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| Course title : **Physics IV** | Full marks : 100 (80T + 20P) |
| Course No. : Sc. Ed. 446 | Pass marks : 28T + 8P |
| Nature of the course : Theoretical (T) & Practical (P)  Level : B.Ed. (4 Year) | Periods per week : 9(6T + 3P) ,  Practical ( 3P) : 3pds /week /gr. |
| Year : Fourth | Total Periods : 150 |
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1. **Course Description**

This course aims to develop advanced knowledge in Physics. It has two sections – theoretical and Practical. Students are required to secure pass marks independently both in Theory and Practical. The theoretical part consists of Energy and its uses, Characteristics of fuels, Lagrangian Formulation and applications, Collisions and Motion in Central Field, Relative co-ordinate systems, Atomic model, Free electron theory, Elementary Particles, Optoelectronic devices, Plasma Physics and Cosmology.

This course also includes practical works from the Energy and its uses, Elastic and Inelastic collision and Optoelectronic devices. The aim of this course is to develop knowledge and skills required to conduct Physics practical classes at Secondary School.

1. **General Objectives**

The general objectives of the course are as follows:

* To acquaint the students with the basic knowledge of Energy and fuels.
* To provide the students with a broader understanding of the different aspects of Mechanics.
* To enumerate and illustrate students with the theoretical aspects of Atomic Physics such as atomic model, free electron theory and elementary particles.
* To make familiar with different Optoelectronic devices.
* To make familiar with the different theories related to plasma physics and cosmology.
* To make the students able to solve numerical problems related to the content.

1. **Specific Objectives and Content**

**Part- I Theory**

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| **Specific Objectives** | **Contents** |  |
| * Define and explain energy and write its units. * Discuss the sources of primary energy and secondary energy. * Discuss on the energy consumption in Nepal. * Define and explain the calorific value of fuel. * Discuss on the hydro electric power, solar energy, solar devices, wind energy, energy from Bio sources and geothermal energy in Nepal. * Explain Sankey diagrams. * Define solar constant and explain the nature of solar energy. * Explain the structure and working of passive and active solar devices such as Flat plate solar panel, parabolic solar panel, Photovoltaic cell etc. * Illustrate the extraction of geothermal energy by hot dry rocks or hot dry aquifer. * Explain the energy conservation in Nepal. * Explain the demand of energy in Nepal. Draw flow diagram of energy use in Nepal * Explain energy conversion with the help of energy flow diagram for electric motor. * Explain energy conversion with the help of energy flow diagram. * Explain efficiency of an energy conversion process. Name the efficiency percentage of electric motor, generator, boiler, steam turbine and car engine and their energy change. * Explain guiding principle of energy efficient design. * Explain the energy consumption patterns of five different countries in the world * Explain energy converters in terms of First group, Second group, and Third group with suitable examples. * Define μ value * Define ventilation. * Explain Energy and entropy * Explain the terms Primary, secondary, end use & functional energy. * Discuss the energy crisis and its remedy i.e. energy conservation. * Solve numerical problems on related topics | **Unit-I Energy and its uses 20hrs**   * 1. Introduction.   2. Energy sources – energy conversion   3. Energy converters   4. Calorific value   5. Energy consumption – energy use in Nepal   6. Fuels and pollution – hydroelectric power   7. Solar energy   1.8 Solar devices  1.9 Wind energy   * 1. Energy from bio sources   1.11 Geothermal energy  1.12 Sankey diagrams  1.13 Efficiency  1.14μ-value  1.15 Energy and entropy   * 1. Primary, secondary, use & functional energy.   1.17 Energy crisis and Conservation of energy. |  |
| * Explain the characteristics of fuels such as energy density, transportability, time and feasibility. * Explain the consequences of fuel use. * Explain the thermal pollution and other sources of pollution. * Explain the risks of fuel production. * Explain the factors in relation with the prediction of future fuel:   -Population growth  -Increasing expectations  -Making savings | **Unit II Characteristics of fuels 20hrs**   * 1. Characteristics of fuels   2.1.1Energy density  2.1.2 Transportability  2.1.3 Time   * + 1. Feasibility   1. Consequences of fuel use   2. Pollution   -Thermal pollution  -Air pollution  -Water pollution   * 1. Ozone layer * Formation * Causes of depletion * Remedies of depletion   1. Other sources of pollution   2. Greenhouse effect   3. Risks in fuel production   2.6 Making prediction of future fuel |  |
| * Describe Constraints with example. * Discuss the degree of freedom. * Derive generalized co-ordinates with generalized notations of displacement, velocity, acceleration, momentum, force and potential. * Explain Lagrangian Formulation * Derive Langrange’s equations. * State and prove D’Alembert’s principles. * Derive Langrange’s equations from D’Alembert’s principle. * Discuss the applications of Lagrange’s equations of motion in following cases: * Linear harmonic oscillator * Simple pendulum   Conservation theorems   * Conservation of linear momentum * Conservation of angular momentum * Conservation of energy * Solve numerical problems on related topics | **Unit III Lagrangian Formulation and**  **Applications 20hrs**   * 1. Constraints   2. Degree of freedom   3. Generalized co-ordinates   4. Generalized notations   5. Lagrangian Formulation   6. Langrange’s equations   7. D’Alembert’s principles   8. Langrange’s equations from D’Alembert’s principles.   9. Applications of Lagrange’s equations of motion      1. Linear harmonic oscillator      2. Simple pendulum      3. Conservation theorems         1. Conservation of linear momentum         2. Conservation of angular momentum         3. Conservation of energy |  |
| * Discuss collision of particles * Explain collisions in laboratory and center of mass systems * Describe cross section * Explain Rutherford scattering * Explain motion in central force field * Discuss motion in arbitrary potential field * Describe equation of orbits * Explain Kepler’s laws of planetary motion * Solve numerical problems on related topics | **Unit IV Collisions and Motion in Central Field**  **15hrs**  4.1 Collision of particles  4.2 Collision in laboratory and center of mass  systems  4.3 cross section  4.4 Rutherford scattering  4.5 Motion in central force field  4.6 Motion in arbitrary potential field  4.7 Equation of orbits  4.8 Kepler’s laws of planetary motion |  |
| * Discuss the Inertial versus Non-inertial systems. * Describe translational motion and its co-ordinate system * Derive rotating co-ordinate systems * Explain Coriolis force * Derive Focault’s pendulum * Solve numerical problems on related topics | **Unit V Relative co-ordinate systems 5hrs**  5.1 Inertial versus Non- inertial systems  5.2 Translational motion and translational co-  ordinate system  5.3 Rotating co-ordinate systems  5.4 Free fall of a body on earth’s surface  6.4.1 Coriolis force  5.5 Focault’s pendulum |  |
| * Review of Bohr’s model of the hydrogen atom and Review of expression for radii of the stationary orbits, total energy of the electron in nth orbit. * Write down the limitations of Bohr’s model. * Describe Sommerfeld non-relativistic atom. * Discuss Sommerfeld relativistic correction. * Explain the Vector atomic model on the basis of spatial quantization and spinning electron. * Describe quantum numbers associated with the vector atom model. * Solve numerical problems related to * Sommerfeld’s theory * Vector atom model * Application of vector model of atom. | **Unit VI Atomic model 20hrs**   * 1. Review of Bohr’s theory   2. Limitations of Bohr's model.   6.3 Somerfield atomic model  6.3.1 non- relativistic atom  6.3.2 relativistic correction  6.4 The Vector atom model  6.4.1 Spatial quantization.  6.4.2 Spinning electron  6.5 Quantum numbers associated  with the Vector atom model  6.5.1 The principal quantum  number (n)  6.5.2 The orbital (azimuthal)  quantum number(l)  6.5.3 The spin quantum  number(s)  6.5.4 Total angular momentum  quantum number (j)  6.5.5 Magnetic orbital quantum  number (ml)  6.5.6 Magnetic spin quantum  number (ms)  6.5.7 Magnetic total angular  momentum number (mj) |  |
| * Explain free electron theory and its applications such as   -Electrical conduction in metal  -Thermal conductivity   * Discuss the criticism of free electron theory. * Explain the phenomenon of thermo- ionic emission * Describe Thermionic valves such as vacuum tube diode with their construction and functions. * Explain the characteristics of a diode valve. * Discuss the action of vacuum tube diode as rectifier. * Explain vacuum tube triode valve with their construction and functions. * Explain the characteristics of a Triode valve. * Describe bonding in crystals like   -ionic bond  -covalent bond  -Metallic bond  -Molecular bond  -Hydrogen bond   * Explain superconductors and superconductivity with some properties like Magnetic effect and Messiner effect and quantum flux. * Describe briefly Nano-science and technology * Discuss the applications of nanotechnology with its potential. * Solve some numerical problems on related topics. | **Unit VII Free electron theory 15hrs**   * 1. Free electron theory   2. Applications   3. Criticism   4. Sources of electron   7.4.1 Thermo ionic emission  7.4.2 Thermo ionic valves  7.4.2.1 Vacuum tube diode  7.4.2.2 Vacuum tube triode  7.5 Bonding in crystals  7.6 Superconductivity  7.7 Introduction to Nano science and  Technology  7.8 Application of nanotechnology and its  Potential. |  |
| * Describe particles & antiparticles * Explain types of force * Discuss Grand Unified Theory (GUT) * Describe particle classification. | **Unit VIII Elementary particles 8hrs**  8.1 Particles & antiparticles  8.2 Types of force  8.3 Grand Unified Theory (GUT)  8.4 Classification. |  |
| * Describe the function of photo transistor * Explain the working of photoconductors * Explain Liquid crystal display (LCD) | **Unit IX Optoelectronic devices 7hrs**  9.1 Photo transistor  9.2 Photoconductors  9.3 Liquid crystal display (LCD) |  |
| * Describe Cosmic rays and its discoveries. * Discuss different theory of origin of cosmic rays. * Explain the variation of intensity of cosmic rays with latitude effect, east-west effect and altitude effect. * Discuss the various types of cosmic rays as   -Primary cosmic rays  -secondary cosmic rays   * Explain cosmic rays showers * Describe Cascade theory of showers and following processes involved during it:   -radiative collision  -pair production | **Unit X Plasma Physics 20hrs**  10.1 Cosmic rays  10.2 Discovery of cosmic rays  10.3 Origin of cosmic rays  10.4 Explosion theory  105 Origin from sun  10.6 Origin from cosmic rays stars  10.7 Latitude effect  10.8 The east-west effect (azimuth effect)  10.9 Altitude effect  10.10 Types of cosmic rays  10.11 Cosmic ray showers  10.12 Cascade theory of showers |  |

***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 angle of dip in the laboratory by using dip circle. * Determine the pole strength and magnetic moment of a bar magnet by locating the neutral points keeping North Pole pointing towards the geographical south. * Determine the pole strength and magnetic moment of a bar magnet by locating the neutral points keeping North Pole pointing towards geographical north. * Use of deflection magnetometer to determine the pole strength and magnet moment of a bar magnet in TanA position. * Use of deflection magnetometer to determine the pole strength and magnet moment of a bar magnet in TanB position. * Use of deflection magnetometer to compare the magnetic moments of given bar magnets. * Use of oscillation magnetometer to determine pole strength and magnetic moments of a bar magnet. * Use of oscillation magnetometer to determine pole strength and magnetic moments of a bar magnet to compare magnetic moments of two bar magnets. | 1. Estimate the Calorific value of supplied material. Study and interpret the pattern of temperature of graph drawn.   **Supplied materials:**   1. Wood 2. Wax 3. Paper pieces 4. Kerosene oil 5. Cow dung etc. 6. Study and interpret the supplied data and charts. |
| * Study the construction, working and maintenance of the solar panel. * Study the consumption of petrol oil and diesel from particular nearby petrol pump.   (Include model no., production capacity, service type, draw back, efficiency etc.)   * Study the pattern of annual electrical energy consumption in house. * Study the energy consumption of same power rated electric bulb and fluorescent lamp. * Study the solid waste management of Kathmandu municipality. * Prepare a case study of the student. * Survey of teaching physics at secondary level. * Make a report on any two optoelectronics devices useful to our daily-life. * Make a report on life history and contributions of any one of the Physicist. | * Study the construction, working and maintenance of the solar panel. * Study the consumption of petrol oil and diesel from particular nearby petrol pump.   (Include model no., production capacity, service type, drawback, efficiency etc.)   * Study the pattern of annual electrical energy consumption in house. * Study the energy consumption of same power rated electric bulb and fluorescent lamp. * Study the solid waste management of Kathmandu municipality. * Study one dimensional elastic collision using two hanging solid spherical balls. * Make a report on any two optoelectronics devices useful to our daily-life. * Make a report on life history and contributions of any one of the Physicist. |

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.

**4.1. General Instructional Techniques**

* Lecture method;
* Discussion method;
* Demonstration method;
* Collaborative method;
* Problem solving;
* Internet search
* Project method

**4.2. Specific Instructional Techniques/Activities**

The topics included in the unit- I should be taught with project method.

1. **Evaluation**

**Theory part**

The annual examination of theoretical part will be held by the Office of the Controller of Examinations. The types and number of question to be included in the annual examination are given below.

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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 |

**Practical Part**

The marks allocated to practical part are given in the following table.

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| **Examination** | **Area of examination** | **Marks** | **Total** |
| Internal | Regularity | 1 | 4 |
| Regular practical performance | 1.5 |
| Record Book | 1.5 |
| External | Experiment | 12 | 16 |
| Viva | 4 |

**Recommended Books and References**

**Text books:**

Verma H.C. (2010). ***Concept of Physics. (Part II).***BharatiBhawan publishers & distributers; Patana; India **(For Unit I, II, III, IV, V, VI, VII& IX)**

Murugesan , R , S. Kiruthiga,(2012)Modern Physics ,New Delhi. S. Chand Publications.

**(For Unit X&XI)**

Thereja, B.L (2008) Basic electronics and solid states New Delhi. S. Chand Publications

**(For Unit VIII&XII)**

**References:**

Sears, F.W., Zemanasky M.W., Young H.D. , Freedman R.A. & Ford A. L.

(2009); University Physicss; Pearson Education; Singapore.

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

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

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

Gupta S.K. and Pradhan J.M. (2009). A text book of physics (Part I &II). Surya publication; Jalandhar; India

Maheshwori .A and Parmar .G (2008), A test book of energy, ecology, environment and society, New Delhi: Anmol publication Pvt. Ltd.( unit 1 and 2)

Murugeshan R. (2009), Modern physics,New Delhi: S.Chand and company Ltd., ( unit 3,4,5,6)

Saxena B.S., Gupta R. and Saxena P.N. (2009), Fundamentals of solid state,Meerut: PragatiPrakashan. ( unit 4)

Theraja B.L. (2008), Basic electronics and solid states, New Delhi: S. Chand and Company Ltd.( units 8&9)

Mehta V.K. (2009), Principles of electronics,New Delhi: S.Chand and Co. Ltd.

Nelkon M. and Parker P. (2009), Advanced level of physics (fifth edition),New Delhi: GulabVazirani for Arnold- Heinemann publication.

Rajan J.B. (2009), Atomic physics,New Delhi: S.Chand& Company Ltd. Subrahmanyam N. and BrijLal (2009), Principles of physics,New Delhi: S.Chand publications.