Rayat Shikshan Sanstha

# SADGURU GADGE MAHARAJ COLLEGE, KARAD

(An Autonomous College- Affiliated to Shivaji University, Kolhapur)

**Revised B. Sc. Part-III Physics (CBCS) Syllabus w. e. f. June 2024**

## 1. Structure of Syllabus:

### B.Sc.-III Semester-V

| Paper Title | Theory | | | Practical | | |
|---|---|---|---|---|---|---|
| | Paper Code | Lectures Per week | Credits | Paper Title | Lectures per week | Credits |
| **Compulsory Papers** | | | | - | 10 | 4 |
| Mathematical Physics | NBPT22-501 | 3 | 2 | | | |
| Quantum Mechanics | NBPT22-502 | 3 | 2 | | | |
| Classical Mechanics Relativity and Electrodynamics | NBPT22-503 | 3 | 2 | - | 10 | 4 |
| **Paper-X: Elective Papers (Any one)** | | | | | | |
| Electrical Winding, Analog Circuits and Instrumentation | NBPT22-504A | 3 | 2 | | | |
| Electrical Winding, Digital Electronics | NBPT22-504B | | | | | |
| Electrical Winding, Modern Physics | NBPT22-504C | | | | | |
| Numerical Skills in Physics | SECCPT505 | 2 | 1 | SECCPP508 | 4 | 1 |

### B.Sc.-III Semester-VI

| Paper Title | Theory | | | Practical | | |
|---|---|---|---|---|---|---|
| | Paper Code | Lectures Per week | Credits | Paper Title | Lecture sper week | Credits |
| **Compulsory Papers** | | | | NBPP22-606 | 10 | 4 |
| Nuclear and Particle Physics | NBPT22-601 | 3 | 2 | | | |
| Solid State Physics | NBPT22-602 | 3 | 2 | | | |
| Atomic, Molecular and Astrophysics | NBPT22-603 | 3 | 2 | NBPP22-607 | 10 | 4 |
| **Elective Papers (Any one)** | | | | | | |
| Solar Energy and Wind Energy Studies | NBPT22-604A | 3 | 2 | | | |
| Solar Energy and Energy Harvesting | NBPT22-604B | | | | | |
| Solar Energy, Transducers and Sensors | NBPT22- 604C | | | | | |
| Entrepreneurship Development | SECCPT605 | 2 | 1 | SECCPP608 | 4 | 1 |

## Title of Papers

| Semester-V | | | Semester-VI | |
|---|---|---|---|---|
| **Sr. No.** | **Paper Code** | **Paper Name** | **Paper Code** | **Paper Name** |
| 1 | NBPT22-501 | Mathematical Physics | NBPT22-601 | Nuclear and Particle Physics |
| 2 | NBPT22-502 | Quantum Mechanics | NBPT22-602 | Solid State Physics |
| 3 | NBPT22-503 | Classical Mechanics, Relativity and Electromagnetics | NBPT22-603 | Atomic, Molecular and Astrophysics |
| **Elective Papers (Any one)** | | | | |
| 4 | NBPT22-504A<br><br>NBPT22-504B<br><br>NBPT22-504C | Electrical Winding, Analog Circuits and Instrumentation<br><br>Electrical Winding, Digital Electronics<br><br>Electrical Winding, Modern Physics | NBPT22-604A<br><br>NBPT22-604B<br><br>NBPT22-604C | Solar Energy and Wind Energy Studies<br><br>Solar Energy and Energy Harvesting<br><br>Solar Energy, Transdusers and Sensors |
| 5 | SECCPT505 | Numerical Skills in Physics | SECCPT605 | Entrepreneurship Development |
| 6 | NBPP22-506 | Practical Paper V | NBPP22-606 | Practical Paper VII |
| 7 | NBPP22-507 | Practical Paper VI | NBPP22-607 | Practical Paper VIII |
| 8 | SECCPP508 | Numerical Skills Practical | SECCPP608 | Entrepreneurship Development (Industrial Visit and Project Proposal Writing) |

# Evaluation Structure: B. Sc. III Semester-V & VI (Physics)

| Semester | Theory | | | Practical | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | **Paper No. & Code** | **SEE** | **CCE** | **Paper Code** | **Exam** | **Journal** | **Day to Day Performance** | |
| **V** | Paper IX: NBPT22- 501 | 40 | 10 | **Practical examination will be Annually** | | | | - |
| | Paper X: NBPT22- 502 | 40 | 10 | | | | | - |
| | Paper XI: NBPT22- 503 | 40 | 10 | | | | | |
| | Paper XII: NBPT22- 504 A | 40 | 10 | | | | | |
| | **Total** | **160** | **40** | | | | | **200** |
| **VI** | Paper XIII: NBPT22- 601 | 40 | 10 | NBPP22-606 + Seminar | 80 | 10 | 10 | **100** |
| | Paper XIV: NBPT22- 602 | 40 | 10 | NBPP22-607+ Seminar | 80 | 10 | 10 | **100** |
| | Paper XV: NBPT22- 603 | 40 | 10 | | | | | |
| | Paper XVI: NBPT22- 604A | 40 | 10 | | | | | |
| | **Total** | **160** | **40** | | | | | **200** |
| **Total (Sem. V + VI)** | | **320** | **80** | | **80** | **10** | **10** | **600** |

# Question Paper Pattern

**Rayat Shikshan Sanstha's**

# Sadguru Gadge Maharaj College, Karad

**(An Autonomous College, Affiliated to Shivaji University, Kolhapur)**

**SEE Examination, March/April-2024-25**

**Course Name - B.Sc.- III Semester – V**

**Subject - Physics,**

**Subject Code No. - NBPT22-501 (Mathematical Physics)**

**Day:** **Total Marks: 40**

**Date:** **Time: 02 Hours**

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**Q.1) Choose correct alternative from the following. 08 marks**

**Q.2) Attempt any two of the following. (Given Three) 16 marks**

**Q.3) Attempt any four of the following. (Given Six) 16 marks**

# B. Sc. III Semester V

## NBPT22-501: Mathematical Physics

**Theory: Lectures 30 Hours**

**Marks -50 (Credits: 02)**

**Learning Objectives:**

1. To understand wave method of solving partial differential equations.
2. To study applications of partial differential equations.
3. To study Cartesian, spherical polar and cylindrical co-ordinate systems.
4. To understand Beta and Gamma functions.

**UNIT-I**

**1. Partial Differential Equation (9)**

Introduction to differential equations, Method of separation of variables for solving second order partial differential equations, Form of two dimensional Laplace differential equation in Cartesian coordinates and its solution, Three dimensional partial differential equation in Cartesian coordinates and its solution,

**2. Applications of Partial Differential Equations (6)**

The differential equation of progressive wave and its solution, Equation of Vibrating String, One Dimensional Heat Flow, Two Dimensional Heat Flow.

**UNIT-II**

**3. Orthogonal Curvilinear Coordinates (10)**

Introduction to Cartesian, spherical polar and cylindrical co-ordinate systems, concept of orthogonal curvilinear co-ordinates, unit tangent vectors, arc length, area and volume elements in orthogonal curvilinear co-ordinate system, gradient, divergence, curl, del and Laplacian in orthogonal curvilinear co-ordinate system, extension of gradient, divergence, curl, del and Laplacian in Cartesian, spherical polar and cylindrical coordinate systems.

**4. Some Special Integrals (5)**

Gamma function, Properties of Gamma function, Beta function, Properties of Beta function, Relation between Beta and Gamma functions, Error function (Probability Integral).

**Learning outcomes:**

Students will be able to

1. Solve partial differential equations.
2. Understand applications of partial differential equations.
3. Understand Cartesian, spherical polar and cylindrical co-ordinate systems.
4. Understand Beta and Gamma functions.

**Reference Books**


1. Advanced calculus, Robert C. Wrede, Murray Spiegel.
2. Differential Equations with Modeling Applications, Dennis G. Zill.
3. Differential Equations, Ramachandra Rao, H. R. Anuradha.
4. Partial Differential Equations, N. P. Bali.
5. Mathematical Physics, B. S. Rajput.
6. Mathematical Methods for Physicists, Arfken, Weber, 2005, Elsevier. **(Unit I, II, III)**
7. Mathematical Methods for Scientists and Engineers, McQuarrie, 2003, Viva Books.
8. Mathematical Physics, H. K. Das, Rama Varma. **(Unit I, II, III & IV)**
9. Essential Mathematical methods, K. F. Riley, M. P. Habson, 2011, Cambridge.
10. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Books/Cole.

**NBPT22-502: Quantum Mechanics**
**Theory: Lectures 30 Hours**
**Marks -50 (Credits: 02)**

**Learning Objectives:**

1. To understand wave particle duality, uncertainty principle and its applications.
2. To study Schrödinger wave equations, Eigen values and Eigen functions.
3. To study the applications of Schrödinger wave equation.
4. To understand operators, Eigen values and Eigen functions of $L^2$ and Lz operators Commutation relation between x and p and the Hilbert space and wave functions.

**Unit-I:**

**1. Matter Waves (7)**

Wave particle duality, De-Broglie hypothesis of matter waves, Derivation of wavelength of matter wave, Concept of wave packet, Relations between group velocity - phase velocity and group velocity-particle velocity, Davisson and Germer experiment, Uncertainty principle (statement only): position–momentum and energy- time, Application of uncertainty principle-nonexistence of free electrons in the nucleus.

**2. Schrodinger's Wave Equation (8)**

Wave function and its physical interpretation, Condition of physically acceptable wave function, Normalized and orthogonal wave functions, Schrödinger time dependent and time independent (steady state) wave equations in 1D and 3D, Probability current density (continuity equation), Eigen values and Eigen functions, Expectation values of dynamic variables.

**Unit-II:**

**1. Applications of Schrodinger's Equation (7)**

Particle in a rigid box (infinite potential well) in one dimension and three dimension, Step potential- reflection and transmission coefficients, Potential barrier-tunneling effect (qualitative treatment), Schrodinger equation for Hydrogen atom in spherical polar coordinates, Separation of radial and angular parts, Solution of radial part of Schrodinger's equation - Energy Eigen values.

**2. Operators and Mathematical Tools in Quantum Mechanics (8)**

Definition of an operator, Position operator (x), Linear momentum operator (p), Hamiltonian operator (H), Angular momentum operator (L)–components of angular momentum operator in Cartesian coordinate system, Ladder operators, Eigen values of $L_z$ and $L^2$ (use equations for $L^2$ and $L_z$ in spherical polar coordinates), Commutation relation between x and p, The Hilbert space and wave functions: The linear vector space, The Hilbert space, Dimension and basis of a vector space, Square integrable functions (Wave functions)

**Learning outcomes:** Students will be able to

1. Understand Concept of wave packet and Uncertainty principle.
2. Understand Schrödinger time dependent and time independent (steady state) wave equations
3. Understand applications of Schrodinger equation.
4. Understand operators, Commutation relations and Hilbert space.

**Reference Books**


**1.** Quantum Mechanics Concept and Applications-Nouredine Zettili (2nd Edition, A John Wiley and Sons, Ltd., Publication) **(Units I and IV)**

**2.** Quantum Mechanics-Satya Prakash and C. K. Singh (KedarNath and RamNath Co. Publisher) **(Units I and IV)**

**3.** Quantum Mechanics-V. Murugan (Pearson Publisher) **(Unit III)**

**4.** Quantum Mechanics- G. Aruldas (2nd Edi., PHI learing Pvt. Ltd.Publisher)**(Units I, II & III)**

**5.** A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, 2nd Edn.,2010, Tata McGraw Hill, **(Units II and III)**

**6.** Quantum Mechanics Theory and Applications, A. K. Ghatak and S. Lokanathan, Third Edn.1995, Macmillan India Ltd.**(Unit IV)**

**NBPT22-503: Classical Mechanics, Relativity and Electrodynamics**
**Theory: Lectures 30 Hours**
**Marks -50 (Credits: 02)**

**Learning Objectives:** To understand

1. Langrangian formulation, D'Alembert's principle and applications.
2. Moving co-ordinate system and pseudo forces.
3. Concepts in special theory of relativity.
4. Concept of motion of charged particles in uniform electric and magnetic fields.

**UNIT I**

**1. Langrangian and Hamiltonian Formulation: (8)**

Constraints, degrees of freedom, generalized co-ordinates, principle of virtual work, D'Alembert's principle, Lagrange's equation from D'Alembert's principle, Applications of Langrange's equation: Motion of particle in free space, Atwood's machine and Bead sliding on rotating wire.

**2. Hamiltonian Formulation: (7)**

Hamilton's principle, deduction of Hamilton's principle from D'Alembert's principle, deduction of Langrange's equation from Hamilton's principle, Applications - Shortest distance between two points in a plane, Brachistochrone problem.

**UNIT II**

**3. Special theory of Relativity (7)**

Inertial and Non-Inertial frame of references, Galilean transformation equations, Michelson-Morley experiment, Ether hypothesis, Postulates of special theory of relativity, Lorentz transformation equations, Relativistic addition of velocities, Length contraction, Time dilation, variation of mass with velocity, mass energy relation.

**4. Charged particle Dynamics (8)**

Poisson's and Laplace's equation and their physical significance, Laplace equation in one dimension and it's solutions, non-relativistic motion of charged particles- in uniform electric field E, magnetic field B, crossed uniform electric field E and magnetic field B, Relativistic motion of charged particles- in constant electric field E, magnetic field B.

**Learning Outcomes:**

**UNIT I**: Students will be able to:

1. Define constraints, Degree of freedom and generalized coordinates etc.
2. Understand principle of virtual work and D'Alembert's principle.
3. Derive Lagrange's equation from D'Alembert's principle.
4. Understand application of Langrange's equation

**UNIT II:** Student will be able to:

1. Define Inertial and Non–Inertial reference frames
2. Understand Michelson Morley experiment
3. Define Relativistic addition of velocities, Length contraction, Time dilation.
4. Describe mass energy relation
5. Define Poisons and Laplace equation and their physical significance
6. Describe motion of charged particles in electric and magnetic fields

**Reference books**


**1.** Classical mechanics, Goldstein Herbert, Narosa public/Person education.2018 **(Unit 2.1)**

**2.** Classical Mechanics – N. C. Rana and P. S. Joag **(Unit 1.1)**

**3.** Classical Mechanics – Gupta, Kumar and Sharma. **(Unit 2.1)**

**4.** Classical mechanics – P.V. Panat **(Unit 1.1)**

**5.** Introduction to Classical Mechanics- R.G.Takawale and P.S. Puranik **(Unit 2.1)**

**6.** Classical Electrodynamics, Puri S.P. Tata McGraw Hill **(Unit 2.2)**

**7.** Classical Electrodynamics, Jackson J.D. Wiley India, 2007 **(Unit 2.2)**

**NBPT22-504A: Electrical Winding, Analog Circuits and Instrumentation**
**Theory: Lectures 30 Hours**
**Marks -50 (Credits: 02)**

**Learning Objectives:** To understand

1. Electrical supply system and Introduction to re-winding.
2. Rewinding procedure of motors.
3. Amplifier, power supply and oscillator.
4. Basic theory and applications of Cathode Ray Oscilloscope.

**UNIT-I**

**1. Electrical supply system** and **Introduction to re-winding:** **(8)**

AC single phase and 3-phase supply, Difference between single and three phase supply in respect of voltage, current and power, Safe handling of stripping/winding tools, BIS rules for winding/rewinding, Types of winding wires, Types of insulating materials, Insulating materials as per class of insulation (A/E/B/C/F/H), Reasons for insulation failure in electrical machines.

**2. Rewinding procedure of motors:** **(7)**

Procedure followed for re-winding of all kind of electric motors like single phase AC motors, pump motors, ceiling fan motors, table fan motors, submersible pump motor, etc., various methods of inserting coil into the slots. Preparation of winding table, connection diagram, winding diagram for given Motor, Testing for continuity and insulation.

**Unit-II**

**1. Transistor Amplifier and Oscillator** **(8)**

Single stage transistor CE amplifier, load line analysis- D.C. load line, A.C. load line and Q point. Basic Concept of feedback in amplifier, Types of feedback, Barkhausen's criterion for sustained oscillations, Oscillatory circuit (tank circuit), essentials of transistor oscillator, sinusoidal oscillators-phase shift oscillator, Colpitts oscillator, Crystal oscillator using transistors.

**2. Basic Theory and Applications of Cathode Ray Oscilloscope** **(7)**

Introduction to CRO, Block diagram of CRO, Principle, Construction and working of CRT, Applications of CRO: measurement of A.C. and D. C. voltages, periodic time, frequency and phase difference, Lissajous figures.

**Learning Outcomes:** Students will able to

1. Explain single phase and 3-phase supply electrical supply system.
2. Explain rewinding procedure of motors.
3. Explain Amplifier, power supply and oscillator.
4. Explain basic theory and applications of Cathode Ray Oscilloscope.

**Reference Books**


**1.** Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill. **(Unit I, II, III, )**

**2.** Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill. (**Unit I, II)**

**3.** Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.

**NBPT22-504B: Electrical Winding, Instrumentation and Digital Electronics**
**Theory: Lectures 30 Hours**
**Marks-50 (Credits: 02)**

**Learning Objectives:** To understand

1. Single phase and 3-phase supply electrical supply system.
2. Rewinding procedure of motors.
3. Working of operational Amplifier and Timer.
4. Derived gates.

**UNIT-I**

**1. Electrical supply system** and **Introduction to re-winding:** **(8)**

AC single phase and 3-phase supply, Difference between single and three, phase supply in respect of voltage, current and power, Safe handling of stripping/winding tools, BIS rules for winding/rewinding, Types of winding wires, Types of insulating materials, Insulating materials as per class of insulation (A/E/B/C/F/H), Reasons for insulation failure in electrical machines, Method of stripping the old winding, Methods of preparing the winding former and the coils. Preparation of winding data as per old winding and rating plate of machine

**2. Rewinding procedure of motors:** **(7)**

Procedure followed for re-winding of all kind of electric motors like single phase AC motors, pump motors, ceiling fan motors, table fan motors, submersible pump motor, etc., various methods used of inserting coil into the slots. Preparation of winding table, connection diagram, winding diagram for given Motor, Testing for continuity and insulation.

**Unit-II:**

**3. Operational Amplifier:** **(7)**

Differential amplifier and its type, Op-Amp, Block diagram of an Op- Amp. Op-Amp parameters, Characteristics of an ideal and practical Op-Amp (IC 741), Applications of Op-Amps: Inverting amplifier and Non-inverting amplifier, Adder, Substractor, Differentiator, Integrator.

**4. Digital Electronics and Timer IC** **(8)**

Review of number system, Binary number system, Binary Arithmetic, 1's and 2's Compliment Method, Octal number System, Hexadecimal number System. Review of basic logic gates, Derived logic gates (NOR, NAND, XOR and XNOR gates), NAND and NOR gates as universal gates, De Morgan's theorems. Block diagram of IC 555, IC 555 Pin configuration, Applications of IC 555 as astable and monostable multivibrator.

**Learning Outcomes:** Students will able to explain

1. Single phase and 3-phase supply electrical supply system.
2. Rewinding procedure of motors.
3. Working of operational Amplifier and Timer.
4. Derived gates.

**Reference Books**


**1.** Digital Principles & Applications, A.P. Malvino, D.P. Leach &Saha, 7th Ed., 2011,Tata McGraw Hill **(Unit III)**

2. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.

3. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Ltd.

**4.** OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. **(Unit I)**

**5.** Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill. (**Unit I, II, III)**

**6.** Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill. **(Unit I, II, III)**

**NBPT22-504C: Electrical Winding, Instrumentation and Modern Physics**
**Theory: Lectures 30 Hours**
**Marks -50 (Credits: 02)**

**Learning Objectives:** To understand

1. Single phase and 3-phase supply electrical supply system.
2. Rewinding procedure of motors.
3. Concept of optical fibre.
4. Number system.

**UNIT-I**

**1. Electrical supply system** and **Introduction to re-winding: (8)**

AC single phase and 3-phase supply, Difference between single and three, phase supply in respect of voltage, current and power, Safe handling of stripping/winding tools, BIS rules for winding/rewinding, Types of winding wires, Types of insulating materials, Insulating materials as per class of insulation (A/E/B/C/F/H), Reasons for insulation failure in electrical machines, Method of stripping the old winding, Methods of preparing the winding former and the coils. Preparation of winding data as per old winding and rating plate of machine

**2. Rewinding procedure of motors: (7)**

Procedure followed for re-winding of all kind of electric motors like single phase AC motors, pump motors, ceiling fan motors, table fan motors, submersible pump motor, etc., various methods used of inserting coil into the slots. Preparation of winding table, connection diagram, winding diagram for given Motor, Testing for continuity and insulation.

**UNIT-I**

**1. Optical Fibers (7)**

Principle and structure, types of optical fibers, numerical aperture (definition only) and pulse dispersion in step index fiber, fiber optic communication system (qualitative treatment only), advantages of optical fibers.

**2. Number System: (8)**

Review of number system, Binary to decimal conversion, Decimal to binary conversion, One's Complement Representation, Two's Complement Representation ,Binary Arithmetic, Octal to decimal conversion, Decimal to octal conversion, Octal to Binary conversion, Binary to Octal conversion, Hexadecimal to Decimal conversion, Decimal to hexadecimal conversion, Hexadecimal to Binary conversion, Binary to Hexadecimal conversion.

**Learning Outcomes:** Students will be able to explain

1. Electrical supply system and Introduction to re-winding.
2. Rewinding procedure of motors.
3. Concept of optical fibre.
4. Number system.

**References:**


**1.** Modern Physics by BVN Rao, Wiley Eastern Limited, 1993. **(Unit I)**

**2.** Concepts of Modern Physics by Arthur Beiser, Shobhit Mahajan, S Rai Chaudhury, Seventh Edition, McGraw Hill Education Pvt. Ltd. 2015. **(Unit II)**

**3.** Modern Physics by B. L. Theraja, 16th Edition, S. Chand and Company, 2008. **(Unit I)**

4. Modern Digital Electronics by R. P Jain, Fourth Edition, Tata McGraw Hill Pvt. Ltd. 2012. **(Unit II)**

## NBPP22-506: Practical Paper V

**Learning Objectives:** To understand

1. Experimental determination of surface tension by various methods.
2. Experimental determination of Yong's modulus (Y) by various methods.
3. Use of C programming to solve physics experimental calculations.
4. Use of Scilab software to solve physics experimental problems.

**Experiments**

1. Resonance pendulum
2. S.T. of soap solution
3. Surface tension of mercury by Fergusson modified method.
4. Surface tension of mercury by ripple method.
5. Y and η using Flat Spiral Spring
6. Y by Koenig's method
7. Y by Cornu's spiral
8. Searle's Viscometer
9. C program to arrange the given set of numbers in ascending/descending order
10. C program to find largest/smallest number from a given set of numbers
11. Scilab Expt. 1 (problem from Quantum Mechanics)
12. Scilab Expt. 2 (problem from Quantum Mechanics)

**Learning Outcomes: Students will be able to**

1. Determine surface tension of mercury by various practical methods.
2. Determine Yong's modulus (Y) by various practical methods.
3. Use C programm to solve physics experimental calculations.
4. Use Scilab software to solve physics experimentalproblems.

**REFERENCE BOOKS:**


1. Advanced Practical Physics for Students: B. L. Worsnop and H. T. Flint, 1971 Asia Publ. House.
2. Practical Physics: S. L. Gupta and V. Kumar, Pragati Prakashan, 27th Edition, 2010.
3. An Advanced course in Practical Physics: D. Chattopadhyay and P. C. Rakshit, 7th edition, 2005.
4. New Central Book Agency Pvt. Ltd.
5. Experimental College Physics: White and manning, McGRAW-HILL Book Company. 3rd edition.
6. B.Sc. Practical Physics - H. Singh and P.S. Hemne, S. Chand Publication
7. Practical Physics – Arora, S. Chand Publication.

## NBPP22-507: Practical Paper VI

**Learning Objectives:** To understand

1. Building and testing of various oscillators using BJT.
2. Use of C.R.O. to determine A.C. and D. C. voltages.
3. Methods fault finding and repairing in various electrical motors.

**Experiments**

1. To design a single stage CE amplifier of given gain using voltage divider bias.
2. To build and test Colpitts oscillator using BJT.
3. To build and test Phase shift oscillator using BJT.
4. To build and test Hartley oscillator using BJT.
5. To determine A.C. and D.C. sensitivity of the C.R.O. and to measure unknown frequency.
6. Measurement of phase shift of RC network using CRO.
7. Band gap energy of semiconductor using p-n junction diode.
8. Verification of D'Morgans Theorems.
9. UJT as Relaxation oscillator.
10. Fault finding and repairing of Pump motors.
11. Fault finding and repairing of ceiling fan motors, table fan motors.
12. Fault finding and repairing of submersible pump motor.

**Learning Outcomes: Students will able to**

1. Built and test various oscillators using BJT.
2. Use C.R.O. to determine A.C. and D. C. voltages.
3. Find fault and its repairing in various electrical motors.

**REFERENCE BOOKS:**


1. Advanced Practical Physics for Students: B. L. Worsnop and H. T. Flint, 1971 Asia Publ. House.
2. Practical Physics: S. L. Gupta and V. Kumar, Pragati Prakashan, 27th Edition, 2010.
3. An Advanced course in Practical Physics: D. Chattopadhyay and P. C. Rakshit, 7th edition, 2005.
4. New Central Book Agency Pvt. Ltd.
5. Experimental College Physics: White and manning, McGRAW-HILL Book Company. 3rd edition.
6. B.Sc. Practical Physics - H. Singh and P.S. Hemne, S. Chand Publication
7. Practical Physics – Arora, S. Chand Publication.

# B.Sc. III, Semester VI

## NBPT22-601: Nuclear and Particle Physics

**Theory: Lectures 30 Hours**

**Marks -50 (Credits: 02)**

**Learning Objectives:** To understand

1. The knowledge of particles.
2. To learn about the decay phenomenon and the process how they will occur.
3. Knowledge of various model compare to nucleus.
4. Knowledge of detectors and accelerators.

**UNIT I**

**1. General properties of nuclei and nuclear reactions (7)**

Composition of nucleus, Nuclear size, Nuclear radius, Nuclear spin, Nuclear magnetic moment, Electric quadrupole moment, Mass defect, Packing fraction, Magic numbers, Binding energy, Binding energy per nucleon and its variation with mass number, Nucleus as a liquid drop, Liquid drop model of nucleus to obtain semi-empirical mass formula.

**2. Particle Accelerators: (8)**

Need of accelerators, Cyclotron- construction, working, theory- expression for energy of cyclotron and its limitations, Principle of phase stable orbits, Synchrocyclotron- construction, working, advantages and disadvantages, Betatron- Principle, construction, working condition, expression of energy gain.

**UNIT II**

**1. Nuclear Detectors: (7)**

Ionization chamber, Geiger Muller counter- construction, working and theory, dead time and recovery time, quenching mechanism, photoelectric effect, construction of photo-multiplier tube (PMT), Scintillation detector-principle, construction and working, Wilson cloud chamber, Semiconductor detector, cerenkov radiations, cerenkov detector.

**2. Particle Physics: (8)**

Elementary particles and their classification into leptons, mesons and baryons, Symmetries and conservation laws: energy and momentum, angular momentum, parity, Baryon number, Lepton number, isospin, strangeness and charm, quark model.

**Learning Outcomes: Students will be able to**

1. Explain about the knowledge of particles.
2. Significance of various decays tells the students about the nuclear process..
3. It will teach the students about the spin parity concept &magic no. Related to shell.
4. About the detectors and accelerators how it will occur.

**References:**


**1.** Nuclear Physics – D. C. Tayal. **(UNIT I, II)**

**2.** Atomic Physics – Yarwood. **(UNIT II-3)**

3. Introduction to Nuclear Physics- H. AEnge (Addition Wesley co.)
4. Nuclear Physics – J. B. Rajam.
5. Nuclear Physics – Burcham.
6. Basic Concepts of Nuclear Physics – Cohen.
7. Atomic and Nuclear Physics – N. Subramanayam and Brijlal
8. Nuclear Physics – B. N. Shrivastav

**NBPT22-602: Solid State Physics**
**Theory: Lectures 30 Hours**
**Marks-50 (Credits: 02)**

**Learning Objectives:** To understand

1. Understand types of crystal structure and types of solids.
2. X-ray diffraction methods for structural analysis of crystals.
3. Origin of bands in solid and distinction between metals, semiconductors and insulators
4. The superconductivity and types of superconductor

**UNIT I**

**1. Crystal Structure**: **(8)**

Solids: amorphous, polycrystalline and crystalline materials; lattice, basis, unit cell-primitive, non-primitive unit cell, symmetry elements of a cube, Bravais lattices in three and two dimensions, Miller indices and interplaner spacing, simple crystal structures – SC, BCC, FCC and HCP (coordination number, atoms per unit cell and packing fraction).

**2. X – Ray Diffraction by Crystals**: **(7)**

Reciprocal lattice and its properties, Brillouin zone, Diffraction of X-rays by crystals, Ewald construction, Bragg's law in reciprocal lattice, Experimental methods X-ray diffraction (Laue method, rotating crystal method, powder photograph method), Analysis of cubic crystal by powder crystal method.

**UNIT II**

**1. Elementary Band Theory of Solids**: **(8)**

Origin of energy bands, one electron approximation, Bloch theorem (statement only), Kronig-Penny model, Velocity of electrons according to band theory, Effective mass of an electron, Distinction between metals, semiconductors and insulators, Hall Effect- Hall voltage and Hall Coefficient.

**2. Superconductivity** **(7)**

Idea of superconductivity, Critical temperature, Critical magnetic field, Meissner effect, Type-I and Type-II superconductors, Introduction of BCS theory, London equation and penetration depth, Isotope effect, Application (magnetic levitation)

**Learning Outcomes:** Student will able to understand

1. various types of solids depending on crystal structure
2. different methods for structural analysis of crystal
3. energy bands in solid
4. superconductivity phenomenon and its types

**References**:


**1.** Solid state Physics: S. O. Pillai, 7th Ed,New Age Internationl, Publishers **(Unit I, II, II, IV)**

**2.** Solid state Physics - Saxena and Gupta **(Unit I,II, IV)**

**3.** Solid State Physics - A. J. Dekker, Macmillan Publishers India Ltd. **(Unit III,IV)**

**4.** Introduction to Solid state Physics-Charles Kittel,8th Ed.,Wiley India Pvt **(Unit I, II, II, IV)**

**5.** Elements of X-ray diffraction- B. D. Cullity and S.Stock . **(Unit II)**

6. Solid state Physics - R. L. Singhal.

7. Solid state Physics - C. M. Kachhava (TMH ).

8. Solid state Physics - M.A.Wahab,3rd Ed.,2018, Narosa Publishing House Pvt.Ltd

**BPT603: Atomic and Molecular Physics and Astrophysics**
**Theory: Lectures 30 Hours**
**Marks -50 (Credits: 02)**

**Learning Objectives:** To understand

1. Atomic structure, atomic models and atomic spectra.
2. Fine structure and Zeeman effect.
3. Rotational spectra and Vibrational spectra.
4. Raman Effect and Characteristic properties of Raman lines.
5. Milky Way galaxy and origin of solar system.

**UNIT-I**

**1. Atomic Structure** **(5)**

Revision of atomic models- Rutherford and Bohr model. Electron orbits, Atomic spectra, Bohr atom, Energy level and spectra, Atomic excitation, Vector atom model- quantum numbers, Pauli's exclusion principle.

**2. Atomic Spectra** **(5)**

Observed hydrogen fine structure, Spectral notations and optical spectral series for doublet structure, Spectrum of sodium and its doublet fine structure, Selection and intensity rules for fine structure doublets, Normal and anomalous Zeeman effect and their explanation from vector atom model, Lande's g factor.

**3. Molecular Spectra** **(5)**

Molecular bond, Electron sharing, $H_2^+$ molecular ion, The hydrogen molecule, Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational spectra, Vibration – rotation spectra, Electronic spectra of diatomic molecules.

**UNIT-II**

**1. Raman Spectra** **(7)**

Raman Effect, Classical and quantum theory of Raman Effect, Characteristic properties of Raman lines, Difference between Raman spectra and infrared spectra.

**2. Structure of Universe**: **(8)**

Milky Way galaxy, Origin of solar system - Condensation theory; arguments for and against the theory. Hubble law, Big-Bang theory, Steady state theory, Oscillating theory, Cosmological tests.

**Learning Outcomes**: Students will be able to explain

1. Atomic structure, atomic models and atomic spectra.
2. Fine structure and Zeeman effect.
3. Rotational spectra and Vibrational spectra.
4. Raman Effect and Characteristic properties of Raman lines**.**
5. Milky Way galaxy and origin of solar system.

**Reference books**


1. Modern Physics – J.B. Rajam **(Unit I-1)**
2. Introduction to Atomic Spectra – H. E. White. **(Unit I-1,2)**
3. Concepts of Modern Physics-Arthur Beiser. **(Unit I-1) and (Unit I-2,3)**
4. Spectroscopy (Atomic and Molecular and LASER Physics)- Gupta, Kumar, Sharma. **(Unit II-1).**
5. Astronomy Fundamentals and Frontiers-Robert Jastrow and M. H.Thompson. **(Unit II-2)**
6. Molecular spectroscopy- G. Herzberg. **(Unit I-3) (Unit II-1)**
7. Fundamentals of molecular spectroscopy – Colin N. Banwell and Elaine M. McCash **(Unit II-1)**

**NBPT22-604A: Solar Energy and Wind Energy Studies**
**Theory: Lectures 30 Hours**
**Marks 50 (Credits: 02)**

**Learning Objectives:** To Understand

1. The solar dryer in which the grains are dried simultaneously by the heated air from the solar collector.
2. To prepare foods for drying
3. to operate the Solar Food Dryer during the drying process
4. The renewable energy systems, its components and interactions between the components.
5. The knowledge in a special field such as solar energy, storage.

**UNIT-I:**

**1. Energy and Wind Energy (7)**

Energy, Forms of energy, Man and environment, Energy chains, Classification of energy resources, Energy demands, Age of renewable and alternatives, Wind energy, Wind energy chains, Wind energy quantum, Planning of wind farm, Wind power density, Efficiency factor of wind turbine (P-H graph), Power of wind turbine for a given incoming wind velocity, Types of a wind turbine generator unit, Horizontal axis propeller type wind turbine generator unit.

**2. Solar Energy (8)**

Solar energy, Solar energy spectrum (UV, Visible and IR), Utilization of solar energy-thermal route, photovoltaic route, Essential subsystems in solar energy plant, Solar constant, Clarity index, Solar insolation, Solar energy from satellite station through microwave to earth station, Solar photovoltaic systems, Merits and limitations of solar PV systems, Prospects of solar PV systems, Power of a solar cell and solar PV panel.

**UNIT-II:**

**1. Solar Drying (9)**

Introduction: Drying fundamentals, Sun Vs Solar Drying, Types of Solar Dryers; Direct mode, indirect mode, mixed mode, Solar Dryers in practice: Direct mode natural convection dryers, Direct mode forced convection dryers, Indirect mode forced convection dryers.

**2. Evaluation of Solar Dryers (6)**

Overall System drying efficiency, Pick up efficiency, Solar collection efficiency, Performance of solar dryer, comparative testing. Technical development, costs and design.

**Learning Outcomes: Students will be able to**

1. Design the solar dryer.
2. Test foods after drying
3. Perform an initial design of a renewable energy system.
4. Identify, define, present and communicate issues within the subject area.

**Reference Books**


1. Solar Energy Conversion and Photo-energy Systems-R J Fuller
2. Energy Technology – Non-conventional, Renewable and Conventional – S. Rao and Dr. Parulekar.
3. Non-conventional Energy sources - G. D. Rai ($4^{th}$ edition), Khanna Publishers, Delhi.
4. Solar Energy - S.P. Sukhatme (second edition), Tata Mc.Graw Hill Ltd, New Delhi.
5. Solar Energy Utilization - G. D. Rai (5th edition), Khanna Publishers, Delhi.

**NBPT22-604B: Solar Energy and Energy Harvesting**
**Theory: Lectures 30 Hours**
**Marks 50 (Credits: 02)**

**Learning Objectives:** To Understand

1. The solar dryer in which the grains are dried simultaneously by the heated air from the solar collector.
2. To prepare foods for drying.
3. To operate the Solar Food Dryer during the drying process.
4. The Piezoelectric energy harvesting applications.
5. The electromagnetic energy harvesting.

**UNIT-I**

**1. Solar Drying (9)**

Introduction: Drying fundamentals, Sun Vs Solar Drying, Types of Solar Dryers; Direct mode, indirect mode, mixed mode, Solar Dryers in practice: Direct mode natural convection dryers, Direct mode forced convection dryers, Indirect mode forced convectiondryers.

**2. Performance Evaluation of Solar Dryers (6)**

Overall System drying efficiency, Pick up efficiency, Solar collection efficiency, Performance of solar dryer, comparative testing. Technical development, costs and design.

**Unit II:**

**1. Piezoelectric Energy harvesting (8)**

Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.

**2. Electromagnetic Energy Harvesting (7)**

Linear generators, recent applications, Carbon captured technologies, cell, batteries, power consumption, Environmental issues and Renewable sources of energy, sustainability.

**Learning Outcomes: Students will be able to**

1. Design the solar dryer.
2. Test foods after drying.
3. Have deep knowledge on piezoelectric energy harvesting.
4. Have deep knowledge on electromagnetic Energy Harvesting

**References:**


1. Non conventional energy sources- G.D. Rai-Khanna Publishers,New Delhi
2. Solar enrgy- M. P. Agrawal- S Chand and Co. Ltd
3. Renewable Energy,Power for a suitable future- Golfrey Boyle, Oxford University Press, in association with the open University
4. Solar Energy: Resourse Assesment Handbook,2009, Dr. P, Jayakumar.

**NBPT22-604C: Solar Energy and Transducers and Sensors**
**Theory: Lectures 30 Hours**
**Marks 50 (Credits: 02)**

**Learning Objectives:** To Understand

1. The solar dryer in which the grains are dried simultaneously by the heated air from the solar collector.
2. To prepare foods for drying
3. To operate the Solar Food Dryer during the drying process
4. To elucidate sensors and signal conditioning circuits.
5. The different types sensors and transducers

**UNIT-I:**

**1. Solar Drying (9)**

Introduction: Drying fundamentals, Sun Vs Solar Drying , Types of Solar Dryers; Direct mode, indirect mode, mixed mode, Solar Dryers in practice: Direct mode natural convection dryers, Direct mode forced convection dryers, Indirect mode forced convection dryers.

**2. Performance Evaluation of Solar Dryers (6)**

Overall System drying efficiency, Pick up efficiency, Solar collection efficiency, Performance of solar dryer, comparative testing. Technical development, costs anddesign.

**UNIT-II**

**1. Mechanical and Electromechanical Transducers: (7)**

Introduction of Transducers, classification- Active and Passive transducers, Characteristics, Mechanical and electromechanical Transducers: LVDT,Resistive Potentiometer, strain gauge-inductive Transducer, capacitative Transducer, Ultrasonic Transducer.

**2. Sensors Basic characteristics (8)**

Types of photosensistors/photodetectors, X-ray and Nuclear radiation sensors, Fibre optic sensors, Smart sensors, Applications of sensors, Introduction-primary sensors, Excitation amplification, Filters, converters-data communication, standards for smart sensor interface, Film sensors, MEMS sensors, Nano sensors, Applications of sensors.

**Learning Outcomes: Students will be able to**

1. Design the solar dryer.
2. Test foods after drying
3. Ability to analyse, formulate and select suitable sensor for the given industrial applications.
4. Acquire In depth Knowledge on different types of sensors and transducers.

**Reference Books**


1. Solar Energy Conversion and Photo-energy Systems-R J Fuller (**UNIT-I)**
2. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice-Hall of India (2005).
3. M.J. Usher, Sensors and Transducers, Macmillan, London (1985). (**UNIT-II)**

## NBPP22-606: Practical Paper VII

**Learning Objectives:** To understand

1. Experimental determination of wavelength of sodium by various optical methods.
2. Absorption spectrum of a liquid $KMnO_4$ solution.
3. Practical use of optical fiber.

**Experiment**

1. Cardinal points by turn table method
2. Measurement of temperature of Na flame
3. Diffraction at a Single Slit
4. Diffraction at cylindrical obstacle
5. Lloyd's single mirror
6. Double refracting prism
7. Diameter of Lycopodium powder
8. Absorption spectrum of a liquid ( $KMnO_4$ solution)
9. Study of divergence of LASER beam
10. Determination of Thickness of air film by interference.
11. Measurement of Numerical Aperture
12. Design of fiber optic Transmitter/ Receiver.

**Learning Outcomes: Students will able to**

1. Determinate wavelength of sodium by various optical methods.
2. Understand absorption spectrum of a liquid $KMnO_4$ solution.
3. Know practical use of optical fiber.

**REFERENCE BOOKS:**


1. Advanced Practical Physics for Students: B. L.Worsnop, H. T. Flint, 1971 Asia Publ.House.
2. Practical Physics: S. L. Gupta and V. Kumar, Pragati Prakashan, 27th Edition, 2010.
3. An Advanced course in Practical Physics: D. Chattopadhyay and P. C. Rakshit, 7th edition, 2005.
4. New Central Book Agency Pvt. Ltd.
5. Experimental College Physics: White and manning, McGraw-Hill Book Comp. 3rd edition.
6. B.Sc. Practical Physics - H. Singh and P.S. Hemne, S. Chand Publication Practical Physics – Arora, S. Chand Publication

## NBPP22-607: Practical Paper VIII

**Learning Objectives:** To understand

1. Experimental determination of Self and Mutual Inductance by various methods.
2. Calibration of wire by various electrical methods.
3. Practical use of solar energy.

**Experiment**

1. Self Inductance by Owen's Bridge
2. Self Inductance by Rayleigh's Method
3. Measurement of $B_H$ , $B_V$ and $\theta$ using Earth Inductor
4. Mutual inductance using Ballistic galvanometer.
5. Resistance of B.G. by half deflection method
6. Calibration of wire by Carey Foster bridge
7. Calibration of wire by Griffith's method
8. Absolute capacity of condenser
9. I-V characteristics of Solar Cell
10. Study of solar collector.
11. Study of solar hot air collector/ solar dryer.
12. Performance evaluation of box type and concentrating type solar cooker.
13. Determination of efficiency of DC/AC inverter.
14. Study of Performance of Solar Lamp.
15. Determination of "Star Rating" of Refrigerator.

**Learning Outcomes: Students will able to**

1. Determine Self and Mutual Inductance by various methods.
2. Calibrate wire by various electrical methods.
3. Use solar energy in practical life.

**REFERENCE BOOKS:**


1. Advanced Practical Physics for Students: B. L.Worsnop, H. T. Flint, 1971 Asia Publ.House.
2. Practical Physics: S. L. Gupta and V. Kumar, Pragati Prakashan, 27th Edition, 2010.
3. An Advanced course in Practical Physics: D. Chattopadhyay and P. C. Rakshit, 7th edition, 2005.
4. New Central Book Agency Pvt. Ltd.
5. Experimental College Physics: White and manning, McGraw-Hill Book Comp. 3rd edition.
6. B.Sc. Practical Physics - H. Singh and P.S. Hemne, S. Chand Publication Practical Physics – Arora, S. Chand Publication