R. J. COLLEGE

[Arts, Science & Commerce]
NAAC Re-Accreditation "A" Grade
"BEST COLLEGE" University of Mumbai

Autonomous

(Affiliated to Mumbai University)

Program Code: **RJSUPHY**

Syllabus for the S. Y. B.Sc. Course in Physics

(Choice Based Credit System with effect from academic year 2018-19)

Ramniranjan Jhunjhunwala College of Arts, Science and Commerce, Ghatkopar

Title : Syllabus for the B.Sc. Course in Physics (from academic year 2018-19) for Semester III & IV

Program Code: **RJSUPHY**

Objective :

Upon completion of the course, students should have acquired the following knowledge and skills:
1. a thorough quantitative and conceptual understanding of the core areas of physics, including mechanics, , thermodynamics, quantum mechanics, electronics at a level compatible with graduate programs in physics at peer institutions.

2. the ability to analyze and interpret quantitative results, both in the core areas of physics and interdisciplinary areas.

3. the ability to use contemporary experimental apparatus and analysis tools to acquire, analyze and interpret scientific data.

4. the ability to apply the principles of physics to solve new and unfamiliar problems.

5. the ability to communicate scientific results effectively in presentations or posters.

Eligibility:Passed semester I and Semester II**;** as per rules of passing

Evaluation: The evaluation will be as per the following pattern-

Theory component Total marks per paper = 100	Semester end evaluation	Continuation evaluation
	60 marks for semester end exam Duration: 2 hrs	40 marks for two class tests Duration: 30 min for each test
Practical component Total marks =150	60 % (120 marks)	40% (30 marks)

Question paper pattern: (pattern as per guidelines)

Syllabus in Physics (Theory and Practical)
as per Choice based Credit and Grading system
Second Year B.Sc. 2018-2019

The syllabus in Physics as per credit based system (with choice) of the Second Year B.Sc. course will be implemented from the academic year 2018-2019.

Objectives:
- To develop analytical abilities towards real world problems
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem solving hands on activities, study visits, projects etc.

Semester	Paper	Title	Credits
III	RJSUPHY301	Mechanics and thermodynamics	2
III	RJSUPHY302	Vector calculus ,Analog Electronics	2
III	RJSUPHY303	Applied Physics -I	2
III	RJSUPHY30P1 RJSUPHY30P2 RJSUPHY30P3	Practical course -3 (Group A,B,C and Skill)	3
		Total	**9**
IV	RJSUPHY401	Optics	2
IV	RJSUPHY402	Quantum Mechanics	2
IV	RJSUPHY403	Applied Physics-II	2
IV	RJSUPHY40P1 RJSUPHY40P2 RJSUPHY40P3	Practical course -4 (Group A,B,C and Demo)	3
		Total	**9**

SEMESTER III

RJSUPHY301: Mechanics and Thermodynamics

Learning Outcomes:
On successful completion of this course, students will be able to:
1. Understand the concepts of mechanics & properties of matter & to apply them to problems.
2. Comprehend the basic concepts of thermodynamics & its applications in physical situation.
3. Learn about situations in low temperature.
4. Demonstrate tentative problem solving skills in all above areas.

UNIT –I   **15 Lectures**

1. Oscillations ,The Simple Harmonic Oscillator , Relation between Simple Harmonic Motion and Uniform Circular Motion , Two Body Oscillations, Damped Harmonic Motion , Forced Oscillations and Resonance.
2. Compound pendulum:
   Expression for period, maximum and minimum time period, centres of suspension and oscillations,

reversible compound pendulum, Kater's reversible pendulum, compound pendulum and simple pendulum-a relative study.

3. Center of Mass , Motion of the Center of Mass , Linear momentum of a Particle, Linear momentum of a System of Particles , Linear momentum w.r.t. CM coordinate (i.e shift of origin from Lab to CM), Conservation of Linear Momentum , Some Applications of the Momentum Principle , System of Variable Mass (more problems)

UNIT –II   15 Lectures
(Review of zeroth and first law of thermodynamics)
1.   Conversion of heat into work, heat engine, Carnot's cycle: its efficiency.

2.   Second law of thermodynamics, Statements, Equivalence of Kelvin and Plank statement, Carnot's theorem, Reversible and irreversible process, Absolute scale of temperature.

3.   Clausius theorem, Entropy, Entropy of a cyclic process, Reversible process, Entropy change, Reversible heat transfer, Principle of increase in entropy, generalized form of first and second law, entropy change of an ideal gas, entropy of steam, entropy and unavailable energy, entropy and disorder, absolute entropy.

UNIT –III   15 Lectures
1.   Third law of thermodynamics, Nernst heat theorem, Consequences of the third law, Maxwell's thermodynamic relations, Clausius – Clapeyron equation, Thermal Expansion.
2.   Steam engine, Rankine cycle, Otto engine, Efficiency of Otto cycle, Diesel cycle, Efficiency of Diesel cycle, Otto and diesel comparison (more problems)
3.   Low temp Physics: Different methods of liquefaction of gases, methods of freezing, Cooling by evaporation, cooling by adiabatic expansion
      Joule - Thomson effect, JT effect of Vander Waal's gas, Liquefaction of helium, properties and uses of liquid Helium

References:
1. Resnick and Halliday : Physics – I
2. Mechanics – H. S. Hans and S. P. Puri, Tata McGraw Hill (2_{nd} ED.)
3. Thermal Physics, AB Gupta and H. Roy, Book and Allied (P) Ltd, Reprint 2008, 2009.
4. Heat thermodynamics and Statistical Physics, Brijlal, N. Subramanyam, P.S. Hemne, S. Chand, edition 2007.
5. Heat and Thermodynamics, Dittman & Zeemanskey, 7th Edition

Additional reference:
1. Mechanics by K.R Symon.
2. Classical Dynamics of particles and systems by Thornton and Marian, (CENGAGE Learning)
3. Basic Thermodynamics : Evelyn Guha (Narosa Publications)
4. Classical mechanics by Kleppener , Kollenkov
5. A treatise on heat :Meghanad Saha and B N Srivastava , 1969, India Press.
6. Mechanics and Electrodynamics Rev Edn. 2005 by Brijlal and Subramanyan and Jeevan Seshan.

RJSUPHY302: Vector Calculus, Analog Electronics

Learning Outcomes:
On successful completion of this course students will be able to:
1.   Understand the basic concepts of mathematical physics and their applications in physical situations.
2.   Understand the basic laws of electrodynamics and be able to perform calculations using them.
3.   Understand the basics of transistor biasing, operational amplifiers, their applications
4.   Understand the basic concepts of oscillators and be able to perform calculations using them.
5.   Demonstrate quantitative problem solving skill in all the topics covered.

Unit I: Vector Calculus   **15 Lectures**
1.   Line, Surface and Volume Integrals, The Fundamental Theorem of Calculus, The Fundamental Theorem of Gradient, The Fundamental Theorem of Divergence , The Fundamental Theorem of Curl (Statement and Geometrical interpretation is included, Proof of these theorems are omitted). Problems based on these theorems are required to be done.
2.   Curvilinear Coordinates: Cylindrical Coordinates, Spherical Coordinates

Unit II: Analog Electronics-I   **15 Lectures**
1.   Transistor Biasing, Inherent Variations of Transistor Parameters, Stabilization, Essentials of a Transistor Biasing Circuit, Stability Factor, Methods of Transistor Biasing, Base Resistor Method, Emitter Bias Circuit, Circuit analysis of Emitter Bias, Biasing with Collector Feedback Resistor, Voltage Divider Bias Method, Stability factor for Potential Divider Bias.
2.   General amplifier characteristics: Concept of amplification, amplifier notations, current gain, Voltage gain, power gain, input resistance, output resistance, general theory of feedback, reasons for negative feedback, loop gain.
3.   Practical circuit of transistor amplifier, phase reversal, frequency response, Decibel gain and Band width.

Unit III: Analog Electronics-II   **15 Lectures**
1.   Oscillators: Introduction, effect of positive feedback. Requirements for oscillations, phase shift oscillator, Wien Bridge Oscillator, Colpitt's oscillator, Hartley oscillator

2.   Operational Amplifiers: Introduction, Schematic symbol of OPAMP, Output voltage from OPAMP, AC analysis, Bandwidth of an OPAMP, Slew rate, Frequency Response of an OPAMP, OPAMP with Negative feedback, Inverting Amplifier, Non-Inverting Amplifier, Voltage Follower, Summing Amplifier, Applications of Summing amplifier, OPAMP as Difference Amplifier, OPAMP Integrator and Differentiator, Critical frequency of Integrator, Comparator

References:
1.   Introduction to Electrodynamics 3rd Ed by D.J. Griffith
2.   Principles of Electronics – V. K. Mehta and Rohit Mehta. (S. Chand –Multicoloured illustrative edition)
3.   Electronic devices and circuits – An introduction - Allan Mottershead (PHI Pvt. Ltd.– EEE – Reprint – 2013)

RJSUPHY303: Applied Physics – I

This paper consists of three modules (units) designed in a way so as to offer interdisciplinary & application oriented learning.

Learning Outcomes :
On completion of this, it is expected that
1. Students will be exposed to contextual real life situations.
2. Students will appreciate the role of Physics in 'interdisciplinary areas related to materials, Bio Physics, Acoustics etc.
3. The learner will understand the scope of the subject in Industry & Research.
4. Experimental learning opportunities will faster creative thinking & a spirit of inquiry.

Unit I :   Acoustics , Lasers and fibre optics   **15 Lectures**
1. Acoustics of Buildings: Reverberation, Sabine's formula (without derivation) Absorption coefficient, Acoustics of Buildings, factors affecting Acoustics of Buildings, Sound distribution in an auditorium.
2. Laser : Introduction, transition between Atomic energy states (without   derivation), Principle of Laser, Properties of Laser, Helium–Neon Laser, Application of Laser, Holography
3. Fibre Optics: Light propagation through Fibres, Fibre Geometry, Total Internal reflection, Numerical Aperture, Step-Index and Graded-Index Fibres, Applications of Optical Fibres.

References:
1. Modern Physics Concept and Applications – Sanjeev Puri, Narosa Publication.
2. Properties of matter and Acoustics – R Murugeshan and K. Shivaprasath, S Chand &Co.Ltd. (2005-Ed)

Unit II :   Biophysics   **15 Lectures**

Introduction to Biophysics, Biological fluids, Physical-chemical properties: Viscosity, Surface tension, Diffusion, Cell – a unit of life, Fundamental understanding of prokaryotic and eukaryotic cell structure and functions, Electrical properties of cell - membrane potential, Action potential, propagation of action potential, Nernst equation, Goldman equation, Voltage clamp technique.

References:
1. Text Book of Biophysics by R N Roy
2. The Cell: A Molecular Approach by Geoffrey Cooper
3. Medical Physiology by Guyton
4. Molecular Biology of Cell by Bruce Albert

Unit III : Materials – properties and applications   **15 Lectures**
1. Introduction to Materials
   Classification of Materials based on structures (Crystalline and Amorphous, single crystal, polycrystalline and nanomaterials) and Functionality (Conducting, insulating, superconducting, reflecting, transmitting etc)
2. Types of Materials: Metals and alloys, Ceramics and Polymers Thin Films
   (mention) Nanomaterials(mention);
3. Properties of materials
   Electrical Properties: Review of energy band diagram for materials - conductors, semiconductors

and insulators, Electrical conductivity in metals, semiconductors and insulators (dielectrics), effect of temperature on conductivity.

Magnetic Properties: Origin of magnetism in solids (basic idea), Types of magnetic order (paramagnetism, diamagnetism, antiferro magnetism, ferromagnetism, ferrimagnetism), magnetic hysteresis

References:
1. Electronic Properties of Materials by Rolf E Hummel
2. Materials Science and Engineering: A First Course by V. Raghavan

RJSUPHY30P1:Practical course -3

Instructions:
i)   All the measurements and readings should be written with proper units in SI system only.
ii)   After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.
iii) While evaluating practical, weight age should be given to circuit/ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
iv)   Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

Learning outcomes:
On successful completion of this course students will be able to :
i)   Understand &practice the skills while performing experiments.
ii)   Understand the use of apparatus and their use without fear& hesitation.
iii) Correlate the physics theory concepts to practical application.
iv)   Understand the concept of errors and their estimation.

Note: Exemption of two experiments from section A and / or B and / or C may be given if student carries out any one of the following activity.
1.   Collect the information of at least five Physicists with their work or any three events on physics, report that in journal.
2.   Execute a mini project to the satisfaction of teacher in-charge of practical.
3.   Participate in a study tour or visit & submit a study tour report.
For practical examination, the learner will be examined in three experiments (one from each group). Each experiment will be of three hours' duration, Minimum 4 from each group and in all minimum 12 experiments must be reported in journal.
All the skill experiments are required to be completed compulsorily. Students are required to report all these experiments in the journal. Evaluation in viva voce will be based on regular experiments and skill experiments.
A learner will be allowed to appear for the semester and practical examination only if he submits a certified journal of Physics or a certificate that the learner has completed the practical course of Physics Semester III as per the minimum requirements.

RJSUPHY30P1 (Group A)

1. Flat spiral spring (η)
2. Kater's pendulum
3. Young's modulus by Koenig's method.
4. Determination of thermal conductivity of bad conductor by Lee's Method.
5. Verification of Stefan's law (electrical method) (3 graph method)
6. Charging and discharging of capacitor.
7. Figure of merit of a mirror galvanometer.
8. Measurement of resistance of galvanometer (G by shunting)

RJSUPHY30P2 (Group B)

1. Passive low pass filter
2. Passive high pass filters.
3. Op-amp: Inverting amplifier with different gains
4. Op-amp: Non-inverting amplifier with different gains and voltage follower
5. CE amplifier: variation of gain with load
6. Lissajous figures using CRO.
7. Colpitts oscillator
8. LCR parallel Resonance

RJSUPHY30P3 (Group C)

1. Determination of λ(wavelength) of Laser using single slit
2. Optical fibre: transmission of signal
3. Study of beats
4. Study of Coupled oscillations and resonance
5. Standardization of pH meter & acid-base titration.
6. Determination of Y- Flat spiral spring
7. Synthesis of materials - mini project - thin film/nano materials/bulk powders using different routes etc.
8. Visit to research institutes (equivalent to three practical sessions).

Skill experiments

1. Wiring of a simple circuit using bread board
2. Use of DMM
3. Use of oscilloscope
4. Travelling microscope (to find element of wire mesh)
5. Spectrometer: optical leveling and Shuster's method and determination of Angle of prism.
6. Component testing, colour code of resistors, capacitors etc.
7. Drawing of graph on semi logarithmic.
8. Estimation of uncertainties.

References:
1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit& B Saha. (6th Edition) Book and Allied Pvt.Ltd.
2. B.Sc Practical Physics – Harnam Singh S.Chand& Co. Ld. 2001
3. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency

(3rd edition)
4. B.Sc. Practical Physics – C L Arora (1st Edition) -2001 S.Chand and Co Ltd.
5. Practical Physics CL Squires (3rd Edition) Cambridge University
6. University Practical Physics – D C Tayal. Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint.

SEMESTER IV

RJSUPHY401: OPTICS

Learning Outcomes:
On successful completion of this course students will be able to :
1. Understand the diffraction and polarization processes and applications of them in physical situations.
2. Understand the applications of interference in design and working of interferometers.
3. Understand the resolving power of different optical instruments.
4. Demonstrate quantitative problem solving skills in all the topics covered.

Unit I: Diffraction   **15 Lectures**
1. **Fresnel's Diffraction**: Fresnel's assumptions, Rectilinear propagation (Half period zones) of light, Diffraction pattern due to straight edge, Positions of maxima and minima in intensity, Intensity at a point inside the geometrical shadow(straight edge), Diffraction due to a narrow slit, Diffraction due to a narrow wire
2. **Fraunhoffer Diffraction :** Introduction, Fraunhoffer diffraction at a single slit, Intensity distribution in diffraction pattern due to a single slit, Fraunhoffer diffraction at a double slit, Distinction between single slit and double slit diffraction pattern and missing orders, Plane diffraction Grating, Theory of plane transmission grating, Width of principal maxima .

Unit II: Polarization   **15 Lectures**

1. Introduction, Plane polarized light, Circularly polarized light, Elliptically polarized light, Partially polarized light.
2. Production of Plane polarized light- Polarization by reflection from dielectric surface, Polarization by refraction –pile of plates, Polarization by scattering, Polarization by selective Absorption, Polarization by double refraction.
3. Anisotropic crystal, Calcite crystal, Optic Axis, Polarizer and Analyzer, Malus' Law, Double refraction in calcite crystal, Huygens' explanation of double refraction, Ordinary and Extra ordinary rays, Positive and Negative crystals. Superposition of waves linearly polarized at right angles, Superposition of e-Ray and o-Ray.
4. Retarders, Quarter wave plate, Half wave plate, Production of linearly, elliptically, circularly polarized light.
5. Analysis of polarized light,Applications of polarized light.

Unit III: **15 Lectures**
1. **Interferrometry**
   Michelson's interferometer and its applications, Fabry-Perot Interferrometer and its applications

2. **Resolving power of optical instruments**
   Rayleigh's criterion, R P of telescope, prism, grating

References:
1. A Text Book Of Optics By: Dr.N.Subrahmanyam, Brijlal, Dr M.N. Avadhaanulu (S.Chand, 25th Revised edition2012 Reprint 2013)
2. OPTICS (4thEdition) : Ajoy Ghatak(The McGraw Hill)
3. Optics by Eugene Hecht (Pearson Education)
4. Optics and Atomic Physics: Singh and Agarwal (Pragati Prakashan)

RJSUPHY402: QUANTUM PHYSICS

Learning Outcomes :

On successful completion of this course students will be able to:

1. Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics.
2. Demonstrate quantitative problem solving skills in all the topics covered.

Background Reading (Review):

Origin of Quantum Mechanics:
1. Review of Black body radiation, Review of photoelectric effects.
2. Matter waves-De Broglie hypothesis. Davisson and Germer experiment.
3. Wave particle duality
5. Concept of wave packet, phase velocity, group velocity and relation between them
6. Heisenberg's uncertainty principle with thought experiment, different forms of uncertainty.

Unit I: The Schrodinger wave equation: **15 Lectures**

1. Concept of wave function, Born interpretation of wave function.
   Concepts of operator in quantum mechanics examples – position, momentum and energy operators.
   Eigen value equations, expectation values of operators.
2. Schrodinger equation, Postulates of Quantum Mechanics, Analogy between Wave equation and Schrodinger equation, Time dependent and time independent (Steady State) Schrodinger equation, Stationary State.
3. Superposition principle, Probability current density, Equation of continuity and its physical significance.

Unit II: Applications of Schrodinger steady state equation- I   **15 Lectures**
1. Free particle, Particle in infinitely deep potential well (one - dimension).
2. Particle in finitely deep potential well (one - dimension).
3. Step potential, Particle in three dimension rigid box, degeneracy of energy state.

Unit III: Applications of Schrodinger steady state equation –II   **15 Lectures**

1. Potential barrier (Finite height and width) penetration and tunneling effect (derivation of approximate

transmission probability), Application (STM and SEM).
2. Theory of alpha particle decay from radioactive nucleus.
3. Harmonic oscillator (one-dimension), correspondence principle.

[Note: A good number of numerical examples are expected to be covered during the prescribed lectures].

Reference Books:
1. Concepts of Modern Physics – A. Beiser (6th Ed.) Tata McGraw Hill.
2. Quantum Mechanics – S P Singh, M K Bagade, Kamal Singh, - S. Chand : 2004 Ed.
3. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles. - By R. Eisberg and R. Resnik Published by Wiley.
5. Introduction to Quantum Mechanics. - By D. Griffiths Published by Prentice Hall.
6. Quantum Mechanics. - By Ghatak and Lokanathan Published by Mc. Millan.
7. Quantum Mechanics. - By L. I. Schiff.
8. Quantum Mechanics. - By Powell and Crasemann, Addison-Wesley Pub. Co.

RJSUPHY403 : APPLIED PHYSICS_II

Learning Outcomes :
On successful completion of this course, students will be able to :
i) Understand the concepts of mechanics & properties of matter & to apply them to problems.
ii) Comprehend the basic concepts of thermodynamics & its applications in physical situation.
iii) Learn about situations in low temperature.
iv) Demonstrate tentative problem solving skills in all above areas.

Unit I :Digital Electronics   **15 Lectures**

Background knowledge (devote one lecture at commencement):

1.Binary number system , Arithmetic building blocks , Types of registers, Digital IC signal levels, Binary to Decimal ,Decimal to binary , Hexadecimal number, Hexadecimal to decimal Conversion, Decimal to hexadecimal conversion, Hexadecimal to binary conversion, Binary to hexadecimal conversion, Binary addition, Unsigned binary numbers, Sign magnitude numbers , 2's complement , Converting to and from 2's complement representation , 2's complement arithmetic, The adder-subtractor (ignore IC specific diagrams)

2.RS Flip-Flops (only NOR gate latch, NAND gate latch) , Gated Flip-Flops, Edge-Triggered RS Flip-Flop, Edge- Triggered D Flip-Flop, Edge-Triggered J-K Flip-Flop, JK Master- Slave Flip-Flops, Bounce elimination switch

3.Types of registers: SISO, SIPO, PISO, PIPO [in this chapter the teacher should make all IC specific diagrams into general diagrams ie. Ignore pin numbers and IC numbers]

4.Asynchronous counter -3 bit (ignore IC specific diagrams), Synchronous counter only mod 8, Decade Counters Mod5 and Mod10

Unit II : Communication Techniques   15 Lectures

1. Basics of Communication

Block diagram of communication system, types of communication system: simplex, duplex, analog and digital communication,

Electromagnetic spectrum, base band and broad band communication.

2. Noise

Introduction, Internal and External noise, signal to noise ratio, noise figure, noise temperature.

3. Amplitude Modulation

Need of modulation, concept of modulation, AM waveform, Theory of AM techniques, Concept of side bands, Concept of sidebands, DSBSC, SSB technique, VSB technique, Generation of SSB and CSBSC signal, Demodulation principles. AM Receiver: TRF and super-heterodyne receiver,

4. Frequency Modulation

Definition, Mathematical representation, Frequency spectrum, Bandwidth and modulation index.

5. Digital Modulation Techniques: ASK, PSK, FSK

Pulse Modulation Techniques: PAM, PWM, PPM, PCM.

6. Antenna: Introduction, Antenna equivalent circuits, Isotropic radiator, Power gain of an antenna, Effective length and area of an antenna

References:

1. Digital Principles and AplicationsBy Leach, Malvino, Saha 6[th]edn.
2. Digital Fundamentals by Thomas L Floyd 10[th]edn. (Additional Reading)
3. Modern Digital Electronics by R P Jain 4[th]edn. (Additional Reading)
4. Communication Electronics: Principles and applications by Louis E Frenzel 3rd edition TMH Publications.
5. Electronics Communication Systems by Kennedy
6. Telecommunication Switching Systems and Network by Vishwanathan and Thiagarajan, PHI publication.
7. Electronics Communication Systems by Denis Roddy and John Coolen, PHI publication.
8. Principles of Communication System by Herbert Taub and Schilling

Unit III: Introduction to Geophysics   15 Lectures
1. Introduction to Geophysics its branches and relationship with other sciences.
2. Earth and solar system: Meteorites and other extra-terrestrial materials.
3. Age of Earth and various methods of determination. Planetary evolution of the Earth and its

internal structure: Elastic waves and variation of physical and chemical properties in the interior of Earth.

4. Major tectonic features of the ocean oceanic and continental crust.
5. Continental drift – geological and geophysical evidence: mechanisms, objections and present status.
6. Gravity and magnetic anomalies at Mid-ocean ridges: deep sea trenches, continental shield areas and mountain chains.
7. Geomagnetism, elements of Earth's magnetism: Internal, external fields and their causes, Palaeomagnetism, Polar wandering paths and reversals, Seafloor spreading and Plate tectonics.
8. Seismic belts of the Earth: Seismicity and plate movements.
9. Geodynamics of the Indian plate.
10. Utility of the different geophysical techniques (discussed above) in exploration for academic as well as for harnessing resources. Geophysical potential fields: Principles of Gravity and Magnetic methods.
11. Instrumentation, field procedures used in geophysical studies.
12. Problems.

References:

1. *Geomagnetism: Solid Earth and Upper Atmosphere Perspectives.* Nathani Basavaiah, Springer (2011).

2. *Introduction to Applied Geophysics: Exploring the Shallow Subsurface.* H.R. Burger, A.F. Sheehan and C.H. Jones. W.W. Norton, New York (2006).

3. *Earth Science.* E.J. Tarbuck, F.K. Lutgens and D. Tasa, Prentice & Hall (2005).

4. *Mantle Plumes and Their Record in Earth History.* K.C. Condie, Cambridge University Press, Cambridge, UK (2001)

5. *The Magnetic Field of the Earth: Paleomagnetism, the Core, and the Deep Mantle.* R.T. Merrill, M.W. McElhinny and P.L. McFadden, International Geophysical Series 63, Academic Press (1996).

6. *Applied Geophysics (Paperback).* W.M. Telford, L.P. Geldart and R.E. Sheriff, Cambridge University Press, Cambridge (1990).

Additional References:

1. *Energy and Environment, 3rd Edition.* Robert A. Ristinen and Jack P. Kraushaar, John Wiley and Sons, Inc. (2015).

2. *Geomagnetism: Solid Earth and Upper Atmosphere Perspectives.* Nathani Basavaiah, Springer (2011).

3. *Textbook of Environmental Chemistry.* Balaram Pani, I.K. International Publishing House (2007).

4. *A Textbook of Environmental Studies, 1/e.* D.K. Asthana and Meera Asthana, S. Chand and Co. Publishing (2006).

RJSUPHY40P: Practical course

Instructions:
  i. All the measurements and readings should be written with proper units in SI system only.
  ii. After completing all the Required number of experiments in the semester and recording them in
  iii. Students will have to get their journal certified and produce the certified journal at the time of practical examination.
  iv. While evaluating practical, weight age should be given to circuit/ray diagram, observations, tabular representation, experimental skills and procedure, graph,

calculation and result.
      v.   Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

Learning Outcomes :
On successful completion of this course students will be able to :
i)   Understand & practice the skills while performing experiments.
ii)   Understand the use of apparatus and their use without fear & hesitation.
iii)   Correlate their physics theory concepts to practical application.
iv)   Understand the concept of errors and their estimation.

For practical examination the learner will be examined in the experiments (one from each group) . Each experiment will be of three hour duration;

Minimum 4 from each group and in all minimum 12 experiments and demonstration experiments are required to be completed compulsorily.

Students are required to report all these experiments in the journal. Evaluation in viva voce will be based on regular experiments and skill experiments.

A learner will be allowed to appear for the semester and practical examination only if he submits a certified journal of Physics or a certificate that the learner has completed the practical course of Physics Semester III as per the minimum requirements.

RJSUPHY40P1 (Group A)

1. Optical lever: determination of μ
2. Cylindrical obstacle: determination of λ
3. Fresnel's bi-prism: determination of λ
4. Determination of Cauchy's constants.
5. R.P. of telescope.
6. Brewster's law: determination of μ
7. Determination of R.I. of liquid using laser
8. μ by total internal reflection

RJSUPHY40P2 (Group B)

1. Square wave oscillator using gates.
2. Half adder and full adder (7486, 7408)
3. Transistorized Astable multivibrator
4. Transistorized Monostable multivibrator
5. Transistorized Bistable multivibrator
6. Op-Amp as Astable multivibrator
7. IC 555 timer as Astable multivibrator
8. IC 555 timer as Monostable multivibrator

RJSUPHY40P3 (Group C)

1. R-S Flipflop
2. Study of MS-JK flip flop
3. Mod 2, 5, 10 counters
4. To study Amplitude Modulation
5. Frequency Shift Keying(FSK) using IC 555 or XR 2206
6. Determination of λ(wavelength) of Laser using Transmission Grating

7.Determination of sound absorption coefficient of a material

8.Visit to research institute (Equivalent to three practical sessions)

Demonstration Experiments

1. Double refraction
2. Wave form generator using Op-amp
3. PC simulations: graph, curve fitting etc.
4. Straight edge Fresnel diffraction
5. Fibre Optics
6. DSO computational physics
7. Interferometer (Michelson's)
8.Polarimeter

References:
1. Advanced course in Practical Physics D. Chattopadhya, P C Rakshit & B Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B. Sc PRACTICAL Physics – Harnam Singh S.Chand & Co. Ld. 2001
3. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics – CL Arora (1st Edition) -2001 S.Chand and Co Ltd.
5. Practical Physics CL Squires (3rd Edition) Cambridge University
6. University Practical Physics – DC Tayal. Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint.

S Y B Sc (Credit Based Semester and Grading System) PHYSICS
Program code: RJSUPHY

Course Outcomes:
Upon completion of this program, students will be able to:

1	Understand the basic laws of electrodynamics and be able to perform calculations using them.
2	Understand the basic concepts of mathematical physics and their applications in physical situations.
3	Understand the basics of transistor biasing, operational amplifiers, their applications.
4	Understand the basic concepts of oscillators and be able to perform calculations using them.
5	Understand the role of Physics in interdisciplinary areas related to materials, Bio Physics, Acoustics etc.
6	Understand the scope of the subject in Industry & Research.
7	Understand the diffraction and polarization processes and applications of them in physical situations.
8	Understand the applications of interference in design and working of interferometers and understand the resolving power of different optical instruments.
9	Understand the working of digital circuits and use IC 555 timer for various timing applications.
10	Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics.
11	Demonstrate quantitative problem solving skills in all the topics covered.

Learning Outcomes:
On successful completion of the course, students will be able to

1	Understand the concept of compound pendulum, differentiate between simple and compound pendulum, and study the working of Kater's pendulum as an example of compound pendulum.
2	Learn concepts of center of mass and linear momentum of a system of particles, conservation of linear momentum and its applications.
3	Understand the concept of angular momentum, its law of conservation and solve the related problems.
4	Analyze the relation between simple harmonic motion and uniform circular motion, Resonance and forced oscillations.
5	Understand the concept of conversion of heat into work and study its application in Carnot's heat engine and calculate its efficiency.
6	State and prove second law of thermodynamics, Carnot's theorem, Clausius theorem, generalized form of first and send law of thermodynamics.
7	Explain third law of thermodynamics and its consequences, state Nernst heat theorem, explain Clausius-Clapeyron equation.
8	Study comparatively the construction and working of Otto and Diesel engine and their efficiencies, understand the concept of low temperature of Physics, liquefaction of gases,

	different methods of cooling of gases, Joule-Thompson effect of Vander Wall's gases, application of liquid helium.
9	Understand the fundamental theorems of divergence, curl and gradient and solve problems based on these theorems.
10	Study comparatively the cylindrical and spherical ordinates.
11	Understand the concept methods of transistor biasing and do the circuit analysis.
12	Explain the concept of amplification and its parameters, its practical application as a transistor amplifier, study its frequency response.
13	Study the effect of positive feedback in oscillator, types of oscillators as a practical application.
14	Understand the concept of operational amplifier, its ideal parameters, AC analysis, and various applications of operational amplifier in electronics field.
15	Explain the application of sound in the designing buildings, concert halls and factors affecting the acoustics of buildings.
16	Understand the concept of laser and its application in holography, industry, medical fields, to study the application of optical fibers in optical communication and solve problems to calculate critical, acceptance angle and numerical aperture.
17	understand the scope of biophysics, properties of biological fluids, Fick's law of diffusion, study of structure, types and function of a cell, transport process through biological membrane, study of action potential and methods of measurement of action potential, its correlation with physical parameters like impedance and capacitance.
18	Classify materials on the basis of structure and functionality, study comparatively types of materials like nanomaterials, polymers and composites, thin films, learn the methods of material synthesis, both physical and chemical methods.
19	Describe electrical, optical and magnetic properties of materials.
20	Study the applications of optical, magnetic and dielectric materials in real life situations.
21	Distinguish between Fresnel and Fraunhoffer diffraction. Study Fresnel diffraction pattern at a straight edge, differentiate between the diffraction patterns due to single slit and double slit.
22	Classify polarized light and describe the methods of producing polarized light. Study the Malu's law and Brewster's law of polarization. Study the practical examples where polarization phenomenon is used. Differentiate between quarter wave plate and half wave plate and solve problems based on the thickness of wave plate formula.
23	Study the phenomenon of double refraction and correlate it with Huygen's thory. Study the superposition of linearly polarized waves which are at right angles to each other.
24	Study the binary and hexadecimal number systems and their inter conversion. Correlate the conversion with basic binary addition, subtraction circuits which are used in digital electronics.
25	Study types of Flip-flops and their importance in digital counter circuits. Differentiate registers based on data transfer mode. Distinguish between asynchronous and synchronous counters.
26	Study the postulates of Quantum Mechanics and understand the analogy between wave equation and Schrodinger's equation. Differentiate between Schrodinger's time dependent and independent equations, state superposition principle.

27	study the cases of application of one dimensional Schrodinger's steady state equation to free particle, particle in finite and infinitely deep potential well, step potential and particle in three dimensional rigid box.
28	Study the application of one dimensional Schrodinger's steady state equation to harmonic oscillator and explain correspondence principle.
29	Study the relation between geophysics and other branches of science. Study various methods of determination of age of earth.
30	Explain the geological and geophysical evidence of continental drift.
31	Concept of geomagnetism and explain various elements of earth's magnetism. Explain Seismicity and Geodynamics of the Indian plate.
32	Study the effect of urbanization, mining, a costal and desert management on ecosystem.
33	Analyze scientifically the natural hazards like earthquake, landslide, Tsunami and floods. Do the case study of impact assessment of Anthropogenic activities such as heavy metal pollution in Mumbai aquatic system with industrial waste and Thermal power plant.
34	Study the internal structure of 8085 microprocessor. Explain its bus organization. Explain the terms related to assembly language programming using 8085 microprocessor.
35	Study various sources of radiation and its effects. Explain types of radiation detectors and analyzers.
36	Differentiate between analog and digital communication system. What is the need of modulation?
37	Describe amplitude modulation and demodulation process in digital communication system.
38	Describe frequency modulation and derive expression for modulation index. Explain the concepts of Amplitude Shift Keying, Frequency Shift Keying, Phase Shift keying modulation processes.