MAA PATESWARI UNIVERSITY, BALRAMPUR UTTAR PRADESH

DEPARTMENT OF PHYSICS

COMMON MINIMUM CURRICULAM

FOR UNIVERSITY CAMPUS AND AFFILIATED COLLEGE

National Education Policy -2020

Common Minimum Syllabus for all U.P. State Universities

MAA PATESWARI UNIVERSITY, BALRAMPUR, U.P.

MAA PATESWARI UNIVERSITY, BALRAMPUR, UTTAR PRADESH

Structure of Syllabus for the Program: B. Sc. Subject: Physics

w. e. f. Session 2025-26

Structure of Syllabus Developed by			
Name of BOS Convener/ BOS Member	**Designation**	**Department**	**College/ University**
Prof. Jitendra Singh	Convener	Faculty of Physics	Shri Lal Bahadur Shastri Degree College, Gonda
Dr. Alok Shukla	Member	Physics	M. L. K. P. G. College, Balrampur
Sri Santosh Kumar Srivastava	Member	Physics	Shri Lal Bahadur Shastri Degree College, Gonda
Dr. Suraj Kumar Rai	Member	Physics	A. N. D. Kisan P. G. College, Babhnan, Gonda
Prof. Rakesh Tiwari	External Expert	Physics	Pt. Deen Dayal Upadhyay University, Gorakhpur
Prof. Om Prakash Yadav	External Expert	Physics	K.S. Saket P.G. College, Ayodhya
Dr Ram Kishor Singh	External Expert	Physics	Shivpati Degree College, Shohratgarh, Siddharthnagar

MAA PATESWARI UNIVERSITY, BALRAMPUR, U.P.

Syllabus for B.Sc.

SUBJECT: PHYSICS

SEMESTER WISE TITLES OF THE PAPERS OF PHYSICS AS MAJOR SUBJECT IN B.Sc. PROGRAM					
YEAR	**COURSE CODE**	**PAPER TITLE**	**THEORY/ PRACTICAL**	**CREDITS**	**MAX. MARKS**
FIRST		**SEMESTER-I**			
	B010101T	MATHEMATICAL PHYSICS AND NEWTONIAN MECHANICS	THEORY	4	100
	B010102P	PRACTICAL	PRACTICAL	2	100
		SEMESTER-II			
	B010201T	THERMAL PHYSICS & SEMICONDUCTOR DEVICES	THEORY	4	100
	B010202P	PRACTICAL	PRACTICAL	2	100
SECOND		**SEMESTER-III**			
	B010301T	ELECTROMAGNETIC THEORY & COMMUNICATION SYSTEMS	THEORY	4	100
	B010302P	PRACTICAL	PRACTICAL	2	100
		SEMESTER-IV			
	B010401T	PERSPECTIVES OF MODERN PHYSICS & MODERN OPTICS	THEORY	4	100
	B010402P	PRACTICAL	PRACTICAL	2	100
THIRD		**SEMESTER-V**			
	B010501T	CLASSICAL & STATISTICAL MECHANICS	THEORY	6	100
	B010502T	DIGITAL ELECTRONICS & MICROPROCESSOR	THEORY	4	100
	B010503P	PRACTICAL	PRACTICAL	2	100
		SEMESTER-VI			
	B010601T	QUANTUM PHYSICS & SPECTROSCOPY	THEORY	6	100
	B010602T	SOLID STATE & NUCLEAR PHYSICS	THEORY	4	100
	B010603P	PRACTICAL	PRACTICAL	2	100

MAA PATESWARI UNIVERSITY, BALRAMPUR, U.P.

Marking distribution out of 100: **25 Marks: Assessment, Attendance & Mid Semester Test**
75 Marks: Theory Paper
25 Marks: Internal Practical Exam
75 Marks: External Practical Exam

PROGRAMME OUTCOMES (POs)

The practical value of science for productivity, for raising the standard of living of the people is surely recognized. Science as a power, which provides tools for effective action for the benefit of mankind or for conquering the forces of Nature or for developing resources, is surely highlighted everywhere. Besides the utilitarian aspect, the value of Science, lies in the fun called intellectual enjoyment. Science teaches the value of rational thought as well as importance of freedom of thought.

Our teaching so far has been aimed more at formal knowledge and understanding instead of training and application oriented. Presently, the emphasis is more on training, application and to some extent on appreciation,the fostering in the pupils of independent thinking and creativity. Surely, teaching has to be more objective based. The process of application based training, whether we call it a thrill or ability, is to be emphasized as much as thecontent.

Physics is a basic science; it attempts to explain the natural phenomenon in as simple a manner as possible. It is an intellectual activity aimed at interpreting the Multiverse. The starting point of all physics lies in experience. Experiment, whether done outside or in the laboratory, is an important ingredient of learning physics and hence the present programme integrates six experimental physics papers focusing on various aspects of modern technology based equipments. With all the limitations imposed (even the list of experiments as given in the syllabus) if the spirit of discovery by investigation is kept in mind, much of the thrill can be experienced.

1. The main aim of this programme is to help cultivate the love for Nature and its manifestations, to transmit the methods of science (the contents are only the means) to observe things around, to generalize, to do intelligent guessing, to formulate a theory & model, and at the same time, to hold an element of doubt and thereby to hope to modify it in terms of future experience and thus to practice a pragmatic outlook.
2. The programme intends to nurture the proficiency in functional areas of Physics, which is in line with the international standards, aimed at realizing the goals towards skilled India.
3. Keeping the application oriented training in mind; this programme aims to give students the competence in the methods and techniques of theoretical, experimental and computational aspects of Physics so as to achieve an overall understanding of the subject for holistic development. This will cultivate in specific application oriented training leading to their goals of employment.
4. The Bachelor's Project (Industrial Training / Survey / Dissertation) is intended to give an essence of research work for excellence in explicit areas. It integrates with specific job requirements / opportunities and provides a foundation for Bachelor (Research) Programmes.

PROGRAMME SPECIFIC OUTCOMES (PSOs)	
FIRST YEAR	• This programme aims to give students the competence in the methods and techniques of calculations using Newtonian Mechanics and Thermodynamics. At the end of the course the students are expected to have hands on experience in modeling, implementation and calculation of physical quantities of relevance. • An introduction to the field of Circuit Fundamentals and Basic Electronics which deals with the physics and technology of semiconductor devices is practically useful and gives the students an insight in handling electrical and electronic instruments. • Experimental physics has the most striking impact on the industry wherever the instruments are used. The industries of electronics, telecommunication and instrumentation will specially recognize this course.
SECOND YEAR	• This programme aims to introduce the students with Electromagnetic Theory and Relativistic Mechanics. Electromagnetic Wave Propagation serves as a basis for all communication systems and deals with the physics and technology of semiconductor optoelectronic devices. These are becoming important components in consumer Optoelectronics, IT and Communication devices, and in industrial instrumentation. • The need of Optical instruments and Lasers is surely highlighted everywhere and at the end of the course the students are expected to get acquaint with applications of Lasers in technology. • Companies and R&D Laboratories working on Electromagnetic properties, Laser Applications, Optoelectronics and Communication Systems are expected to value this course.
THIRD YEAR	• This programme contains very important aspects of modern day course curriculum, namely, Classical, Quantum and Statistical computational tools required in the calculation of physical quantities of relevance in interacting many body problems in physics. It introduces the branches of Solid State Physics and Nuclear Physics that are going to be of utmost importance to both undergraduate and graduate level. Proficiency in this area will attract demand in research and industrial establishments engaged in activities involving applications of these fields. • This course amalgamates the comprehensive knowledge of Digital Electronics and Microprocessor. It presents an integrated approach to hardware and software in context of the 8085 microprocessor. • Present course will attract immense recognition in R&D sectors and in the entire cutting edge technology based industry.

B.Sc. I (SEMESTER-I) PAPER-I
MATHEMATICAL PHYSICS & NEWTONIAN MECHANICS

Programme: B.Sc.	Year: First	Semester: First
Subject: Physics		
Course Code: B010101T	Course Title: MATHEMATICAL PHYSICS & NEWTONIAN MECHANICS	

Course Outcomes (COs)

1. Recognize the difference between scalars, vectors, pseudo-scalars and pseudo-vectors.
2. Understand the physical interpretation of gradient, divergence and curl.
3. Comprehend the difference and connection between Cartesian, spherical and cylindrical coordinate systems.
4. Know the meaning of 4-vectors, Kronecker delta and Epsilon (Levi Civita) tensors.
5. Study the origin of pseudo forces in rotating frame.
6. Study the response of the classical systems to external forces and their elastic deformation.
7. Understand the dynamics of planetary motion and the working of Global Positioning System (GPS).
8. Comprehend the different features of Simple Harmonic Motion (SHM) and wave propagation.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
	Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).	
	PART A **BASIC MATHEMATICAL PHYSICS**	
I	Vector Algebra Coordinate rotation, reflection and inversion as the basis for defining scalars, vectors, pseudo scalars and pseudo-vectors (include physical examples). Component form in 2D and 3D. Geometrical and physical interpretation of addition, subtraction, dot product, wedge product, cross product and triple product of vectors. Position, separation and displacement vectors.	7
II	**Vector Calculus** Geometrical and physical interpretation of vector differentiation, Gradient, Divergence and Curl and their significance. Vector integration, Line, Surface (flux) and Volume integrals of vector fields. Gradient theorem, Gauss-divergence theorem, Stoke-curl theorem, Greens theorem and Helmholtz theorem (statement only). Introduction to Dirac delta function.	8
III	**Coordinate Systems** 2D & 3D Cartesian, Spherical and Cylindrical coordinate systems, basis vectors, transformation equations. Expressions for displacement vector, arc length, area element, volume element, gradient, divergence and curl in different coordinate systems. Components of velocity and acceleration in different coordinate systems. Examples of non-inertial coordinate system and pseudo-acceleration.	8

IV	**Introduction to Tensors** Principle of invariance of physical laws w.r.t. different coordinate systems as the basis for defining tensors. Coordinate transformations for general spaces of nD, contravariant, covariant & mixed tensors and their ranks, 4-vectors. Index notation and summation convention. Symmetric and skew-symmetric tensors. Invariant tensors, Kronecker delta and Epsilon (Levi Civita) tensors. Examples of tensors in physics.	7

	PART B **NEWTONIAN MECHANICS & WAVE MOTION**	
V	**Dynamics of a System of Particles** Review of historical development of mechanics up to Newton. Background, statement and critical analysis of Newton's axioms of motion. Dynamics of a system of particles, centre of mass motion, and conservation laws & their deductions. Rotating frames of reference, general derivation of origin of pseudo forces (Euler, Coriolis & centrifugal) in rotating frame, and effects of Coriolis force.	8
VI	**Dynamics of a Rigid Body** Angular momentum, Torque, Rotational energy and the inertia tensor. Rotational inertia for simple bodies (ring, disk, rod, solid and hollow sphere, solid and hollow cylinder, rectangular lamina). The combined translational and rotational motion of a rigid body on horizontal and inclined planes. Elasticity, relations between elastic constants, bending of beam and torsion of cylinder.	8
VII	**Motion of Planets & Satellites** Two particle central force problem, reduced mass, relative and centre of mass motion. Newton's law of gravitation, gravitational field and gravitational potential. Kepler's laws of planetary motion and their deductions. Motions of geo-synchronous & geo-stationary satellites and basic idea of Global Positioning System (GPS).	7
VIII	**Wave Motion** Differential equation of simple harmonic motion and its solution, use of complex notation, damped and forced oscillations, Quality factor. Composition of simple harmonic motion, Lissajous figures. Differential equation of wave motion. Plane progressive waves in fluid media, reflection of waves and phase change, pressure and energy distribution. Principle of superposition of waves, stationary waves, phase and group velocity.	7

Suggested Readings

PART A

1. Murray Spiegel, Seymour Lipschutz, Dennis Spellman, "Schaum's Outline Series: Vector Analysis", McGraw Hill, 2017, 2e
2. Shanti Narayan, P.K. Mittal, "A Text Book of Vector Analysis", S. Chand Publishing, 2010
3. Shanti Narayan, P.K. Mittal, "A Text Book of Vector Calculus", S. Chand Publishing, 1987, 4e

PART B

1. Charles Kittel, Walter D. Knight, Malvin A. Ruderman, Carl A. Helmholz, Burton J. Moyer, "Mechanics (In SI Units): Berkeley Physics Course Vol 1", McGraw Hill, 2017, 2e
2. Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 1", Pearson Education Limited, 2012
3. Hugh D. Young and Roger A. Freedman, "Sears & Zemansky's University Physics with Modern Physics", Pearson Education Limited, 2017, 14e
4. D.S. Mathur, P.S. Hemne, "Mechanics", S. Chand Publishing, 1981, 3e

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Test / Quiz / Assignment / Seminar /Research Orientation assignment	20
2	Class interaction	05

Suggested Equivalent Online Courses

1. Coursera, https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy
2. edX, https://www.edx.org/course/subject/physics
3. MIT Open Course Ware - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/
4. Swayam - Government of India, https://swayam.gov.in/explorer?category=Physics
5. National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/course.html

Further Suggestions

- In End-Semester University Examinations, equal weightage should be given to Part A (units I to IV) and Part B (units V to VIII) while framing the questions.

B.Sc. I (SEMESTER-I) PAPER-II
PRACTICAL

Programme: B.Sc.	**Year: First**	**Semester: First**
Subject: Physics		
Course Code: B010102P	**Course Title: PRACTICAL**	

Course Outcomes (COs)

Experimental physics has the most striking impact on the industry wherever the instruments are used to determine the mechanical properties. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

Credits: 2	**Core Compulsory / Elective**
Max. Marks: 25 +75	**Min. Passing Marks: As per UGC/ University CBCS norm.**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topics	No. of Lectures
	Lab Experiment List 1. Moment of inertia of a flywheel 2. Moment of inertia of an irregular body by inertia table 3. Modulus of rigidity by statistical method (Barton's apparatus) 4. Modulus of rigidity by dynamical method (sphere / disc / Maxwell's needle) 5. Young's modulus by bending of beam 6. Young's modulus and Poisson's ratio by Searle's method 7. Poisson's ratio of rubber by rubber tubing 8. Surface tension of water by capillary rise method 9. Surface tension of water by Jaeger's method 10. Coefficient of viscosity of water by Poiseuille's method 11. Acceleration due to gravity by bar pendulum 12. Frequency of AC mains by Sonometer 13. Height of a building by Sextant 14. Study the wave form of an electrically maintained tuning fork / alternating current sourcewith the help of cathode ray oscilloscope.	60
	Online Virtual Lab Experiment List / Link Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/?sub=1&brch=74 1. Torque and angular acceleration of a fly wheel 2. Torsional oscillations in different liquids 3. Moment of inertia of flywheel 4. Newton's second law of motion 5. Ballistic pendulum 6. Collision balls 7. Projectile motion 8. Elastic and inelastic collision	

B.Sc. I (SEMESTER-II) PAPER-I

THERMAL PHYSICS & SEMICONDUCTOR DEVICES

Programme: B.Sc.	Year: First	Semester: Second
Subject: Physics		
Course Code: B010201T	Course Title: THERMAL PHYSICS & SEMICONDUCTOR DEVICES	

Course Outcomes (COs)

1. Recognize the difference between reversible and irreversible processes.
2. Understand the physical significance of thermodynamical potentials.
3. Comprehend the kinetic model of gases w.r.t. various gas laws.
4. Study the implementations and limitations of fundamental radiation laws.
5. Utility of AC bridges.
6. Recognize the basic components of electronic devices.
7. Design simple electronic circuits.
8. Understand the applications of various electronic instruments.

Credit: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
	PART A **THERMODYNAMICS & KINETIC THEORY OF GASES**	
I	**0^{th} & 1^{st} Law of Thermodynamics** State functions and terminology of thermodynamics. Zeroth law and temperature. First law, internal energy, heat and work done. Work done in various thermodynamical processes. Enthalpy, relation between C_P and C_V. Carnot's engine, efficiency and Carnot's theorem. Efficiency of internal combustion engines (Otto and diesel).	8
II	**2^{nd} & 3^{rd} Law of Thermodynamics** Different statements of second law, Clausius inequality, entropy and its physical significance. Entropy changes in various thermodynamical processes. Third law of thermodynamics and unattainability of absolute zero. Thermodynamical potentials, Maxwell's relations, conditions for feasibility of a process and equilibrium of a system. Clausius- Clapeyron equation, Joule-Thompson effect.	8
III	**Kinetic Theory of Gases** Kinetic model and deduction of gas laws. Derivation of Maxwell's law of distribution of velocities and its experimental verification. Degrees of freedom, law of equipartition of energy (no derivation) and its application to specific heat of gases (mono, di and poly atomic).	7
IV	**Theory of Radiation** Blackbody radiation, spectral distribution, concept of energy density and pressure of radiation. Derivation of Planck's law, deduction of Wien's distribution law, Rayleigh-Jeans law, Stefan-Boltzmann law and Wien's displacement law from Planck's law.	7

PART B CIRCUIT FUNDAMENTALS & SEMICONDUCTOR DEVICES		
V	**DC & AC Circuits** Growth and decay of currents in RL circuit. Charging and discharging of capacitor in RC, LC and RCL circuits. Network Analysis - Superposition, Reciprocity, Thevenin's and Norton's theorems. AC Bridges - measurement of inductance (Maxwell's, Owen's and Anderson's bridges) and measurement of capacitance (Schering's, Wein's and de Sauty's bridges).	6
VI	**Semiconductors & Diodes** P and N type semiconductors, qualitative idea of Fermi level. Formation of depletion layer in PN junction diode, field & potential at the depletion layer. Qualitative idea of current flow mechanism in forward & reverse biased diode. Diode fabrication. PN junction diode and its characteristics, static and dynamic resistance. Principle, structure, characteristics and applications of Zener, Tunnel, Light Emitting, Point Contact and Photo diodes. Half and Full wave rectifiers, calculation of ripple factor, rectification efficiency and voltage regulation. Basic idea about filter circuits and voltage regulated power supply.	9
VII	**Transistors** Bipolar Junction PNP and NPN transistors. Study of CB, CE & CC configurations w.r.t. characteristics; active, cutoff & saturation regions; current gains & relations between them. DC Load Line analysis and Q-point stabilisation. Voltage Divider bias circuit for CE amplifier. Qualitative discussion of RC coupled voltage amplifier.	9
VIII	**Electronic Instrumentation** Multimeter: Principles of measurement of dc voltage, dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, electron gun, electrostatic focusing and acceleration (no mathematical treatment). Front panel controls, special features of dual trace CRO, specifications of a CRO and their significance. Applications of CRO to study the waveform and measurement of voltage, current, frequency & phase difference.	6

Suggested Readings

PART A

1. M.W. Zemansky, R. Dittman, "Heat and Thermodynamics", McGraw Hill, 1997, 7e
2. F.W. Sears, G.L. Salinger, "Thermodynamics, Kinetic theory & Statistical thermodynamics", Narosa Publishing House, 1998
3. Enrico Fermi, "Thermodynamics", Dover Publications, 1956
4. S. Garg, R. Bansal, C. Ghosh, "Thermal Physics", McGraw Hill, 2012, 2e
5. Meghnad Saha, B.N. Srivastava, "A Treatise on Heat", Indian Press, 1973, 5e

PART B

1. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015, 7e
2. W.D. Stanley, "Electronic Devices: Circuits and Applications", Longman Higher Education, 1989
3. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975, 5e
4. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43e

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Test / Quiz / Assignment / Seminar /Research Orientation assignment	20
2	Class interaction	05

Suggested Equivalent Online Courses

1. Coursera, https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy
2. edX, https://www.edx.org/course/subject/physics
3. MIT Open Course Ware - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/
4. Swayam - Government of India, https://swayam.gov.in/explorer?category=Physics
5. National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/course.html

Further Suggestions

- In End-Semester University Examinations, equal weightage should be given to Part A (units I to IV) and Part B (units V to VIII) while framing the questions.

B.Sc. I (SEMESTER-II) PAPER-II
PRACTICAL

Programme: B.Sc.	Year: First	Semester: Second
Subject: Physics		
Course Code: B010202P	Course Title: PRACTICAL	

Course Outcomes (COs)

Experimental physics has the most striking impact on the industry wherever the instruments are used to determine the thermal and electronic properties. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

Credits: 2	Core Compulsory / Elective
Max. Marks: 25 + 75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topics	No. of Lectures
	Lab Experiment List	60
	1. Mechanical Equivalent of Heat by Callender and Barne's method 2. Coefficient of thermal conductivity of copper by Searle's apparatus 3. Coefficient of thermal conductivity of rubber 4. Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method 5. Value of Stefan's constant 6. Verification of Stefan's law 7. Variation of thermo-emf across two junctions of a thermocouple with temperature 8. Temperature coefficient of resistance by Platinum resistance thermometer 9. Charging and discharging in RC and RCL circuits 10. A.C. Bridges: Various experiments based on measurement of L and C 11. Resonance in series and parallel RCL circuit 12. PN Junction, Zener and LED diode characteristics 13. Half wave and full wave rectifiers 14. Characteristics of a transistor (PNP and NPN) in CE, CB and CC configurations 15. Frequency response of RC coupled amplifier 16. Handling of Cathode Ray Oscilloscope (CRO)	
	Online Virtual Lab Experiment List / Link	
	Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/?sub=1&brch=194 1. Heat transfer by radiation 2. Heat transfer by conduction 3. Heat transfer by natural convection 4. The study of phase change 5. Black body radiation: Determination of Stefan's constant 6. Newton's law of cooling 7. Lee's disc apparatus 8. Thermo-couple: Seebeck effects	

	Virtual Labs an initiative of MHRD Govt. of India http://vlabs.iitkgp.ernet.in/be/index.html# 1. Familiarisation with resistor 2. Familiarisation with capacitor 3. Familiarisation with inductor 4. Ohm's Law 5. VI characteristics of a diode 6. Half & Full wave rectification 7. Capacitative rectification 8. Zener Diode voltage regulator 9. BJT common emitter characteristics 10. BJT common base characteristics 11. Studies on BJT CE amplifier 12. RC frequency response	

Suggested Readings

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e
3. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014, 2e

Suggestive Digital Platforms / Web Links

1. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=194
2. Virtual Labs an initiative of MHRD Govt. of India, http://vlabs.iitkgp.ernet.in/be/index.html#
3. Digital platforms of other virtual labs

Suggested Continuous Evaluation Methods (Internal) (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Record File	15
2	Viva voce	05
3	Class interaction	05

Further Suggestions

- The institution may add / modify / change the experiments of the same standard in the subject.
- The institution may suggest a minimum number of experiments (say 6) to be performed by each student per semester from the Lab Experiment List.
- The institution may suggest a minimum number of experiments (say 3) to be performed by each student per semester from the Online Virtual Lab Experiment List / Link.

B.Sc. II (SEMESTER-III) PAPER-I

ELECTROMAGNETIC THEORY & COMMUNICATION SYSTEMS

Programme: B.Sc.	Year: Second	Semester: Third
Subject: Physics		
Course Code: B010301T	Course Title: ELECTROMAGNETIC THEORY & COMMUNICATION SYSTEMS	

Course Outcomes (COs)

1. Better understanding of electrical and magnetic phenomenon in daily life.
2. To troubleshoot simple problems related to electrical devices.
3. Comprehend the powerful applications of ballistic galvanometer.
4. Study the fundamental physics behind reflection and refraction of light (electromagnetic waves).
5. Understand the various components and features of a general communication system.
6. Recognize the importance of amplitude modulation and demodulation.
7. Insight in basics and properties of frequency and phase modulation.
8. Comprehend the theory and working of optical fibers along with its applications.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
	PART A **ELECTROMAGNETIC THEORY**	
I	**Electrostatics** Electric charge & charge densities, electric force between two charges. General expression for Electric field in terms of volume charge density (divergence & curl of Electric field), general expression for Electric potential in terms of volume charge density and Gauss law (applications included). Study of electric dipole. Electric fields in matter, polarization, auxiliary field **D** (Electric displacement), electric susceptibility and permittivity.	8
II	**Magnetostatics** Electric current & current densities, magnetic force between two current elements. General expression for Magnetic field in terms of volume current density (divergence and curl of Magnetic field), General expression for Magnetic potential in terms of volume current density and Ampere's circuital law (applications included). Study of magnetic dipole (Gilbert & Ampere model). Magnetic fields in matter, magnetisation, auxiliary field **H**, magnetic susceptibility and permeability.	8
III	**Time Varying Electromagnetic Fields** Faraday's laws of electromagnetic induction and Lenz's law. Displacement current, equation of continuity and Maxwell-Ampere's circuital law. Self and mutual induction (applications included). Derivation and physical significance of Maxwell's equations. Theory and working of moving coil ballistic galvanometer (applications included).	7

IV	**Electromagnetic Waves** Electromagnetic energy density and Poynting vector. Plane electromagnetic waves in linear infinite dielectrics, homogeneous & inhomogeneous plane waves and dispersive & non-dispersive media. Reflection and refraction of homogeneous plane electromagnetic waves, law of reflection, Snell's law, Fresnel's formulae (only for normal incidence & optical frequencies) and Stoke's law.	7
	PART B **COMMUNICATION SYSTEMS & INTRODUCTION TO FIBER OPTICS**	
V	**Communication System** Introduction and Block diagram. Components of Communication System - amplifier, transmitter, channel receiver and band spectrum modulation. Types of modulation, modulation factor & its importance. Forms of modulation.	7
VI	**Basics of Amplitude Modulation** Modulation-index, frequency spectrum, generation of AM (balanced modulator, collector modulator). Amplitude Demodulation (diode detector), Double Side Band Suppressed Carrier (DSBSC) generation, Single Side Band Suppressed Carrier (SSBSC) generation.	8
VII	**Introduction to Angle Modulation** General Frequency & Phase modulation, frequency spectrum, bandwidth requirement, Frequency & Phase Deviation, Modulation index, equivalence between FM & PM, Generation of FM and FM detector.	7
VIII	**Introduction to Fiber Optics** Basics of Fiber Optics, step index fiber, graded index fiber, light propagation through an optical fiber, acceptance angle & numerical aperture, intermodal dispersion losses and applications of optical fibers.	8

Suggested Readings

PART A

1. D.J. Griffiths, "Introduction to Electrodynamics", Prentice-Hall of India Private Limited, 2002, 3e
2. E.M. Purcell, "Electricity and Magnetism (In SI Units): Berkeley Physics Course Vol 2", McGraw Hill, 2017,2e
3. Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 2", Pearson Education Limited, 2012
4. D.C. Tayal, "Electricity and Magnetism", Himalaya Publishing House Pvt. Ltd., 2019, 4e

PART B

1. M.S. Roden, "Analog and Digital Communication Systems", Discovery Press, 2003, 5e
2. D. Roddy, J. Coolen, "Electronic Communications", Pearson Education Limited, 2008, 4e
3. Jeffrey S. Beasley, Gary M. Miller, "Modern Electronic Communication", Pearson Education Limited, 2007, 9e
4. W. Schweber, "Electronic Communication Systems: A Complete Course", Pearson Education Limited, 2001, 4e
5. John M. Senior, "Optical Fiber Communications: Principles and Practice", Pearson Education Limited, 2010, 3e
6. John Wilson, John Hawkes, "Optoelectronics: Principles and Practice", Pearson Education Limited, 2018, 3e

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

Suggested Continuous Evaluation Methods (Max. Marks: 25)		
S.No.	**Assessment Type**	**Max. Marks**
1	Test / Quiz / Assignment / Seminar /Research Orientation assignment	20
2	Class interaction	05

Suggested Equivalent Online Courses

1. Coursera, https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy
2. edX, https://www.edx.org/course/subject/physics
3. MIT Open Course Ware - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/
4. Swayam - Government of India, https://swayam.gov.in/explorer?category=Physics
5. National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/course.html

Further Suggestions

- In End-Semester University Examinations, equal weightage should be given to Part A (units I to IV) and Part B (units V to VIII) while framing the questions.

B.Sc. II (SEMESTER-III) PAPER-II
PRACTICAL

Programme: B.Sc.	Year: Second	Semester: Third
Subject: Physics		
Course Code: B010302P	Course Title: PRACTICAL	

Course Outcomes (COs)

Experimental physics has the most striking impact on the industry wherever the instruments are used to determine the electric and magnetic properties. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

Credits: 2	Core Compulsory / Elective
Max. Marks: 25 + 75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topics	No. of Lectures
	Lab Experiment List	60
	1. Variation of magnetic field along the axis of single coil 2. Variation of magnetic field along the axis of Helmholtz coil 3. Ballistic Galvanometer: Ballistic constant, current sensitivity and voltage sensitivity 4. Ballistic Galvanometer: High resistance by Leakage method 5. Ballistic Galvanometer: Low resistance by Kelvin's double bridge method 6. Ballistic Galvanometer: Self-inductance of a coil by Rayleigh's method 7. Ballistic Galvanometer: Comparison of capacitances 8. Carey Foster Bridge: Resistance per unit length and low resistance 9. Deflection and Vibration Magnetometer: Magnetic moment of a magnet and horizontal component of earth's magnetic field 10. Earth Inductor: Horizontal component of earth's magnetic field	
	Online Virtual Lab Experiment List / Link	
	Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/?sub=1&brch=192 1. Tangent galvanometer 2. Magnetic field along the axis of a circular coil carrying current 3. Deflection magnetometer 4. Van de Graaff generator 5. Barkhausen effect 6. Temperature coefficient of resistance 7. Anderson's bridge 8. Quincke's method	

Suggested Readings

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e
3. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014, 2e

Suggestive Digital Platforms / Web Links

1. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=192
2. Digital platforms of other virtual labs

Suggested Continuous Evaluation Methods (Internal) (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Record File	15
2	Viva voce	05
3	Class interaction	05

Further Suggestions

- The institution may add / modify / change the experiments of the same standard in the subject.
- The institution may suggest a minimum number of experiments (say 6) to be performed by each student per semester from the Lab Experiment List.
- The institution may suggest a minimum number of experiments (say 3) to be performed by each student per semester from the Online Virtual Lab Experiment List / Link.

B.Sc. II (SEMESTER-IV) PAPER-I
PERSPECTIVES OF MODERN PHYSICS & MODERN OPTICS

Programme: B.Sc.	Year: Second	Semester: Fourth
Subject: Physics		
Course Code: B010401T	Course Title: PERSPECTIVES OF MODERN PHYSICS & MODERN OPTICS	

Course Outcomes (COs)

1. Recognize the difference between the structure of space & time in Newtonian & Relativistic mechanics.
2. Understand the physical significance of consequences of Lorentz transformation equations.
3. Comprehend the wave-particle duality.
4. Develop an understanding of the foundational aspects of Quantum Mechanics.
5. Study the working and applications of Michelson and Fabry-Perot interferometers.
6. Recognize the difference between Fresnel's and Fraunhofer's class of diffraction.
7. Comprehend the use of polarimeters.
8. Study the characteristics and uses of lasers.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
	PART A **PERSPECTIVES OF MODERN PHYSICS**	
I	**Relativity-Experimental Background** Structure of space & time in Newtonian mechanics and inertial & non-inertial frames. Galilean transformations. Newtonian relativity. Galilean transformation and Electromagnetism. Attempts to locate the Absolute Frame: Michelson-Morley experiment and significance of the null result. Einstein's postulates of special theory of relativity.	7
II	**Relativity-Relativistic Kinematics** Structure of space & time in Relativistic mechanics and derivation of Lorentz transformation equations (4-vector formulation included). Consequences of Lorentz Transformation Equations (derivations & examples included): Transformation of Simultaneity (Relativity of simultaneity); Transformation of Length (Length contraction); Transformation of Time (Time dilation); Transformation of Velocity (Relativistic velocity addition); Transformation of Acceleration; Transformation of Mass (Variation of mass with velocity). Relation between Energy & Mass (Einstein's mass & energy relation) and Energy & Momentum.	9
III	**Inadequacies of Classical Mechanics** Particle Properties of Waves: Spectrum of Black Body radiation, Photoelectric effect, Compton effect and their explanations based on Max Planck's Quantum hypothesis. Wave Properties of Particles: Louis de Broglie's hypothesis of matter waves and their experimental verification by Davisson-Germer's experiment and Thomson's experiment.	7

IV	**Introduction to Quantum Mechanics** Matter Waves: Mathematical representation, Wavelength, Concept of Wave group, Group (particle) velocity, Phase (wave) velocity and relation between Group & Phase velocities. Wave Function: Functional form, Normalisation of wave function, Orthogonal & Orthonormal wave functions and Probabilistic interpretation of wave function based on Born Rule.	7
	PART B **PHYSICAL OPTICS & LASERS**	
V	**Interference** Conditions for interference and spatial & temporal coherence. Division of Wavefront - Fresnel's Biprism and Lloyd's Mirror. Division of Amplitude - Parallel thin film, wedge shaped film and Newton's Ring experiment. Interferometer - Michelson and Fabry-Perot.	8
VI	**Diffraction** Distinction between interference and diffraction. Fresnel's and Fraunhofer's class of diffraction. Fresnel's Half Period Zones and Zone plate. Fraunhofer diffraction at a single slit, n slits and Diffracting Grating. Resolving Power of Optical Instruments - Rayleigh's criterion and resolving power of telescope, microscope & grating.	8
VII	**Polarisation** Polarisation by dichronic crystals, birefringence, Nicol prism, retardation plates and Babinet's compensator. Analysis of polarized light. Optical Rotation - Fresnel's explanation of optical rotation and Half Shade & Biquartz polarimeters.	7
VIII	**Lasers** Characteristics and uses of Lasers. Quantitative analysis of Spatial and Temporal coherence. Conditions for Laser action and Einstein's coefficients. Three and four level laser systems (qualitative discussion).	7
	Suggested Readings	
	PART A 1. A. Beiser, Shobhit Mahajan, "Concepts of Modern Physics: Special Indian Edition", McGraw Hill, 2009, 6e 2. John R. Taylor, Chris D. Zafiratos, Michael A.Dubson, "Modern Physics for Scientists and Engineers",Prentice-Hall of India Private Limited, 2003, 2e 3. R.A. Serway, C.J. Moses, and C.A. Moyer, "Modern Physics", Cengage Learning India Pvt. Ltd, 2004, 3e 4. R. Resnick, "Introduction to Special Relativity", Wiley India Private Limited, 2007 5. R. Murugeshan, Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publishing, 2019, 18e **PART B** 1. Francis A. Jenkins, Harvey E. White, "Fundamentals of Optics", McGraw Hill, 2017, 4e 2. Samuel Tolansky, "An Introduction to Interferometry", John Wiley & Sons Inc., 1973, 2e 3. A. Ghatak, "Optics", McGraw Hill, 2017, 6e	
	Suggestive Digital Platforms / Web Links	
	1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/ 2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd 3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx 4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8	

Suggested Continuous Evaluation Methods (Max. Marks: 25)		
S.No.	**Assessment Type**	**Max. Marks**
1	Test / Quiz / Assignment / Seminar /Research Orientation assignment	20
2	Class interaction	05

Suggested Equivalent Online Courses

1. Coursera, https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy
2. edX, https://www.edx.org/course/subject/physics
3. MIT Open Course Ware - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/
4. Swayam - Government of India, https://swayam.gov.in/explorer?category=Physics
5. National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/course.html

Further Suggestions

- In End-Semester University Examinations, equal weightage should be given to Part A (units I to IV) and Part B (units V to VIII) while framing the questions.

B.Sc. II (SEMESTER-IV) PAPER-II
PRACTICAL

Programme: B.Sc.	Year: Second	Semester: Fourth
Subject: Physics		
Course Code: B010402P	Course Title: PRACTICAL	

Course Outcomes (COs)

Experimental physics has the most striking impact on the industry wherever the instruments are used to determine the optical properties. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

Credits: 2	Core Compulsory / Elective
Max. Marks: 25 + 75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topics	No. of Lectures
	Lab Experiment List	60
	1. Fresnel Biprism: Wavelength of sodium light 2. Fresnel Biprism: Thickness of mica sheet) 3. Newton's Rings: Wavelength of sodium light 4. Newton's Rings: Refractive index of liquid 5. Plane Diffraction Grating: Resolving power 6. Plane Diffraction Grating: Spectrum of mercury light 7. Spectrometer: Refractive index of the material of a prism using sodium light 8. Spectrometer: Dispersive power of the material of a prism using mercury light 9. Polarimeter: Specific rotation of sugar solution 10. Wavelength of Laser light using diffraction by single slit	
	Online Virtual Lab Experiment List / Link	
	Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/?sub=1&brch=189 1. Michelson's Interferometer 2. Michelson's Interferometer: Wavelength of laser beam 3. Newton's Rings: Wavelength of light 4. Newton's Rings: Refractive index of liquid 5. Brewster's angle determination 6. Laser beam divergence and spot size	

Suggested Readings

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e
3. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014, 2e

Suggestive Digital Platforms / Web Links

1. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=189
2. Digital platforms of other virtual labs

Suggested Continuous Evaluation Methods (Internal) (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Record File	15
2	Viva voce	05
3	Class interaction	05

Further Suggestions

- The institution may add / modify / change the experiments of the same standard in the subject.
- The institution may suggest a minimum number of experiments (say 6) to be performed by each student per semester from the Lab Experiment List.
- The institution may suggest a minimum number of experiments (say 3) to be performed by each student per semester from the Online Virtual Lab Experiment List / Link.

B.Sc. III (SEMESTER-V) PAPER-I
CLASSICAL & STATISTICAL MECHANICS

Programme: B.Sc.	Year: Third	Semester: Fifth
Subject: Physics		
Course Code: B010501T	Course Title: CLASSICAL & STATISTICAL MECHANICS	

Course Outcomes (COs)

1. Understand the concepts of generalized coordinates and D'Alembert's principle.
2. Understand the Lagrangian dynamics and the importance of cyclic coordinates.
3. Comprehend the difference between Lagrangian and Hamiltonian dynamics.
4. Study the important features of central force and its application in Kepler's problem.
5. Recognize the difference between macrostate and microstate.
6. Comprehend the concept of ensembles.
7. Understand the classical and quantum statistical distribution laws.
8. Study the applications of statistical distribution laws.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 6-0-0

Unit	Topics	No. of Lectures
	PART A **INTRODUCTION TO CLASSICAL MECHANICS**	
I	**Constrained Motion** Constraints - Definition, Classification and Examples. Degrees of Freedom and Configuration space. Constrained system, Forces of constraint and Constrained motion. Generalised coordinates, Transformation equations and Generalised notations & relations. Principle of Virtual work and D'Alembert's principle.	6
II	**Lagrangian Formalism** Lagrangian for conservative & non-conservative systems, Lagrange's equation of motion (no derivation), Comparison of Newtonian & Lagrangian formulations, Cyclic coordinates, and Conservation laws (with proofs and properties of kinetic energy function included). Simple examples based on Lagrangian formulation.	8
III	**Hamiltonian Formalism** Phase space, Hamiltonian for conservative & non-conservative systems, Physical significance of Hamiltonian, Hamilton's equation of motion (no derivation), Comparison of Lagrangian & Hamiltonian formulations, Cyclic coordinates, and Construction of Hamiltonian from Lagrangian. Simple examples based on Hamiltonian formulation.	7
IV	**Central Force** Definition and properties (with prove) of central force. Equation of motion and differential equation of orbit. Bound & unbound orbits, stable & non-stable orbits, closed & open orbits and Bertrand's theorem. Motion under inverse square law of force and derivation of Kepler's laws. Laplace-Runge-Lenz vector (Runge-Lenz vector) and its applications.	8
V	**Canonical Transformation** Canonical transformation, generating functions, properties, group properties, examples, infinitesimal generators, Poisson brackets, Poisson theorems, angular momentum, PBs small oscillation.	7

	PART B INTRODUCTION TO STATISTICAL MECHANICS	
VI	**Macrostate & Microstate** Macrostate, Microstate, Number of accessible microstates and Postulate of equal a priori. Phase space, Phase trajectory, Volume element in phase space, Quantisation of phase space and number of accessible microstates for free particle in 1D, free particle in 3D & harmonic oscillator in 1D.	7
VII	**Concept of Ensemble** Problem with time average, concept of ensemble, postulate of ensemble average and Liouville's theorem (proof included). Micro Canonical, Canonical & Grand Canonical ensembles. Thermodynamic Probability, Postulate of Equilibrium and Boltzmann Entropy relation.	7
VIII	**Statistical Distribution Laws** Statistical Distribution Laws: Expressions for number of accessible microstates, probability & number of particles in ith state at equilibrium for Maxwell-Boltzmann, Bose-Einstein & Fermi- Dirac statistics. Comparison of statistical distribution laws and their physical significance	7
IX	**Canonical Distribution Law** Boltzmann's Canonical Distribution Law, Boltzmann's Partition Function, Proof of Equipartition Theorem (Law of Equipartition of energy) and relation between Partition function and Thermodynamic potentials.	6
X	**Applications of Statistical Distribution Laws** Application of Bose-Einstein Distribution Law: Photons in a black body cavity and derivation of Planck's Distribution Law. Application of Fermi-Dirac Distribution Law: Free electrons in a metal, Definition of Fermi energy, Determination of Fermi energy at absolute zero, Kinetic energy of Fermi gas at absolute zero and concept of Density of States (Density of Orbitals).	9
	Suggested Readings	
	PART A 1. Herbert Goldstein, Charles P. Poole, John L. Safko, "Classical Mechanics", Pearson Education, India, 2011, 3e 2. N.C. Rana, P.S. Joag, "Classical Mechanics", McGraw Hill, 2017 3. R.G. Takwale, P.S. Puranik, "Introduction to Classical Mechanics", McGraw Hill, 2017 **PART B** 1. F. Reif, "Statistical Physics (In SI Units): Berkeley Physics Course Vol 5", McGraw Hill, 2017, 1e 2. B.B. Laud, "Fundamentals of Statistical Mechanics", New Age International Private Limited, 2020, 2e 3. B.K. Agarwal, M. Eisner, "Statistical Mechanics", New Age International Private Limited, 2007, 2e	
	Suggestive Digital Platforms / Web Links	
	1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/ 2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd 3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx 4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8	

Suggested Continuous Evaluation Methods (Max. Marks: 25)		
S.No.	**Assessment Type**	**Max. Marks**
1	Test / Quiz / Assignment / Seminar /Research Orientation assignment	20
2	Class interaction	05

Suggested Equivalent Online Courses

1. Coursera, https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy
2. edX, https://www.edx.org/course/subject/physics
3. MIT Open Course Ware - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/
4. Swayam - Government of India, https://swayam.gov.in/explorer?category=Physics
5. National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/course.html

Further Suggestions

- In End-Semester University Examinations, equal weightage should be given to Part A (units I to IV) and Part B (units V to VIII) while framing the questions.

B.Sc. III (SEMESTER-V) PAPER-II
DIGITAL ELECTRONICS & MICROPROCESSOR

Programme: B.Sc.	Year: Third	Semester: Fifth
Subject: Physics		
Course Code: B010502T	Course Title: DIGITAL ELECTRONICS & MICROPROCESSOR	

Course Outcomes (COs)

1. nderstand various number systems and binary codes.
2. Familiarize with binary arithmetic.
3. Study the working and properties of various logic gates.
4. Comprehend the design of combinational and sequential circuits.
5. Learn the basics of microprocessor architecture.
6. Study the 8085 BUS organization.
7. Comprehend the Memory and I/O Interfacing.
8. Develop the technique of programming in 8085.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
	PART A **DIGITAL ELECTRONICS**	
I	**Number System** Number Systems: Binary, Octal, Decimal & Hexadecimal number systems and their inter conversion. Binary Codes: BCD, Excess-3 (XS3), Parity, Gray, ASCII & EBCDIC Codes and their advantages & disadvantages. Data representation.	7
II	**Binary Arithmetic** Binary Addition, Decimal Subtraction using 9's & 10's complement, Binary Subtraction using 1's & 2's compliment, Multiplication and Division.	6
III	**Logic Gates** Truth Table, Symbolic Representation and Properties of NOT, AND, OR, NOR, NAND, EX-OR & EX- NOR Gates. NOR and NAND Gates as Universal Gates. Boolean Algebra. Karnough Map.	8
IV	**Combinational & Sequential Circuits** Combinational Circuits: Half Adder, Full Adder, Parallel Adder, Half Substractor, Full Substractor, Multiplexer, Demultiplexer. Sequential Circuits: Flip-Flop, Counters and Sequential Circuits.	9
	PART B **MICROPROCESSOR**	
V	**Microprocessor Architecture** Evolution of microprocessors and microprocessor architecture. Features and PIN diagram of 8085 Microprocessor. Address Bus & Multiplexed Address / Data Bus, Control and Status Signals, Power-supply and Clock frequency, externally initiated signals including Interrupts Serial I/O Ports and Block diagram of 8085 microprocessor.	6

VI	**8085 BUS Organization** 8085 BUS organization and 8085 registers. Microprocessor operations - Microprocessor initiated operations, Internal data operations and Externally initiated operations. Microprocessor Communication & Bus Timings, De-multiplexing the Bus AD7 to AD0, Generating Control Signals. 8085 Machine Cycles & Bus Timings, Opcode Fetch Machine Cycle and Memory Read Machine Cycle.	7
VII	**Memory & I/O Interfacing** Memory and I/O Interfacing. Memory classifications, Flip-Flop or Latch as a storage element. Memory Map and Addresses Memory Instruction. Fetch Memory Interfacing - Memory structure & its requirements, basic concepts in Memory Interfacing circuits, Address Decoding and Memory Addresses. Input & Output Devices - I/Os with 8-Bit Addresses, I/Os with 16-Bit Addresses, Logic devices for Interfacing and Tri-State devices.	8
VIII	**Programming in 8085** Instruction set and Programming techniques. Instruction Formats - Single Byte, Two Bytes & Three Bytes instructions and Opcode format. Instruction Timings & Operation Status, DATA Transfer operations, Arithmetic operations, Logic operations, Branch operations, Stack, I/O & Machine Control instructions, Looping, Counting & Indexing Counter, Timing delays, Stack & Subroutines, Code conversion, BCD Arithmetic operations and 16 Bit data operations. How to write an assemble language program and execute a simple program.	9

Suggested Readings

PART A

1. D. Leach, A. Malvino, Goutam Saha, "Digital Principles and Applications", McGraw Hill, 2010, 7e
2. William H. Gothmann, "Digital Electronics: An Introduction to Theory and Practice", Prentice-Hall of India Private Limited, 1982, 2e
3. R.P. Jain, "Modern Digital Electronics", McGraw Hill, 2009, 4e

PART B

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", Penram International Publishing, 2013, 6e
2. B. Ram, "Fundamentals of Microprocessors and Microcontrollers", Dhanpat Rai Publications, NewDelhi, 2012
3. Dr. D.K. Kaushik, "An Introduction to 8085", Dhanpat Rai Publications, NewDelhi, 2012

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Test / Quiz / Assignment / Seminar /Research Orientation assignment	20
2	Class interaction	05

Suggested Equivalent Online Courses
1. Coursera, https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy 2. edX, https://www.edx.org/course/subject/physics 3. MIT Open Course Ware - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/ 4. Swayam - Government of India, https://swayam.gov.in/explorer?category=Physics 5. National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/course.html
Further Suggestions
• In End-Semester University Examinations, equal weightage should be given to Part A (units I to IV) and Part B (units V to VIII) while framing the questions.

B.Sc. III (SEMESTER-V) PAPER-III
PRACTICAL

Programme: B.Sc.	Year: Third	Semester: Fifth
Subject: Physics		
Course Code: B010503P	Course Title: PRACTICAL	

Course Outcomes (COs)

Electronic instrumentation has the most striking impact on the industry wherever the digital instruments are used to study and determine the electronic properties. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

Credits: 2	Core Compulsory / Elective
Max. Marks: 25 + 75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topics	No. of Lectures
	Lab Experiment List	60
	1. Study and Verification of AND gate using TTL IC 7408 2. Study and Verification of OR gate using TTL IC 7432 3. Study and Verification of NAND gate and use as Universal gate using TTL IC 7400 4. Study and Verification of NOR gate and use as Universal gate using TTL IC 7402 5. Study and Verification of NOT gate using TTL IC 7404 6. Study and Verification of Ex-OR gate using TTL IC 7486 7. Basic Programming (Addition, Subtraction, Multiplication and Division) using 8085 microprocessor	
	Online Virtual Lab Experiment List / Link	
	Virtual Labs an initiative of MHRD Govt. of India https://de-iitr.vlabs.ac.in/List%20of%20experiments.html 1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates 2. Construction of half and full adder using XOR and NAND gates and verification of its operation 3. To study and verify half and full subtractor 4. Realization of logic functions with the help of Universal Gates (NAND, NOR) 5. Construction of a NOR gate latch and verification of its operation 6. Verify the truth table of RS, JK, T and D Flip Flops using NAND and NOR gates 7. Design and Verify the 4-Bit Serial In - Parallel Out Shift Registers 8. Implementation and verification of decoder or demultiplexer and encoder using logic gates 9. Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates 10. Design and verify the 4-Bit Synchronous or Asynchronous Counter using JK Flip Flop 11. Verify Binary to Gray and Gray to Binary conversion using NAND gates only 12. Verify the truth table of 1-Bit and 2-Bit comparator using logic gates	

Virtual Labs an initiative of MHRD Govt. of India
http://209.211.220.205/vlabiitece/mi/labsMI.php

1. Write a Program Using 8085 & verify for:
   a. Addition of Two 8-Bit Numbers
   b. Addition of Two 16-Bit Numbers (with carry)
2. Write a Program Using 8085 & verify for:
   a. Subtraction of Two 8-Bit Numbers (display of barrow)
   b. Subtraction of Two 16-Bit Numbers (display of barrow)
3. Write a Program Using 8085 & test for typical data:
   a. Multiplication of Two 8-Bit Numbers by Bit Rotation Method
   b. Division of Two 8-Bit Numbers by Repeated Subtraction Method
4. Write a Program Using 8085 for finding Square Root of a Number & verify
5. Write a Program to Move a Block of Data Using 8085 & verify
6. Write a Program to Arrange Number in Ascending Order Using 8085 & verify
7. Write a Program to Check Number of 1's and 0's in Given Number Using 8085 & verify
8. Write a Program to Find GCD Of Two Numbers Using 8085 & verify
9. Write a Program to Find LCM Of Two Numbers Using 8085 & verify
10. Write a Program to Add 'N' Two Digit BCD Numbers Using 8085 & verify

Suggested Readings

1. D. Leach, A. Malvino, Goutam Saha, "Digital Principles and Applications", McGraw Hill, 2010, 7e
2. William H. Gothmann, "Digital Electronics: An Introduction to Theory and Practice", Prentice-Hall of India Private Limited, 1982, 2e
3. R.P. Jain, "Modern Digital Electronics", McGraw Hill, 2009, 4e
4. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", Penram International Publishing, 2013, 6e
5. B. Ram, "Fundamentals of Microprocessors and Microcontrollers", Dhanpat Rai Publications, NewDelhi, 2012
6. Dr. D.K. Kaushik, "An Introduction to 8085", Dhanpat Rai Publications, NewDelhi, 2012

Suggestive Digital Platforms / Web Links

1. Virtual Labs an initiative of MHRD Govt. of India, https://de-iitr.vlabs.ac.in/List%20of%20experiments.html
2. Virtual Labs an initiative of MHRD Govt. of India, http://209.211.220.205/vlabiitece/mi/labsMI.php
3. Digital platforms of other virtual labs

Suggested Continuous Evaluation Methods (Internal) (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Record File	15
2	Viva voce	05
3	Class interaction	05

Further Suggestions

- The institution may add / modify / change the experiments of the same standard in the subject.
- The institution may suggest a minimum number of experiments (say 6) to be performed by each student per semester from the Lab Experiment List.
- The institution may suggest a minimum number of experiments (say 3) to be performed by each student per semester from the Online Virtual Lab Experiment List / Link.

B.Sc. III (SEMESTER-VI) PAPER-I
QUANTUM PHYSICS & SPECTROSCOPY

Programme: B.Sc.	Year: Third	Semester: Sixth
Subject: Physics		
Course Code: B010601T	Course Title: QUANTUM PHYSICS & SPECTROSCOPY	

Course Outcomes (COs)

1. Understand the significance of operator formalism in Quantum mechanics.
2. Study the eigen and expectation value methods.
3. Understand the basis and interpretation of Uncertainty principle.
4. Develop the technique of solving Schrodinger equation for 1D and 3D problems.
5. Comprehend the success of Vector atomic model in the theory of Atomic spectra.
6. Study the different aspects of spectra of Group I & II elements.
7. Study the production and applications of X-rays.
8. Develop an understanding of the fundamental aspects of Molecular spectra.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 6-0-0

Unit	Topics	No. of Lectures
	PART A **INTRODUCTION TO QUANTUM MECHANICS**	
I	**Operator Formalism** Operators: Review of matrix algebra, definition of an operator, special operators, operator algebra and operators corresponding to various physical-dynamical variables. Commutators: Definition, commutator algebra and commutation relations among position, linear momentum & angular momentum and energy & time. Simple problems based on commutation relations.	6
II	**Eigen & Expectation Values** Eigen & Expectation Values: Eigen equation for an operator, eigen state (value) and eigen functions. Linear superposition of eigen functions and Non-degenerate & Degenerate eigen states. Expectation value pertaining to an operator and its physical interpretation. Hermitian Operators: Definition, properties and applications. Prove of the hermitian nature of various physical-dynamical operators.	6
III	**Uncertainty Principle** Uncertainty Principle: Commutativity &simultaneity (theorems with proofs). Non commutativity of operators as the basis for uncertainty principle and derivation of general form of uncertainty principle through Schwarz inequality. Uncertainty principle for various conjugate pairs of physical-dynamical parameters and its applications.	8

IV	**Schrodinger Equation and Operators** Schrodinger Equation: Derivation of time independent & time dependent forms, Schrodinger equation as an eigen equation, Deviation & interpretation of equation of continuity in Schrodinger representation and Equation of motion of an operator in Schrodinger representation. linear operators, product of two operators, commuting and non-commuting operator.	8
V	**Applications of Schrodinger Equation** Application to 1D Problems: Infinite Square well potential (Particlein1Dbox), Finite Square well potential, Potential step, Rectangular potential barrier and 1D Harmonic oscillator. Application to 3D Problems: Infinite Square well potential (Particle in a 3D box) and the Hydrogen atom (radial distribution function and radial probability included). (Direct solutions of Hermite, Associated Legendre and Associated Laguerre differential equations to be substituted).	8
	PART B **INTRODUCTION TO SPECTROSCOPY**	
VI	**Vector Atomic Model** Inadequacies of Bohr and Bohr-Sommerfeld atomic models w.r.t. spectrum of Hydrogen atom (fine structure of H-alpha line). Modification due to finite mass of nucleus and Deuteron spectrum. Vector atomic model (Stern-Gerlach experiment included) and physical & geometrical interpretations of various quantum numbers for single & many valence electron systems. LS & jj couplings, spectroscopic notation for energy states, selection rules for transition of electrons and intensity rules for spectral lines. Fine structure of H-alpha line on the basis of vector atomic model.	9
VII	**Spectra of Alkali & Alkaline Elements** Spectra of alkali elements: Screening constants for s, p, d & f orbitals; sharp, principle, diffuse & fundamental series; doublet structure of spectra and fine structure of Sodium D line. Spectra of alkaline elements: Singlet and triplet structure of spectra.	6
VIII	**X-Rays & X-Ray Spectra** Nature & production, Continuous X-ray spectrum & Duane-Hunt's law, Characteristic X-ray spectrum & Mosley's law, Fine structure of Characteristic X-ray spectrum, and X-ray absorption spectrum.	7
IX	**Rotational and Vibrational Spectra** Discrete set of energies of a molecule, electronic, vibrational and rotational energies. Quantisation of vibrational energies, transition rules and pure vibrational spectra. Quantisation of rotational energies, transition rules, pure rotational spectra and determination of inter-nuclear distance.	7
X	**Rotational-Vibrational and Electronic Spectra** Rotational-Vibrational spectra, transition rules, P,Q,R branches, Electronic Spectroscopy of diatomic molecule, Progression and Precession, Frank Condon Principle, Fluorescence and Phosphorescence	7

Suggested Readings

PART A

1. D.J. Griffiths, "Introduction to Quantum Mechanics", Pearson Education, India, 2004, 2e
2. E. Wichmann, "Quantum Physics (In SI Units): Berkeley Physics Course Vol 4", McGraw Hill, 2017
3. Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 3", Pearson Education Limited, 2012
4. R Murugeshan, Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publishing, 2019, 18e

PART B

1. H.E. White, "Introduction to Atomic Spectra", McGraw Hill, 1934
2. C.N. Banwell, E.M. McCash, "Fundamentals of Molecular Spectroscopy", McGraw Hill, 2017, 4e
3. R Murugeshan, Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publishing, 2019, 18e
4. S.L. Gupta, V. Kumar, R.C. Sharma, "Elements of Spectroscopy", Pragati Prakashan, Meerut, 2015, 27e

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Test / Quiz / Assignment / Seminar /Research Orientation assignment	20
2	Class interaction	05

Suggested Equivalent Online Courses

1. Coursera, https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy
2. edX, https://www.edx.org/course/subject/physics
3. MIT Open Course Ware - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/
4. Swayam - Government of India, https://swayam.gov.in/explorer?category=Physics
5. National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/course.html

Further Suggestions

- In End-Semester University Examinations, equal weightage should be given to Part A (units I to IV) and Part B (units V to VIII) while framing the questions.

B.Sc. III (SEMESTER-VI) PAPER-II
SOLID STATE & NUCLEAR PHYSICS

Programme: B.Sc.	Year: Third	Semester: Sixth
Subject: Physics		
Course Code: B010602T	Course Title: SOLID STATE & NUCLEAR PHYSICS	

Course Outcomes (COs)

1. Understand the crystal geometry w.r.t. symmetry operations.
2. Comprehend the power of X-ray diffraction and the concept of reciprocal lattice.
3. Study various properties based on crystal bindings.
4. Recognize the importance of Free Electron & Band theories in understanding the crystal properties.
5. Study the salient features of nuclear forces & radioactive decays.
6. Understand the importance of nuclear models & nuclear reactions.
7. Comprehend the working and applications of nuclear accelerators and detectors.
8. Understand the classification and properties of basic building blocks of nature.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
	PART A **INTRODUCTION TO SOLID STATE PHYSICS**	
I	**Crystal Structure** Lattice, Basis & Crystal structure. Lattice translation vectors, Primitive & non-primitive cells. Symmetry operations, Point group & Space group. 2D & 3D Bravais lattice. Parameters of cubic lattices. Lattice planes and Miller indices. Simple crystal structures - HCP & FCC, Diamond, Cubic Zinc Sulphide, Sodium Chloride, Cesium Chloride and Glasses.	7
II	**Crystal Diffraction** X-ray diffraction and Bragg's law. Experimental diffraction methods - Laue, Rotating crystal and Powder methods. Derivation of scattered wave amplitude. Reciprocal lattice, Reciprocal lattice vectors and relation between Direct & Reciprocal lattice. Diffraction conditions, Ewald's method and Brillouin zones. Reciprocal lattice to SC, BCC & FCC lattices. Atomic Form factor and Crystal Structure factor.	7
III	**Crystal Bindings** Classification of Crystals on the Basis of Bonding - Ionic, Covalent, Metallic, van der Waals (Molecular) and Hydrogen bonded. Crystals of inert gases, Attractive interaction (van der Waals-London) & Repulsive interaction, Equilibrium lattice constant, Cohesive energy and Compressibility & Bulk modulus. Ionic crystals, Cohesive energy, Madelung energy and evaluation of Madelung constant.	7

IV	**Lattice Vibrations** Lattice Vibrations: Lattice vibrations for linear mono & di atomic chains, Dispersion relations and Acoustical & Optical branches (qualitative treatment). Qualitative description of Phonons in solids. Lattice heat capacity, Dulong-Petit's law and Einstein's theory of lattice heat capacity. Free Electron Theory: Fermi energy, Density of states, Heat capacity of conduction electrons, Paramagnetic susceptibility of conduction electrons and Hall effect in metals. Band Theory: Origin of band theory, Qualitative idea of Bloch theorem, Kronig-Penney model, Effectice mass of an electron & Concept of Holes and Classification of solids on the basis of band theory.	9
PART B **INTRODUCTION TO NUCLEAR PHYSICS**		
V	**Nuclear Forces & Radioactive Decays** General Properties of Nucleus: Mass, binding energy, radii, density, angular momentum, magnetic dipole moment vector and electric quadrupole moment tensor. Nuclear Forces: General characteristic of nuclear force and Deuteron ground state properties. Radioactive Decays: Nuclear stability, basic ideas about beta minus decay, beta plus decay, alpha decay, gamma decay & electron capture, fundamental laws of radioactive disintegration and radioactive series.	9
VI	**Nuclear Models & Nuclear Reactions** Nuclear Models: Liquid drop model and Bethe-Weizsacker mass formula. Single particle shell model (the level scheme in the context of reproduction of magic numbers included). Nuclear Reactions: Bethe's notation, types of nuclear reaction, Conservation laws, Cross-section of nuclear reaction, Theory of nuclear fission (qualitative), Nuclear reactors and Nuclear fusion.	9
VII	**Accelerators & Detectors** Accelerators: Theory, working and applications of Van de Graaff accelerator, Cyclotron and Synchrotron. Detectors: Theory, working and applications of GM counter, Semiconductor detector, Scintillation counter and Wilson cloud chamber.	6
VIII	**Elementary Particles** Fundamental interactions & their mediating quanta. Concept of antiparticles. Classification of elementary particles based on intrinsic-spin, mass, interaction & lifetime. Families of Leptons, Mesons, Baryons & Baryon Resonances. Conservation laws for mass-energy, linear momentum, angular momentum, electric charge, baryonic charge, leptonic charge, isospin & strangeness. Concept of Quark model.	6

Suggested Readings

PART A

1. Charles Kittel, "Introduction to Solid State Physics", Wiley India Private Limited, 2004, 8e
2. J.P. Srivastava, "Elementa of Solid State Physics", Prentice-Hall of India Private Limited, 2014, 4e
3. R.K. Puri, V.K. Babbar, "Solid State Physics", S. Chand Publishing, 2015

PART B

1. Kenneth S. Krane, "Introductory Nuclear Physics", Wiley India Private Limited, 2008
2. Bernard L. Cohen, "Concepts of Nuclear Physics", McGraw Hill, 2017
3. D.C. Tayal, "Nuclear Physics", Himalaya Publishing House Pvt. Ltd., 2011, 5e

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Test / Quiz / Assignment / Seminar /Research Orientation assignment	20
2	Class interaction	05

Suggested Equivalent Online Courses

1. Coursera, https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy
2. edX, https://www.edx.org/course/subject/physics
3. MIT Open Course Ware - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/
4. Swayam - Government of India, https://swayam.gov.in/explorer?category=Physics
5. National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/course.html

Further Suggestions

- In End-Semester University Examinations, equal weightage should be given to Part A (units I to IV) and Part B (units V to VIII) while framing the questions.

B.Sc. III (SEMESTER-VI) PAPER-III
PRACTICAL

Programme: B.Sc.	Year: Third	Semester: Sixth
Subject: Physics		
Course Code: B010603P	Course Title: PRACTICAL	

Course Outcomes (COs)

Experimental physics has the most striking impact on the industry wherever the components / instruments are used for electronic / optical communication systems. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

Credits: 2	Core Compulsory / Elective
Max. Marks: 25 + 75	Min. Passing Marks: As per UGC/ University CBCS norm.

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	Topics	No. of Lectures
	Lab Experiment List	60
	1. Amplitude Modulation and Demodulation 2. DSB-SC Modulation and Demodulation 3. SSB-SC Modulation and Demodulation 4. Frequency Modulation and Demodulation 5. To measure Numerical aperture of Single Mode Optical Fiber	
	Online Virtual Lab Experiment List / Link	
	Virtual Labs at Amrita Vishwa Vidyapeetham http://vlab.amrita.edu/index.php?sub=59&brch=163 1. Amplitude Modulation and Demodulation 2. BPSK Modulation and Demodulation 3. Frequency Modulation 4. QPSK Modulation 5. Realization of different modulation schemes using I/Q modulators labAlive Virtual Communications Lab https://www.etti.unibw.de/labalive/#experiments 6. Analog Modulation 7. Digital Modulation 8. To study and verify half and full subtractor 9. Signal Parameters 10. Fourier Transform 11. Wireless Communications	

Virtual Labs at Amrita Vishwa Vidyapeetham
http://vlab.amrita.edu/index.php?sub=59&brch=269

12. Fiber Optic Analog and Digital Link
13. Fiber Optic Bi-directional Communication
14. Wavelength Division Multiplexing
15. Measurement of Bending Losses in Optical Fiber
16. Measurement of Numerical Aperture
17. Study of LED and Detector Characteristics

Suggested Readings

1. M.S. Roden, "Analog and Digital Communication Systems", Discovery Press, 2003, 5e
2. D. Roddy, J. Coolen, "Electronic Communications", Pearson Education Limited, 2008, 4e
3. Jeffrey S. Beasley, Gary M. Miller, "Modern Electronic Communication", Pearson Education Limited, 2007, 9e
4. W. Schweber, "Electronic Communication Systems: A Complete Course", Pearson Education Limited, 2001, 4e
5. John M. Senior, "Optical Fiber Communications: Principles and Practice", Pearson Education Limited, 2010, 3e
6. John Wilson, John Hawkes, "Optoelectronics: Principles and Practice", Pearson Education Limited, 2018, 3e

Course Books published in Hindi may be prescribed by the Universities.

Suggestive Digital Platforms / Web Links

1. Virtual Labs at Amrita Vishwa Vidyapeetham, http://vlab.amrita.edu/index.php?sub=59&brch=163
2. labAlive Virtual Communications Lab, https://www.etti.unibw.de/labalive/#experiments
3. Virtual Labs at Amrita Vishwa Vidyapeetham, http://vlab.amrita.edu/index.php?sub=59&brch=269
4. Digital platforms of other virtual labs

Suggested Continuous Evaluation Methods (Internal) (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Record File	15
2	Viva voce	05
3	Class interaction	05

Further Suggestions

- The institution may add / modify / change the experiments of the same standard in the subject.
- The institution may suggest a minimum number of experiments (say 6) to be performed by each student per semester from the Lab Experiment List.
- The institution may suggest a minimum number of experiments (say 3) to be performed by each student per semester from the Online Virtual Lab Experiment List / Link.