

SAURASHTRA UNIVERSITY

RAJKOT

**Accredited Grade “A” by NAAC
(CGPA 3.05)**



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) <u>One practical from</u> <u>group A</u>	-	6	35(External)+ 15(Internal) = 50 Marks	3

5	Practical -2 (Group B) <u>One practical from</u> <u>group B</u>	-	6	35(External)+ 15(Internal) = 50 Marks	3
6	Practical -3 (Group C) <u>One practical from</u> <u>group C</u>		6	35(External)+ 15(Internal) = 50 Marks	3
7	Project Work & Viva	<ul style="list-style-type: none"> • 1 Guidance Lecture. for a group in a week. • 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.

B.Sc. (Physics)

Semester -5

Paper: Physics-501

(Mathematical Physics, Classical Mechanics & Quantum Mechanics)

Course duration:

Theory: 60 hours, 6 hours a week, Credit: 4

External Marks: 70, Internal Marks: 30, Total: 100

PAPER STYLE For paper 501

1. Syllabus of Physics paper 501 consists of 5 units:
2. All units carry 14 marks each.
3. There would be total 5 questions. One question from each unit.
4. Each question of 14 mark
5. Student can use the scientific (Non programmable) calculator.
6. Time duration:2.5 Hours

Question:1 from Unit 1 : Mark 14

Question:2 from Unit 2 : Mark 14

Question:3 from Unit 3 : Mark 14

Question:4 from Unit 4 : Mark 14

Question:5 from Unit 5: Mark 14

Each Question is divided in sub questions a,b,c and d as shown below

- (a) Short answer questions 4 [4 Marks] (All questions are compulsory)
(A short answer question may comprise of answer of One word, one line, explanation, definition, true or false, fill up the blanks, etc.)
- (b) Sums - Numerical problem solving questions: (1 out of 2) [2 Marks]
- (c) Moderate length questions: (1 out of 2) [3Marks] (In this section atleast one sum / numerical problem solving question should be preferably asked)
- (d) Long questions (1 out of 2) [5 Marks]

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, publisher: 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 coordinates, 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 ψ , 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.

B.Sc. (Physics)
Semester -5
Paper: Physics-502
(Electrodynamics and Relativity)

Course duration:

Theory: 60 hours, 6 hours a week, Credit: 4

External Marks: 70, Internal Marks: 30, Total: 100

PAPER STYLE For paper 502

1. Syllabus of Physics paper 502 consists of 5 units:
2. All units carry 14 marks each.
3. There would be total 5 questions. One question from each unit.
4. Each question of 14 mark
5. Student can use the scientific (Non programmable) calculator.
6. Time duration:2.5 Hours

Question:1 from Unit 1 : Mark 14

Question:2 from Unit 2 : Mark 14

Question:3 from Unit 3 : Mark 14

Question:4 from Unit 4 : Mark 14

Question:5 from Unit 5: Mark 14

Each Question is divided in sub questions a,b,c and d as shown below

- (a) Short answer questions 4 [4 Marks] (All questions are compulsory)
(A short answer question may comprise of answer of One word, one line, explanation, definition, true or false, fill up the blanks, etc.)
- (b) Sums - Numerical problem solving questions:(1 out of 2) [2 Marks]
- (c) Moderate length questions: (1 out of 2) [3Marks] (In this section atleast one sum / numerical problem solving question should be preferably asked)
- (d) Long question: (1 out of 2) [5 Marks]

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 \mathbf{E} and \mathbf{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. Murugesan
4. Electromagnetics - B.B.Laud
5. Electricity and Magnetism - K.K.Tiwari
6. Electricity and Magnetism - Berkeley Physics Course, Vol. II
7. Electricity and Magnetism By D.C. Tayal, Publisher: Himaliya publishing House.
8. Refresher Course in Physics Volume 1,2 & 3 By C.L.Arora

B.Sc. (Physics)
Semester -5
Paper: Physics-503
(Solid State Electronics)

Course duration:

Theory: 60 hours, 6 hours a week, Credit: 4

External Marks: 70, Internal Marks: 30, Total: 100

PAPER STYLE For paper 503

1. Syllabus of Physics paper 503 consists of 5 units:
2. All units carry 14 marks each.
3. There would be total 5 questions. One question from each unit.
4. Each question of 14 mark
5. Student can use the scientific (Non programmable) calculator.
6. Time duration:2.5 Hours

Question:1 from Unit 1 : Mark 14

Question:2 from Unit 2 : Mark 14

Question:3 from Unit 3 : Mark 14

Question:4 from Unit 4 : Mark 14

Question:5 from Unit 5: Mark 14

Each Question is divided in sub questions a,b,c and d as shown below

- (a) Short answer questions 4 [4 Marks] (All questions are compulsory)
(A short answer question may comprise of answer of One word, one line, explanation, definition, true or false, fill up the blanks, etc.)
- (b) Sums - Numerical problem solving questions: (1 out of 2) [2 Marks]
- (c) Moderate length questions: (1 out of 2) [3Marks] (In this section atleast one sum / numerical problem solving question should be preferably asked)
- (d) Long question: (1 out of 2) [5 Marks]

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. 4TH 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) by Lee's Method.
8. n 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 Hysteresis 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 Bridge.

Reference Books:

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