# BHAKTA KAVI NARSINH MEHTA UNIVERSITY

# JUNAGADH

# FACULTY OF SCIENCE
# SYLLABUS FOR
# B.Sc.
# PHYSICS
# (Semester- 5 & 6)
# According to Choice Based Credit System
# Effective from June – 2018

# Syllabus of B.Sc. (Physics) Sem-5
# According to Choice Based Credit System
# Effective from June – 2018

## Course Contents :

- Physics-501 –Theory: Mathematical Physics, Classical Mechanics & Quantum Mechanics
- Physics-502 -Theory: Electrodynamics and Relativity
- Physics-503-Theory: Solid State Electronics
- Practical- Group A
- Practical- Group B
- Practical- Group C
- Project

**Total Credit of the Semester-5: 24**

**Educational Study Tour:**

Physics Department of college should arrange at least one Educational Study tour during semester 5 or 6. In this tour, students may visit any state or national research institute, scientific organization, industry or any educational scientific institute in India. Students have to submit detailed report of this study tour. This report is to be considered as a project of 50 marks.

# B. Sc. Physics Semester : 5

**The Course Design of B. Sc. Sem.- 5 (Physics) according to choice based credit system (CBCS) as follows :**

| Sr.No | Subject | No of theory Lecture per week | No of Practical Lecture per week | Total Marks | Credits |
|---|---|---|---|---|---|
| 1 | **PAPER Physics- 501 (Theory) Mathematical Physics Classical Mechanics & Quantum Mechanics** | 6 | - | 70(External)+ 30(Internal) = 100 Marks | 4 |
| 2 | **PAPER Physics-502 (Theory) Electrodynamics and Relativity** | 6 | - | 70(External)+ 30 (Internal) = 100 Marks | 4 |
| 3 | **PAPER Physics-503 (Theory) Solid State Electronics** | 6 | - | 70(External)+ 30 (Internal) = 100 Marks | 4 |
| 4 | **Practical -1 (Group A)** **One practical from group A** | - | 6 | 35(External)+ 15(Internal) = 50 Marks | 3 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | **Practical -2 (Group B)**<br>**<u>One practical from group B</u>** | - | 6 | 35(External)+<br>15(Internal) =<br>50 Marks | 3 |
| 6 | **Practical -3 (Group C)**<br>**<u>One practical from group C</u>** | | 6 | 35(External)+<br>15(Internal) =<br>50 Marks | 3 |
| 7 | **Project Work & Viva** | • 1 Guidance Lecture. for a group in a week.<br>• Evaluation of project will be in the SIXTH semester | | | 3 |
| | | | | **<u>Total credit of the semester 5</u>** | **24** |

# : Project Work :

**Project work is divided in two parts :**

**(1) : Theoretical essay or educational tour report : 50 marks**

**(2) : Preparation of Working Model : 50 marks**

**Project (1): Theoretical essay or educational tour report:**

Each student has to prepare one detailed essay based on any topic of Physics which includes the principle of physics or based on any theory of physics or application of physics.

**OR**

Student should submit detailed report of educational study tour.

Each student should submit this report at the end of the 6th Semester. The Project work would be evaluated by the examiner based on the presentation of the report by students and conducting viva-voce on the topic.

The distribution of marks is as follows:

| | |
|---|---|
| Essay/ Report writing | : 35 |
| Viva voce | : 15 |
| Total | : 50 |

**Project(2): Preparation of the Working Model:**

**The project work will be assigned in the team (group) of minimum one and maximum four students.**

Students has to prepare one model (preferably working model) based on the principle of Physics. The model, along with a detailed write up (dissertation), explaining the principle, working and applications, should be submitted to the Practical-in-charge at the end of 6th semester.

Each group of the students has to submit a working model in common but each student of the group has to separately submit write up for their common group working model.

Project-in-charge should extend the guidance regarding the selection, preparation and troubleshooting of working model, and there would be one lecture per week per batch of students.

The Project work would be evaluated by the examiner based on the presentation of the report by students and conducting viva-voce and demonstration of the working model.
The distribution of marks is as follows:

| | |
|---|---|
| Model making | : 20 |
| Model presentation | : 15 |
| Viva voce | : 15 |
| Total | : 50 |

**Total Marks of Project: 50 + 50 = 100.**

**The Evaluation of the project work will be done at the end of the sixth semester. For the Evaluation of the both types of project works one session of three hours should be allocated during the practical examination.**

There would be three sessions of 3 hours each for three experimental practical examination. Fourth session of 3 hours would be for the project work evaluation. ( in total a student has to undergo four sessions (3 hours each) of practical +project evaluation examination)

**There shall be batch of 15 students for project and viva.**

**SKELETON OF THEORY EXAMINATION**
**(SEMESTER – I to VI)**

# Paper Style for All Semester

1. The syllabus consists of five Units.
2. All Units carry equal marks.
3. There should be five questions in a question paper.
4. One question is to be asked from each Unit.
5. Each question carries 14 marks.
6. Time duration of 70 marks question paper is 2:30 hours.
7. Each question should be divided into a, b and c as shown below.
   a. Answer the following. (Any one out of Two)----------(07 marks)
      (Theory Question)
   b. Attempt any one. (Out of Two)----------(04 Marks)
      (Application/Example/Problem/Theory)
   c. Attempt any three. (Out of Five) ---------- (03 Marks)
      (short answer/one word/one line/true or false/fill up the blanks)

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## Paper: Physics-501

## (Mathematical Physics, Classical Mechanics & Quantum Mechanics)

**UNIT 1: (12 hour : 14 Mark)**

**Fourier Series:** Definition, Evaluation of the Coefficients of Fourier Series, Cosine Series, Sine Series, Dirichlet's Theorem (Statement only), Extension of Interval, Complex form of Fourier series, Advantages of Fourier series, Properties of Fourier series, Physical Applications of Fourier series analysis (square wave, full wave rectifier, half wave rectifier, triangle wave), Fourier integrals, Fourier Transforms, Fourier sine and cosine Transforms, Numerical Problems.

**Dirac-Delta Function:** Introduction, Representation of the Dirac delta Function, derivative at a discontinuity, properties of Dirac delta function, the three dimensional Dirac delta function, Numerical Problems.

**Reference books :**


1. Mathematical Physics By Rajput, Publisher: Pragati Prakashan, Meerut.
2. Quantum Mechanics theory and applications By Ajoy Ghatak & S Lokanathan Publisher: Macmillan India Limited.
3. Mathematical Physics By H K Dass & Dr. Rama Verma, ublisher:S.Chand
4. Mathematical Physics By P.K.Chattopadhyay


**UNIT 2: (12 hours: 14 Mark)**

**Variational Principle and Lagrangian Formulation:** Constrained motion, Constraints, degree of freedom, Generalized co ordinates, Generalized notation for displacements & Velocity, Limitation of Newton's laws, variation Technique for many independent variables, Euler-Lagrange differential equation, Hamilton's Variational Principle, Deduction of Lagrange's equations of motion from Hamilton's principle (for Conservative System), D'Alembert's principle, Lagrange's equations from D'Alembert's principle, Rayleigh's dissipation function, Deduction

of Hamilton's Principle from D'Alembert's principle, Deduction of Newton's second law from Hamilton's principle, Application of Lagrange's equation of motion – linear Harmonic oscillator, Simple Pendulum, Spherical Pendulum, Electric Circuit, Compound pendulum, Atwood machine, Numerical problems.

**UNIT 3: (12 hour: 14 Mark)**

**Hamiltonian Formulation:** Superiority of Lagrangian approach over Newtonian approach, Non- Holonomic System: Lagrangian method of undetermined multipliers, Application in simple pendulum, Conservation theorems- cyclic or ignorable Co-ordinate, generalized momentum, Phase space and the motion of the System, Hamiltonian, Hamilton's canonical equations of motion, Physical significance of H, Advantage of Hamiltonian approach, Deduction of canonical equations from variational principle, Applications of Hamilton's equations of motion – simple pendulum, Compound Pendulum, linear harmonic oscillator, charged particle in an Electromagnetic field, Numerical problems.

**Reference books for 2 & 3:**


1. Classical Mechanics By Gupta, Kumar, Sharma Publisher: Pragati Prakashan, Meerut **12th edition.**
2. Introduction to Classical Mechanics By R G Takwale & P S Puranik Publisher: TMG
3. Classical Mechanics By Herbert Goldstein Publisher: Narosa Publishing House


**UNIT 4: (12 hour: 14 Mark)**

**Wave particle duality and Schrödinger equation:** Introduction, particle nature of radiation, Compton effect, Wave nature of matter, Uncertainty principle, Schrödinger equation, Commutator, Physical interpretation of $\psi$, Expectation values, Proof of the uncertainty principle, Eigenfunction of operator $p_x$ , General solution of the one dimensional Schrödinger equation for a free particle, Time evolution of

a wave packet, Group velocity of wave packet, Stationary state, Boundary and Continuity conditions, Degeneracy, Orthogonality of eigenfunctions, Parity, Some exact solutions- particles in a one dimensional infinitely deep potential well; particles in a one dimensional potential well of finite depth, Three dimensional Schrödinger equation, Particle in a box- density of states, Numerical Problems.

**UNIT 5: (12 hour: 14 Mark)**

**Harmonic oscillator & Angular momentum:** Introduction, Solution of the time dependent Schrödinger equation, Eigenfunctions, Angular momentum operator, Eigen values and Eigenfunctions of $L^2$ ,Spherically symmetric potentials, Two body problem, Hydrogen-like atom, Bra and ket notation, Linear operator, Eigenvalue equation, Completeness condition, Examples from Matrix Algebra, Solution of the Eigen value problem, Harmonic oscillator wave functions, Coherent state, Time evolution of the coherent state, Number operator, Density operator, Numerical Problems.

**Reference books for 4 & 5:**


1. Quantum Mechanics theory and applications By Ajoy Ghatak & S Lokanathan Publisher: Macmillan India Limited.
2. A text book of quantum mechanics By P M Mathews & K Venkatesan Publisher: TMG.

## Paper: Physics-502

### (Electrodynamics and Relativity)

**UNIT 1: (12 hour : 14 Mark)**

**Electrodynamics:** Ohm's law, Electromotive force and motional emf, Faraday's law, The induced Electric field, inductance, energy in magnetic fields, Electrodynamics before Maxwell, Maxwell's modification of Ampere's law, Maxwell's equations, The continuity equation, Poynting's theorem, Newton's third law in Electrodynamics, Maxwell's stress tensor, conservation of momentum, Angular momentum, Numerical Problems.

**UNIT 2: (12 hour : 14 Mark)**

**Electromagnetic Waves:**

Waves in one dimension: Wave equation, sinusoidal waves, Boundary conditions: Reflection and Transmission, Polarization, Electromagnetic waves in vacuum: The wave equations for **E** and **B**, Monochromatic plane waves, Energy and Momentum in Electromagnetic waves, Numerical Problems.

**UNIT 3: (12 hour : 14 Mark)**

**Potentials and Fields:**

The Potential formulations: Scalar and Vector potentials, Gauge transformations, Coulomb Gauge and Lorentz Gauge, Retarded potentials, Jefimenko's equations, Point charges: Lienard-Wiechert potentials, The fields of a moving point charge, Electric and Magnetic field of moving charge with constant velocity, Numerical Problems.

**UNIT 4: (12 hour : 14 Mark)**

**Radiation:**

Dipole radiation: What is radiation? , Electric dipole radiation, Explanation of Blueness of sky and Redness of sunset, Magnetic dipole radiation, Radiation from an arbitrary source, Power radiated by a point charge, Radiation reaction, The physical basis of radiation reaction, Numerical Problems.

**UNIT 5: (12 hour : 14 Mark)**

## Electrodynamics and relativity:

The special theory of relativity and Einstein postulates of it, The geometry of relativity, Lorentz transformations, structure of space-time, Proper time and Proper velocity, Relativistic momentum and relativistic energy, Relativistic Kinematics, Relativistic Dynamics, Numerical Problems.

**Basic Reference book:** Introduction to electrodynamics By David J Griffiths, Publisher: PHI.

**Other Reference Books:**

1. Electricity and Magnetism - Mahajan and Rangwala
2. Classical Electrodynamics - J.D.Jackson
3. Electricity and Magnetism - R. Murugeshan
4. Electromagnetics - B.B.Laud
5. Electricity and Magnetism - K.K.Tiwari
6. Electricity and Magnetism - Berkeley Physics Course, Vol. II
7. Electricity and Magnetisam By D.C. Tayal, Publisher: Himaliya publishing House.
8. Refresher Course in Physics Volume 1,2 & 3 By C.L.Arora

## Paper: Physics-503
## (Solid State Electronics)

**UNIT 1: (12 hour : 14 Mark)**

**Multi-stage Transistor Amplifiers**: Multistage Transistor Amplifier, Role of Capacitors in Transistor Amplifiers, RC coupled Transistor Amplifier, Transformer Coupled Amplifier, Direct coupled Amplifier, Comparison of Different types of coupling, Numerical Problems.

**Transistor Audio Power Amplifiers:** Transistor Audio Power Amplifier, Difference between Voltage and Power amplifier, Performance Quantities of power amplifier, Classification of Power amplifier, Expression for Collector Efficiency, Efficiency of Class A Amplifier, Maximum Efficiency of Transformer Coupled Class A Power amplifier, thermal Runaway, Heat sinks, Mathematical Analysis, Push pull Amplifier, Complementary Symmetry Amplifier, Numerical Problems.

**UNIT 2: (12 hour : 14 Mark)**

**Solid State Switching Circuits :** Switch, Mechanical switch, Electronic Switches, Advantages of electronic switches, switching transistors, switching action of Transistor, Multivibrators, Types of Multivibrators, Transistor Astable Multivibrators, Transistor Monostable Multivibrators, Transistor Bistable Multivibrators, Differentiating circuit, Integrating circuit, Clipping circuits, Application of Clippers, Basic idea of a clamper, clamping circuits, Numerical Problems.

**UNIT 3: (12 hour : 14 Mark)**

**Regulated D.C. Power Supply:** Ordinary D.C. power supply, Important terms, Regulated Power supply, Types of voltage regulators, Zener diode as a voltage regulator, Transistor series

voltage regulator, Series feedback voltage regulator, Short-circuit protection, Transistor shunt voltage Regulator, Numerical Problems.

**Integrated Circuits:** Integrated Circuits, Advantages &Disadvantages of ICs, Scale of Integration, Classification of ICs, Comparison between different ICs, IC Symbol, Operational Amplifier, Differential Amplifier, Basic circuit of Differential Amplifier, Operation of Differential Amplifier , Common-mode and Differential-mode signals, Common- mode Rejection Ratio, DC Analysis of Differential Amplifier, Ideal Operational Amplifier, OP-AMP Applications, Linear Amplifier, Adder, Subtractor, Integrator, Differentiator, Comparator, Numerical Problems.

**UNIT 4: (12 hour : 14 Mark)**

**Transducer :** Transducer, Classification of Transducers, Resistive Position Transducer, Resistive Pressure Transducer, Inductive Pressure Transducer, Capacitive Pressure Transducer, Self-generating Inductive Transducers, Linear Variable Differential Transformer(LVDT), Piezoelectric Transducer Strain Gauge, Temperature Transducer, Resistance temperature detectors, Thermistor, Thermocouples, Photoelectric Transducer, Various Types of Microphones, Carbon Microphone, Ribbon Microphone, Moving Coil Microphone, Crystal Microphone, Ceramic Microphone, Numerical Problems.

**UNIT 5: (12 hour : 14 Mark)**

**Electronic Instruments:** Analog and Digital Instruments, Functions of Instruments, Electronic versus Electrical Instruments, Essentials of an Electronic Instrument, The Multimeter, Rectifier type AC meter, Electronic Voltmeter, Electronic voltmeter for Alternating currents, Digital voltmeter,

Cathode Ray Oscilloscope, Frequency Determination, Application of CRO.

**Basic Reference Books for above units :**

1. Principles of Electronics By V.K.Mehta & Rohit Mehta. Publisher:S. Chand &Company Ltd.
2. Basic Electronics By B.L.Theraja, Publisher:S. Chand & Company Ltd

## Digital circuits & Applications:

Combinational logic circuits : Introduction, Half adder; Full adder; Multiplexer: 16 to 1 Multiplexer; The 74150; Multiplexer Logic; Bubbles on Signal Lines; Nibble Multiplexers, Demultiplexer: 1 to 16 Demultiplexer; The 74154, 1 of 16 Decoder, BCD To Decimal Decoders; The 7445, Encoder, The 74147.

Sequential logic circuits: Introduction, RS flip-flop, Clocked RS flip-flop, D flip-flop, JK flip-flop JK Master- slave flip-flop.

IC 555 timer and its application as astable and monostable Multivibrator. Numerical Problems.

**Basic Reference Book:**

Digital Principles and Applications By Malvino & Leach, Publisher: Tata McGraw Hill Publishing Company Limited. 4$^{TH}$ Edition.

**Other Reference Books:**

1. Electronic Devices & Circuits By Allen Mottershad, Publisher: Prentice-Hall of India Pvt. Ltd., Delhi
2. Electronic Devices & Circuits Theory by Boylestead & Nashelsky
3. Handbook of Electronics By Kumar & Gupta, Publisher: Pragati Prakashan, Meerut, India
4. Principal of Electronics By Malvino, Publisher: TMG
5. Modern Digital Electronics By R.P.Jain
6. A Text book of Digital Electronics By R.S.Sedha, Publosher:S.Chand

# B.Sc. Semester – 5 - Practical

Each student will have to perform **three (3) experiments ( one from each group)** in the University Examination.

Each Practical would be of 35 Marks and should be performed in a session of 3 Hours in practical exam.

There would be three sessions of 3 hours each for three experimental practical examination.

There shall be **batch of 15 students** for practical exam in university examination.

## List of Experiments

### Group A

1. Determine the "g" using Kater's Pendulum
2. Study of Damped Simple Harmonic Motion
3. Study of Fabry-Perot Etalon
4. Study of Lloyd's Mirror.
5. Study of Double Refraction in Calcite Prism
6. Young Modulus of beam by elevation method
7. To determine the thermal conductivity of cardboard (bad conductor) byLee's Method.
8. $\eta$ of metal rod using Barton's Vertical apparatus
9. To determine radius of curvature of a given lens and refractive index of glass using optical lever method.
10. To study Diffraction at Straight edge.
11. To study the elliptical polarization of light using babinet compensator.
12. To determine viscosity of liquid by log decrement method.

## Group B

1. Study of Absorption spectra of Iodine
2. Comparison of Capacities by Mixture Method
3. Determine the constant of Ballistic Galvanometer
4. Determine the Self Induction of coils using Owen's Bridge
5. Determine the Mutual Induction of coils using Ballistic Galvanometer
6. Study of Transformer's coils using Bridge rectifier
7. Determine e/m using Magnetron Method.
8. Determine e/m using Helical Method
9. Study of Hysterisis loop of Ferromagnetic Material
10. Study of Hall Effect.
11. To determine the self inductance/ Mutual Inductance of a given coil by Rayleigh's method.
12. Absolute value of capacity of a capacitor by B.G.
13. To determine Permeability of Free space.

## Group C

1. Study of h-Parameter of CE- Transistor.
2. Study of Single stage Transformer coupled Amplifier
3. Study of Complementary-Symmetry Power Amplifier
4. Study of Series Voltage Regulator using Transistor
5. Electronic voltmeter using FET
6. Study of Hartley Oscillator.
7. Study of RC phase shift Oscillator.

8. Study of Lissageous figure/Measurement of frequency and phase using CRO.
9. Study of X-OR Gate.
10. Study of X-NOR Gate.
11. Verification of De'Morgans Theorem.
12. To determine the capacitance or to compare capacitance by Wien Brideg.

**Reference Books:**


1. Practical Physics by C.L.Arora ( S.Chand)
2. Advanced Practical Physics by Chauhan & Singh. (Pragati Prakashan)
3. B.Saraf et ai-Physics through experiments Vol.I & II
4. Electronic Laboratory Primer by Poorna Chandra & Sasikala, (S.Chand)
5. Practical Physics by Chattopadhyay, Rakshit & Saha.

# Syllabus of B.Sc. (Physics) Sem-6
# According to Choice Based Credit System
# Effective from June – 2018

## Course Contents :

- Physics-601 -Theory: Nuclear & Particle Physics
- Physics-602 -Theory: Statistical Mechanics & Solid state physics
- Physics-603-Theory: Spectroscopy and Applied Optics
- Practical- Group A
- Practical- Group B
- Practical- Group C
- Project

**Total Credit of the Semester-6: 24**

**Educational Study Tour:**

Physics Department of college should arrange at least one Educational Study tour during semester 5 or 6. In this tour, students may visit any state or national research institute, scientific organization, industry or any educational scientific institute in India. Students submit detailed report of this study tour. This report consider as a project of 50 marks.

# B. Sc. Physics Semester : 6

**The Course Design of B. Sc. Sem.- 6 (Physics) according to choice based credit system (CBCS) as follows :**

| Sr.No | Subject | No of theory Lecture per week | No of Practical Lecture per week | Total Marks | Credits |
|---|---|---|---|---|---|
| 1 | **PAPER Physics-601 (Theory) Nuclear & Particle Physics** | 6 | - | 70(External)+ 30 (Internal) = 100 Marks | 4 |
| 2 | **PAPER Physics-602 (Theory) Statistical Mechanics & Solid state physics** | 6 | - | 70(External)+ 30 (Internal) = 100 Marks | 4 |
| 3 | **PAPER Physics-603 (Theory) Spectroscopy and Applied Optics** | 6 | - | 70(External)+ 30 (Internal) = 100 Marks | 4 |
| 4 | **Practical -1 ( Group A)** **One practical from group A** | - | 6 | 35(External)+ 15(Internal) = 50 Marks | 3 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | **Practical -2 ( Group B)**<br>**<u>One practical from group B</u>** | - | 6 | 35(External)+<br>15(Internal) =<br>50 Marks | 3 |
| 6 | **Practical -3 (Group C)**<br>**<u>One practical from group C</u>** | | 6 | 35(External)+<br>15(Internal) =<br>50 Marks | 3 |
| 7 | **Project Work & Viva** | • 1 Guidance Lecture. for a group in a week.<br>• Evaluation of project will be in SIXTH semester | | 50 + 50 =<br>100 Marks | 3 |
| | | | **<u>Total credit of the semester 6</u>** | | **24** |

**SKELETON OF THEORY EXAMINATION**
**(SEMESTER – I to VI)**

# Paper Style for All Semester

1. The syllabus consists of five Units.
2. All Units carry equal marks.
3. There should be five questions in a question paper.
4. One question is to be asked from each Unit.
5. Each question carries 14 marks.
6. Time duration of 70 marks question paper is 2:30 hours.
7. Each question should be divided into a, b and c as shown below.
   a. Answer the following. (Any one out of Two)----------(07 marks)
      (Theory Question)
   b. Attempt any one. (Out of Two)----------(04 Marks)
      (Application/Example/Problem/Theory)
   c. Attempt any three. (Out of Five) ---------- (03 Marks)
      (short answer/one word/one line/true or false/fill up the blanks)

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# B.Sc. (Physics)
## Semester -6
## Paper: Physics-601
## (Nuclear & Particle Physics)

**UNIT -1: (12 hour: 14 Mark)**

**General Properties of Nuclei & Nuclear Models:** Rutherford's alpha Scattering Experiment, Rutherford's Atom Model, Constitute of nucleus and their intrinsic properties, qualitative facts about size, mass, Charge, density, Classification of Nuclei, Nuclear Stability, binding energy, main features of binding energy versus mass number curve, Nuclear Models: liquid drop model, Shell model: Evidence of Shell Model, Semi empirical mass formula and significance of various terms. Numerical Problems.

**UNIT -2: (12 hour: 14 Mark)**

**Radioactivity:** Natural Radioactivity, Properties of alpha, beta and gamma ray, The Law of Radioactive Decay, Half Life , Mean Life, Radioactive Series, Units of Activity, General Rule of Alpha and Beta Decay, Theory of alpha decay- Barrier Penetration, Beta Decay-Continuous beta ray spectrum- Difficulties in understanding it, Neutrino hypothesis and Fermi theory of Beta Decay, Gamma Decay – Gamma Ray emission, Nuclear isomerism, Internal Conversion, Application of Radio isotopes, Determination of the Age of Earth, Carbon Dating, Numerical Problems.

**UNIT -3: (12 hour: 14 Mark)**

**Interaction of Nuclear Radiation with matter And Detector:**

Interaction between Energetic Particle and matter, Principle construction and working of - Ionization Chamber; Solid state Detector; Scintillation Counters, GM Counter, Plateau Curve.

**Nuclear Reaction:** Rutherford experiment for artificial transmutation, Q-value of Nuclear reaction, Type of Nuclear reactions, Energy balance in Nuclear reaction, Threshold energy of Endoergic reaction, Nuclear Transmutation, Numerical Problems.

**UNIT -4: (12 hour: 14 Mark)**

**Particle Accelerator:** Construction and working of – Linear Accelerator; Cyclotron, Formula of Cyclotron Frequency, Limitation of Cyclotron, Principle of Phase Stability, Synchrocyclotron, Synchrotron - Proton Synchrotron; electron Synchrotron( Betatron).

**Nuclear Fission:** Discovery of Nuclear fission, Energy released in fission, Bohr & Wheeler's theory of fission, Chain reaction, Multiplication Factor, Critical Size, Atom bomb, Nuclear reactors, Use of Nuclear Reactor Power Reactor, Breeder Reactor, Numerical Problems.

**UNIT -5: (12 hour: 14 Mark)**

**Nuclear fusion:** Nuclear fusion, Source of stellar energy, Thermonuclear reactions, Hydrogen Bomb, Controlled Thermo Nuclear Reaction, Fusion Reactor, Plasma Confinement – Gravitation Confinement, Magnetic Bottle, Tokamak, Internal Confinement, Numerical Problems.

**Elementary Particles:** Introduction, Classification of Elementary Particles, Particles & Antiparticles, Antimatter, The fundamental Interactions, Elementary particle Quantum numbers, Conservation laws and symmetry, Quark model.

**Reference Books:**

1. Modern Physics By R.Murugeshan & Kiruthinga Sivaprasatha, Publication: S.Chand & Company Ltd.
2. Nuclear Physics: An Introduction By S.B. Patel Publisher: New Age International (P) Limited.

3. Nuclear Physics By D.C.Tayal Publisher: Himalaya Publishing House.
4. Concept of Nuclear Physics By B.L.Cohen Publisher:TMG
5. Nuclear Physics By Irving Kaplan  Publisher: Narosa Publishing House.
6. Concept of Modern Physics By Arthur Beiser Publisher: TMG
7. Refresher Course in Physics Volume 1,2 & 3 By C.L.Arora

## Paper: Physics-602

### (Statistical Mechanics & Solid state physics)

**UNIT -1: (12 hour: 14 Mark)**

**Classical Distribution Law:** Phase Space (till the derivation of dr> =$h^3$), Volume in Phase Space, Micro States and Macro States(number of microstates accessible to a macroscopic system onwards not included), Stirling's approximation, Thermodynamic Probability, Division of Phase Space into Cells, Classical Maxwell Boltzmann Distribution law. Bose-Einstein and Fermi Dirac Statistics Derivation of the distribution law of Bose-Einstein Statistics, Derivation of the distribution law of Fermi Dirac Statistics, Comparison of the Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics, Numerical Problems.

**Basic Reference Book:**

Elementary Statistical Mechanics by Gupta and Kumar, Publisher: Pragati Prakashan.

**UNIT 2: (12 hour : 14 Mark)**

**Crystal structure:** The crystal lattice and lattice translation vector, Unit cell, Bravais lattice in three dimension, Crystal planes and mirror indices, Simple crystal Structure ( hcp,fcc,bcc,sc,Dimond)

**Crystal binding**: Ionic crystals, Covalent crystals, Metallic crystals, Hydrogen bonded crystals.

**Thermal conductivity of solids:** Heat capacity, classical theory of heat capacity of solids, Einstein model, Debye model, Density modes (one and three dimensions), Debye formula, criticism of Debye model, Thermal expansion, Thermal conductivity of solids, Numerical Problems.

**UNIT 3: (12 hour : 14 Mark)**

**Free electron theory of metals:** Free electron model, Free electron gas in one and three dimensions, Density of states, Effect of temperature, Thermal conductivity of free electron system, Sommerfield

theory of thermal conductivity, The Boltzmann equation, Wiemann-Franz law, Hall effect, Band theory of metals: The Block theorem, Kronig Penny model, Numerical Problems.

**UNIT 4: (12 hour : 14 Mark)**

**Semiconductor physics:** Insulators, Semiconductors, Intrinsic semiconductors: Electron-Hole carrier concentrations, Fermi level, Electrical conductivity and bonding, effect of impurities
Extrinsic semiconductors: Donor-Acceptors states, Fermi level, Thermal ionization, Band structure of Si and Ge crystals, Numerical Problems.

**Basic Reference Book for ( 2 to 4):**
A text book of Solid State Physics By S.L.Kakani & C. Hemrajani, Publisher: S Chand .

**UNIT 5: (12 hour : 14 Mark)**

**Superconductivity:** Experimental Aspects, Influence of external agents on Superconductivity, Meissner effect, Critical field of Small Specimens, Thermodynamic of Superconducting transition, Alloys & Compounds, London's theory, Josephson effects, BCS theory, Applications of Superconductivity, Numerical Problems.

**Basic Reference books:**
1. Fundamental of Solid State Physics By Saxena, Gupta, Saxena, Publisher: Pragati Prakashan
2. A text book of Solid State Physics By S.L.Kakani & C. Hemrajani, Publisher: S Chand .

**Other Reference Books:**

1. Statistical Mechanics by Mayor and Mayor
2. Statistical Mechanics by Agrawal and Eisner
3. Introduction to Solid State Physics by Charles Kittle (7th edition),John Wiley & Sons
4. Solid State Physics by A.J.Dekker, Macmillan India Ltd.

5. Introduction to Solid by L.V.Azaroff, Tata McGraw Hill Pub.
6. Solid State Physics by Puri and Babbar, S.Chand.
7. Superconductivity & Superconducting Materials by Narlikar and Ekbote.
8. Refresher Course in Physics Volume 1,2 & 3 By C.L.Arora

## Paper: Physics-603
## (Spectroscopy and Applied Optics)

**UNIT -1: (12 hour: 14 Mark)**

**Atomic Spectroscopy:**

Production of Spectra, Type of Spectra- Emission Spectra, Absorption Spectra. Bohr's Theory of atom, Franck-Hertz Experiment, Shortcoming of Bohr Theory, Sommerfield Elliptical orbits (theoretical part only), The spinning electron, Space quantization, Quantum numbers and their physical interpretations, Magnetic moments of an Atom and Lande's g Factor.

Experimental study of Zeeman effect, Classical interpretation of Normal Zeeman effect, Vector atom model and Normal Zeeman effect, Vector atom model and Anomalous Zeeman effect, Paschen-Back effect, Stark effect, Numerical Problems.

**Basic Reference Book:** Elements of Spectroscopy By Gupta, Kumar, Sharma Publisher: Pragati Prakashan Twenty-eight Edition 2016.

**UNIT -2: (12 hour: 14 Mark)**

**Molecular Spectroscopy:** Introduction, Experimental study, Theoretical explanation, Theory of pure rotational Spectra, Theory of rotational Vibrational Spectra, Theory of electronic band Spectra,

**Basic Reference Book:** Atomic Physics By J.B.Rajam. Publisher: S.Chand &Company Ltd.

**Raman Spectra:** Raman effect and its Salient features, Observation of Raman Spectra, Classical theory of Raman effect, Quantum theory of Raman effect, Vibrational Raman Spectra, Pure Rotational Raman Spectra, Vibrational- Rotational Raman Spectra, Structure determination from Raman Spectroscopy, Applications and its importance, Numerical Problems.

**Basic Reference Book:** Elements of Spectroscopy By Gupta,
Kumar, Sharma Publisher: Pragati Prakashan Twenty-eight Edition 2016.

**UNIT -3: (12 hour: 14 Mark)**

**Laser:** Three basic radiation process- Spontaneous emission, Stimulated emission, Absorption, Laser principle, Properties of Laser beam, Einstein's Coefficients, Population Inversion, Pumping Processes, Pumping Scheme, Metastable states, The principle pumping schemes, Types of Lasers:Ruby Laser, Nd:YAG Laser, He-Ne Laser,Semiconductor Laser, Holography: Principal of Holography-Recording of hologram, Reconstruction of image, Applications of Laser : Laser in industry, Laser induced fusion, Laser tracking, LIDAR, Numerical Problems.

**Basic Reference Book:** Elements of Spectroscopy By Gupta,
Kumar, Sharma Publisher: Pragati Prakashan Twenty-eight Edition 2016.

**UNIT -4: (12 hour: 14 Mark)**

**X-Rays and X-Ray Diffraction:** Production of X-rays, Properties of X-rays, Continuous X-ray Spectrum, Characteristic Emission Spectrum, Explanation of Emission Spectra, Diffraction of X-ray, Brag's Law, Laue Spots, Bragg's Spectrometer, Spectra, Reciprocal lattice, Properties of reciprocal lattice, Bragg diffraction equation in reciprocal lattice, Brillouin zones, Atomic scattering factors, Structure factor, Experimental methods for X-ray Diffraction: Laue method, Rotating crystal method, Powder diffraction method, Numerical Problems.

**Basic Reference Books:**

1. Elements of Spectroscopy By Gupta,
Kumar, Sharma Publisher: Pragati Prakashan Twenty-eight Edition 2016.
2. A text book of Solid State Physics, S.L.Kakani & C. Hemrajani,
Publisher: S.Chand &Company Ltd.

**UNIT -5: (12 hour: 14 Mark)**

**Fiber optics:** Optical Fibers, Necessary of cladding, Total internal reflection, Critical angle of Propagation, Modes of propagation, Acceptance angle, Fractional refractive index change, Numerical Aperture, Types of Optical Fibers, Losses in optical fiber – Attenuation, Distortion, Applications: Illumination & Image transmission, Military Applications, Medical Applications , Optical fiber Sensors, Fiber optic communication System, Merits of optical fibers, Numerical Problems.

**Basic Reference book** : A Text Book of Optics N.Subrahmanyan, Brij Lal & M.N.Avadhanulu, Publisher: S.Chand &Company Ltd.

**Other Reference Books:**


1. Fundamentals of Solid state Physics by Saxena, Gupta and Saxena, Publisher:Pragati Prakashan
2. Introduction to LASER by Tyagrajan.
3. Optics and Spectroscopy - R. Murugeshan & Kiruthiga Sivaprashatha. Publisher: S.Chand & Company Ltd.
4. Optical Electronics - A.K.Ghatak and K. Thyagarajan. Publisher: Cambridge Uni. Press.
5. A Text Book of Optics N.Subrahmanyan, Brij Lal & M.N.Avadhanulu, Publisher: S.Chand &Company Ltd.
6. Atomic Physics By J.B.Rajam. Publisher: S.Chand &Company Ltd.
7. Modern Physics By S.L.Kakani and Shubhra Kakani
8. Fundamental of Molecular Spectroscopy By Colin N Banwell & Elaine M McCash Publisher: TMG Latest Edition
9. Refresher Course in Physics Volume 1,2 & 3 By C.L.Arora

# B.Sc. Semester – 6 - Practical

Each student will have to perform **three (3) experiments ( one from each group)** in the University Examination.

Each Practical would be of 35 Marks and should be performed in a session of 3 Hours in practical exam.

There would be three sessions of 3 hours each for three experimental practical examination. Fourth session of 3 hours would be for the project work evaluation. (So, in total a student has to undergo four sessions (3 hours each) of practical +project evaluation examination)

There shall be **batch of 15 students** for practical exam in university examination.

## List of Experiments

### Group A

1. To Study of Resonance Pendulum.
2. To Determine the Young's Modulus by Koeing Method.
3. Determine the Elastic constants using Flat Spiral Spring.
4. Study of Platinum Resistance Thermometer.
5. Study of Searle's Goniometer.
6. Resolving power of Diffraction Grating.
7. To Study of Edser-Butler Plate.
8. To determine Planck's constant using Photocell.
9. Study of Temperature ON-OFF Controller with Thermistor.
10. To determine Young's modulus(Y), modulus of rigidity ($\eta$), Poission's ratio ($\sigma$) and bulk modulus (K) for the material of wire by Searl's arrangement.
11. To measure the divergence of a given LASER source.

12. To determine wavelength of LASER by Diffraction Gratting.
13. To determine refractive index of liquid by Bi prism.

## Group B

1. Photo Conductivity of Selenium cell
2. Characteristics of SCR.
3. Study of Linear Variable Differential Transformer (LVDT) Trainer.
4. To determine e/m by Thomson's method.
5. To verify the Thevnin's theorem.
6. To determine self inductance of a coil by Anderson's Bridge.
7. To study variation of thermo-electric emf with temperature for Thermo couple.
8. 'e' By Milikan's Method
9. e/K By Power Transistor
10. Convert a moving coil galvanometer into current meter& Voltmeter
11. Study of the Output Wave form Clipping circuit
12. Study of the Output Wave form Clamping circuit

## Group C

1. Study of OP-AMP using IC 741.(adder and Subtractor)/(inverter and noninverter).
2. To study the working of an OP-AMP as integrator and differentiator.
3. Study of IC 555 Timer circuit.
4. Study of Multiplexer(4-1 line) using (Discrete components or using IC.
5. Study of Demultiplexer(1-4 line) using (Discrete components or using IC
6. Study of Encoder & Decoder Circuit.
7. Study of 4-bit Ripple Counter.
8. Study of Astable/ Monostable Multivibrator.
9. Study of UJT as Relaxation Oscillator.

10. Study of RS, D & JK Flip-flop.
11. Study of Modulation and Demodulation using IC 723.

**Reference Books:**


1. Practical Physics by C.L.Arora ( S.Chand)
2. Advanced Practical Physics by Chauhan & Singh. (Pragati Prakashan)
3. B.Saraf et ai-Physics through experiments Vol.I & II
4. Electronic Laboratory Primer by Poorna Chandra & Sasikala, (S.Chand)
5. Practical Physics by Chattopadhyay, Rakshit & Saha.


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