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

B.Sc. (Physics)

Semester -6

Paper: Physics-601

(Nuclear & Particle Physics)

Course duration:

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

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

PAPER STYLE For paper 601

1. Syllabus of Physics paper 601 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]

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

B.Sc. (Physics)
Semester -6
Paper: Physics-602
(Statistical Mechanics & Solid state physics)

Course duration:

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

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

PAPER STYLE For paper 602

1. Syllabus of Physics paper 602 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-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

B.Sc. (Physics)

Semester -6

Paper: Physics-603

(Spectroscopy and Applied Optics)

Course duration:

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

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

PAPER STYLE For paper 603

1. Syllabus of Physics paper 603 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) Small Length Questions: (1 out of 2) [2 Marks] (In this section sums / numerical problem solving questions should be preferably asked)

(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-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 (η), Poission's ratio (σ) 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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