection  4.3.2 Laws of refraction |
| * Define interference and coherent source * Write the conditions for observable interference. * Derive an expression of fringe width by Young’s double slit experiment. * Explain interference in thin films * Due to reflected light * Due to transmitted light * Explain colors of thin films and blooming. * Determine the wavelength of monochromatic light by using Newton’s ring principle. * Solve numerical problems on the above given topics. | **Unit V : Interference of light wave (15)**  5.1 Introduction  5.2 Coherent source  5.3 Condition for observable interference  5.4 Young’s double slit experiment  5.5 Calculation of fringe separation  5.6 Measurement of wavelength  5.7 White light pattern  5.8 Interference in thin film  5.8.1 Colors of thin films  5.8.2 Blooming  5.8.3 Fringes produce by a wedge shaped thin  film  5.8.4 Newton’s ring |
| * Define diffraction and classify it. * Explain Fraunhoffer diffraction due to a single slit and discuss the minima and maxima and their width. * Explain diffraction grating with central maxima and nth order maxima and minima * Calculate wavelength of light using a diffraction grating. * Describe the construction of spectrometer and discuss the process of determination of refractive index of given medium by using it. * Solve numerical problems on the above given topics. | **Unit VI : Diffraction of light waves (5)**  6.1 Introduction  6.2 Fraunhoffer diffraction due to a single slit  6.3 Diffraction grating  6.4 Spectrometer |
| * Define polarization * Discuss polarized and unpolarized light with their representation. * Explain the polarization by reflection. * State Brewester’s law and prove it. * Explain double refraction and define extraordinary and ordinary ray. * Define optic axis. * Discuss the polarization by scattering. * Describe poloroid and write its applications in daily life. * Discuss the quarter wave plate and half wave plate. * Solve simple numerical examples related to above topics. | **Unit VII : Polarization of light wave (15)**  7.1 Polarization  7.2 Polarized and unpolarized light  7.3 Polarized by reflection  7.4 Brewester’s law  7.5 Double refraction  7.6 Optic axis  7.7 Polarization by scattering  7.8 Polaroid  7.8.1 Applications of polaroid  7.9 Quarter wave plate and half wave plate |
| * Discuss some process of electrification. * Describe quantization of electric charge. * Explain Modern theory of electrification. * Define electrostatic induction. * Explain the process of charging by electrostatic induction. * Describe Faraday’s Ice pail experiment. * Define and explain the term surface charge density. * Discuss action of points. * Describe van de Graff generator. | **Units VIII : Fundamentals of Electrostatics (5)**  8.1 Electrification  8.2 Quantization of electric charge  8.3 Modern theory of electrification  8.4 Electrostatic induction  8.5 Charging by electrostatic induction  8.6 Faraday’s Ice pail experiment  8.7 Surface charge density  8.8 Action of points  8.9 Van de Graff generator |
| * State and explain Coulomb’s law in electrostatics. * Define relative permittivity in terms of electrostatic force. * Write force between multiple electric charges. * Define electric field. * Explain electric field intensity and calculate electric field intensity due to a point charge. * Discuss the term electric flux. * State and explain Gauss’s theorem. * Determine the electric field intensity due to a charged sphere by using Gauss’s theorem. * Calculate the electric field intensity due to an infinite plane sheet of charge by applying Gauss’s theorem. * Calculate the electric field intensity due to a uniform linear charge distribution by applying Gauss’s theorem. * Calculate the electric field intensity due to a uniform charged cylinder by applying Gauss’s theorem. * Explain electric potential and find it due to a point charge. * Derive an expression of potential difference between two points in electric field. * Define electron volt and calculate its value in terms of joule. * Derive a relation between electric field intensity and potential gradient. * Calculate and expression of potential due to several charges. * Solve simple numerical examples related to above topics. | **Unit IX : Electrostatic Force, Field and**  **Potential (l5)**  9.1 Coulomb’s law  9.2 Relative permittivity  9.3 Force between multiple electric charges  9.4 Electric field  9.5 Electric field intensity  9.5.1 Electric field intensity due to a point  charge  9.6 Electric flux  9.7 Gauss’s theorem  9.8 Applications of Gauss’s theorem  9.9 Electric potential due to a point charge  9.10 Potential difference between two points  9.11 Electron volt  9.12 Electric field intensity and potential  gradient  9.13 Potential due to several charges |
| * Define capacitor and capacitance * Calculate the capacitance of parallel plate capacitor, co-axial spherical capacitors and co-axial cylindrical capacitor. * Define permittivity, relative permittivity, dielectric constant and dielectric strength. * Discuss the effects of dielectric on capacitances, charge and potential difference. * Classify dielectrics on the basis of molecular structures. * Explain the dielectric in an electrostatic field and also define polarization. * Derive an expression of equivalent capacitances in * Series combination * Parallel combination * Derive an expression for energy stored in capacitor and energy density. * Discuss the loss of energy in joining capacitors. * Explain sharing of charges between two capacitors. * Describe charging and discharging of a capacitor. * Discuss the following practical capacitors: * Paper capacitor * Electrolyte capacitor * Variable capacitor * Explain the process Lightning (In brief) * Discuss the uses of static electric field in following cases: * The Electrostatic precipitator * Xerography * Solve numerical problems on the above given topics. | **Unit X: Capacitors (15)**  10.1 Capacitors  10.2 Capacitance  10.2.1 Parallel plate capacitor  10.2.2 Co-axial spherical capacitors  10.2.3 Co-axial cylindrical capacitors  10.2.4 Relative permittivity  10.2.5 Dielectric strength  10.2.6 Effects of dielectric  10.3 Classification of dielectrics  10.3.1 Polar dielectrics  10.3.2 Non-polar dielectrics  10.4 Polarization of dielectric  10.5 Combination of capacitors  10.6 Energy stored in capacitor and energy  density.  10.7 Loss of energy in joining Capacitors.  10.8 Sharing of charges between two capacitors.  10.9 Charging and Discharging of a capacitor.  10.10 Practical capacitors  10.10.1 Paper capacitor  10.10.2 Electrolyte capacitor  10.10.3 Variable capacitor  10.9 Lightning  10.10 Uses of static electric field  10.10.1 The Electrostatic precipitator  10.10.2 Xerography |
| * Define the term DC current, current density, resistance, resistivity, conductance and conductivity. * Define the term temperature coefficient of resistance. * State Ohm’s law and verify it experimentally. * Discuss the mechanism of conduction and derivean expression of current relating with drift velocity. * Explain Wheat stone bridge circuit and explain the construction of P.O. box and meter bridge with necessary theory. * State Kirchhoff’s law and use it to prove the Wheat stone bridge principle. * Explain the construction and principle of potentiometer and use of it to compare the emfs’ of two cells and to determine the internal resistance of cell. * Define the term energy and power in DC circuit and derive the relation between them. * Solve simple numerical examples related to above topics. | **Units XI : Direct current circuit (10)**  11.1 Basic concept  11.1.1 DC current  11.1.2 Current density  11.1.3 Resistance  11.1.4 Resistivity  11.1.5 Conductance  11.1.6 Conductivity  11.2 Temperature coefficient of resistance  11.3 Ohm’s law and verification  11.4 Mechanism of conduction.  11.5 Superconductor  11.6 Perfect conductors  11.7 Combination of resistors  11.8 Galvanometer  11.8.1 Shunt  11.8.2 Conversion of galvanometer into an  ammeter  11.8.3 Conversion of galvanometer into a  voltmeter  11.9 Ohmmeter  11.10 Potential divider |
| * Discuss the cause of heating effect in a conductor due to the passage of electricity. * State and explain Joule’s law of heating. * Verify Joule’s law of heating experimentally. * Explain the term electric energy. * Describe the term electric power. * Explain electromotive force, internal resistance and terminal potential difference of a cell derive relation between them. * Discuss the ways of grouping of cells. * Solve simple numerical examples related to above topics. | **Unit XII: Heating effect of current and EMF**  **of Cell (5)**  12.1 Introduction  12.2 Joules law of heating  12.2.1 Experimental verification  12.3 Electric energy  12.4 Electric power  12.5 Electromotive force, internal resistance  and terminal potential difference of a cell  12.6 Grouping of cells |
| * Explain Wheat stone bridge circuit and explain the construction of P.O. box and meter bridge with theory. * State Kirchhoff’s law and use it to prove the wheat stone bridge principle. * Explain the construction and principle of potentiometer. * Compare the emfs’ of two cells by using potentiometer. * Determine the internal resistance of cell by using potentiometer. * Solve simple numerical examples related to above topics. | **Unit XIII: Electrical circuit (5)**  13.1 Wheatstone bridge circuit  13.1.1 P.O. Box  13.1.2 Meter bridge  13.2 Krichhoff’s law and application  13.3 Potentiometer  13.3.1 Applications of potentiometer |
| * Explain the Seebeck’s effect and its cause. * Discuss Thermocouples and Thermoelectric series. * Describe the variation of Thermo emf with temperature and discuss the relation connecting thermoelectric constant. * Explain the Peltier’s effect and its cause. * Discuss the Thomson’s effect and its cause. * Compare the Peltier’s effect and Thomson’s effect with Joule’s effect. * Solve simple numerical examples related to above topics. | **Unit XIV: Thermoelectric Effect (5)**  14.1 Seebeck’s effect and its cause  14.1.1 Thermocouples  14.1.2 Thermoelectric series  14.2 Variation of Thermo emf with temperature  14.3 Peltier’s Effect and its cause  14.4 Thomson’s Effect and its cause  14.5 Comparison of Seebeck’s effect, Peltier’s  effect and Thomson’s effect with Joule’s  law of heating effect. |
| * Explain the theory of electrolysis. * State and explain Faraday’s laws of Electrolysis. * Describe the experimental verification of Faraday’s laws of Electrolysis. * Discuss the relation between Electrochemical Equivalent and Chemical Equivalent. * Define Faraday’s constant in terms of gram equivalent of a substance and Avogadro’s number. * Discuss important practical applications of Electrolysis like: * Electroplating * Purification of metals * Medical application * Printing industry * Production of gases for commercial use etc. * Solve simple numerical examples related to above topics. | **Unit XV: Chemical Effect of current (5)**  15.1 Theory of Electrolysis.  15.2 Faraday’s laws of Electrolysis.  15.3 Experimental verification of Faraday’s  laws of Electrolysis.  15.4 Relation between Electrochemical  Equivalent and Chemical Equivalent.  15.5 Faraday’s constant  15.6 Important practical applications of  Electrolysis |
| * Discuss the process of determination of stellar distance and brightness of stars. * Explain the stellar spectra. * Describe birth and death of stars, life cycle of a star with emphasis on white dwarf, nova, supernova, red giant, black hole etc. * Define and explain pulsars and quasars. * Discuss the Hubble’s law. * Explain the theory of expanding universe and term red shift. * Describe the big-bang theory, pulsating theory and steady state theory. * Define and calculate the critical density of the universe. * Discuss the term dark matter distributed throughout the universe. * Solve simple numerical examples related to above topics. | **Unit XVI: The Universe (15)**  16.1 Stars  16.1.1 Stellar distance  16.1.2 Brightness of stars  16.1.3 Stellar spectra  16.1.4 Birth and death of stars  16.1.5 Pulsars and Quasars  16.2 Cosmological theories of the universe  16.2.1 Hubble’s law  16.2.2 Expanding universe   * The big bang theory * Pulsating theory * Steady state theory   16.3 Critical density  16.4 Dark matter |

***Note:*** *The figures in the parenthesis indicate the approximate teaching hours for the respective units.*

**Part II: Practical**

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| **Specific Objectives** | **Contents** |
| * Determine the velocity of sound in the lab. By resonance method. * Compare the frequency of two tuning forks using the resonance tube apparatus. * Determine the velocity of sound by resonance tube using several tuning forks and find the end correction. * Determine the frequency of the given tuning fork by sonometer method. * Determine the variation of frequency of a stretched wire with length and tension with the help of sonometer. * Verify the law of the length of sonometer wire. * Determine the frequency of AC mains by using sonometer. * Prepare and study the characteristics of musical notes. | **Unit I: Wave and sound**   * 1. Velocity of sound   2. Frequency   3. Characteristics of musical notes |
| * Determine the wavelength of sodium light by using Newton’s ring apparatus. * Use diffraction grating element to determine the wavelength of a given laser light. * Use a diffraction grating element to determine the wavelength of a given sodium light from spectrometer method. | **Unit II: Physical optics**  2.1 Interference  2.2 Diffraction  2.3 Spectrometer |
| * Determine the capacitance of a given capacitor by charging and discharging through resistor. | **Unit III: Electrostatics**  3.1 Charging and discharging capacitor. |
| * Verify Ohm’s law by using ammeter and voltmeter. * Determine the resistivity of a given resistance by using a meter bridge. * Compare the resistances of two given wires by using a meter bridge * Determine the resistivity of a given resistance wire by using Post Office Box. * Verify laws of series and parallel of resistance by using Post Office Box * Measure high resistance by substitution method.. * Compare the emfs’ of two given cells by using a potentiometer. * Calculate the internal resistance of a given cell by using a potentiometer. * Compare the resistances of two given resistance wires by using a potentiometer. | **Unit IV: Current electricity**  4.1 Ohm’s law  4.2 Resistance and resistivity  4.3 Electomotive force of a cell  4.4 Internal resistance of a cell |
| * Prepare the project related to the topics **“The universe”** as given by faculty. | **Unit V: The Universe**  5.1 Project work |

1. **Instructional Techniques**

The instructional techniques for this course are divided into two groups. First group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to specific units.

**General Instructional Techniques**

Lecture method; Discussion method; Demonstration method; Collaborative method; Problem solving; web search. Field visit.

**Specific Instructional Techniques/Activities**

The topics included in the unit XVI should be taught with audio visual and project method.

**5. Evaluation**

**Theory part**

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| **Types of questions** | **Total questions to be asked** | **Number of questions to be answered and marks allocated** | **Total marks** |
| Group A: Multiple choice items | 14 questions | 14 × 1 mark | 14 |
| Group B: Short answer questions | 6 with 2 or questions | 6 × 7 marks | 42 |
| Group C: Long answer questions | 2 with 1 or question | 2 × 12 marks | 24 |

**Evaluation : Practical Part**

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| **S.No.** | **Practical work** | **Marks allocated** |
| 1 | * Practical record | 4 |
| 2 | * Experiment * Viva | 12  4 |
| **Total** | | **20** |

**Recommended Books and References**

**Recommended Books**

Bajaj N. K. (2000); Physics; Tata MC Graw Hill publishing com. Ltd.; New Delhi

**(For Unit – XVI)**

Halliday D.,Resnick R. & Walker J. (2009); ***Fundamentals of Physics***; John Wiley and sons; New York. **( IX and X )**

Nelkon M. & Parker P. (2004); ***Advanced Level Physics***; Arnold-Heinemann Publishers Pvt. Ltd., New Delhi. **(For Unit VIII, IX, X, XI, XII, XIII, XIV& XV)**

Subramanyam N. &BrijLal (2009); ***Waves and Oscillations***; Vikas Publishing House Pvt. ltd.; New Delhi **(For Unit- I, II & III)**

Subramanyam N. and Brijlal (2009); ***A text book of Optics***; S.Chand and company Ltd.; New delhi**(For Unit-IV, V, VI & VII)**

**Recommended Books for Practical**

Arora, CL (2012), ***B.Sc. Practical***, S chand and Co., New Delhi.

Shrestha U.P. (2002), ***Certificate level Physics Practical Guide* (16th edition 2069)**, Ratna Book Distributers, Kathmandu, Nepal.

**References**

Sears, F.W., Zemanasky M.W., Young H.D., Freedman R.A. & Ford A. L.(2011); ***University***

***Physics (twelfth edition)***; Pearson Education; Singapore.

Subramanyam N. and Brijlal (2009); ***Principle of Physics***; S.Chand and company Ltd.; New Delhi,

Tewari K.K., (2012); ***Electricity and Magnetism with Electronics***; S.Chand and company Ltd.; New Delhi

Duncan T. (2008); ***Advanced Physics***; Hodder Education;London.