Siddharth University, Kapilvastu, Siddharth Nagar

NEP

Syllabus

Physics

DEPARTMENT OF HIGHER EDUCATION
U.P. GOVERNMENT, LUCKNOW

National Education Policy-2020
Common Minimum Syllabus for all U.P. State Universities and Colleges
For first three years of Higher Education (UG)

PROPOSED STRUCTURE OF
UG PHYSICS SYLLABUS

SYLLABUS DEVELOPED BY				
S. No.	**NAME**	**DESIGNATION**	**DEPARTMENT**	**COLLEGE / UNIVERSITY**
1	**Dr. Gaurang Misra**	Associate Professor	Department of Physics	**Agra College, Agra** *(Dr. B.R.A. University, Agra)* *Estd. 1823*
2	**Dr. Naresh Kumar Chaudhary**	Associate Professor	Department of Physics & Electronics	**Dr. R.M.L.A. University, Faizabad** *Estd. 1975*
3	**Dr. Vikram Singh**	Assistant Professor	Department of Physics	**St. John's College, Agra** *(Dr. B.R.A. University, Agra)* *Estd. 1850*

SEMESTER-WISE TITLES OF THE PAPERS IN UG PHYSICS COURSE					
YEAR	**SEME-STER**	**COURSE CODE**	**PAPER TITLE**	**THEORY / PRACTICAL**	**CREDIT**
CERTIFICATE IN BASIC PHYSICS & SEMICONDUCTOR DEVICES					
FIRST YEAR	**I**	B010101T	Mathematical Physics & Newtonian Mechanics	Theory	4
		B010102P	Mechanical Properties of Matter	Practical	2
	II	B010201T	Thermal Physics & Semiconductor Devices	Theory	4
		B010202P	Thermal Properties of Matter & Electronic Circuits	Practical	2
DIPLOMA IN APPLIED PHYSICS WITH ELECTRONICS					
SECOND YEAR	**III**	B010301T	Electromagnetic Theory & Communication Systems	Theory	4
		B010302P	Demonstrative Aspects of Electricity & Magnetism	Practical	2
	IV	B010401T	Perspectives of Modern Physics & Modern Optics	Theory	4
		B010402P	Demonstrative Aspects of Optics & Lasers	Practical	2
DEGREE IN BACHELOR OF SCIENCE					
THIRD YEAR	**V**	B010501T	Classical & Statistical Mechanics	Theory	4
		B010502T	Digital Electronics & Microprocessor	Theory	4
		B010503P	Digital Electronics Instrumentation	Practical	2
	VI	B010601T	Quantum Physics & Spectroscopy	Theory	4
		B010602T	Solid State & Nuclear Physics	Theory	4
		B010603P	Exploration of Communication Systems	Practical	2

SUBJECT PREREQUISITES

To study this subject, a student must have had the subjects **Physics & Mathematics** in class 12th.

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 the content.

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)	
CERTIFICATE IN BASIC PHYSICS & SEMICONDUCTOR DEVICES	
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.
DIPLOMA IN APPLIED PHYSICS WITH ELECTRONICS	
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.
DEGREE IN BACHELOR OF SCIENCE	
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.

SEMESTER-WISE PAPER TITLES WITH DETAILS					
YEAR	**SEME-STER**	**PAPER**	**PAPER TITLE**	**PREREQUISITE For Paper**	**ELECTIVE For Major Subjects**
CERTIFICATE IN BASIC PHYSICS & SEMICONDUCTOR DEVICES					
FIRST YEAR	**SEMESTER I**	Theory Paper-1	Mathematical Physics & Newtonian Mechanics	Physics in 12th / Mathematics in 12th	YES Open to all
		Practical Paper	Mechanical Properties of Matter	Opted / Passed Sem I, Th Paper-1	YES Bota./Chem./Comp. Sc./ Math./Stat./Zool.
	SEMESTER II	Theory Paper-1	Thermal Physics & Semiconductor Devices	Physics in 12th / Chemistry in 12th	YES Open to all
		Practical Paper	Thermal Properties of Matter & Electronic Circuits	Opted / Passed Sem II, Th Paper-1	YES Bota./Chem./Comp. Sc./ Math./Stat./Zool.
DIPLOMA IN APPLIED PHYSICS WITH ELECTRONICS					
SECOND YEAR	**SEMESTER III**	Theory Paper-1	Electromagnetic Theory & Communication Systems	Passed Sem I, Th Paper-1	YES Open to all
		Practical Paper	Demonstrative Aspects of Electricity & Magnetism	Opted / Passed Sem III, Th Paper-1	YES Bota./Chem./Comp. Sc./ Math./Stat./Zool.
	SEMESTER IV	Theory Paper-1	Perspectives of Modern Physics & Modern Optics	Passed Sem I, Th Paper-1	YES Open to all
		Practical Paper	Demonstrative Aspects of Optics & Lasers	Opted / Passed Sem IV, Th Paper-1	YES Bota./Chem./Comp. Sc./ Math./Stat./Zool.
DEGREE IN BACHELOR OF SCIENCE					
THIRD YEAR	**SEMESTER V**	Theory Paper-1	Classical & Statistical Mechanics	Passed Sem I, Th Paper-1	YES Chem./Comp. Sc./Math./Stat.
		Theory Paper-2	Digital Electronics & Microprocessor	Passed Sem II, Th Paper-1	YES Open to all
		Practical Paper	Digital Electronics Instrumentation	Opted / Passed Sem V, Th Paper-2	YES Chem./Comp. Sc./Math./Stat.
	SEMESTER VI	Theory Paper-1	Quantum Physics & Spectroscopy	Passed Sem IV, Th Paper-1	YES Chem./Comp. Sc./Math./Stat.
		Theory Paper-2	Solid State & Nuclear Physics	Opted / Passed Sem VI, Th Paper-1	YES Chem./Comp. Sc./Math./Stat.
		Practical Paper	Exploration of Communication Systems	Passed Sem III, Th Paper-1	YES Chem./Comp. Sc./Math./Stat.

FIRST YEAR

DETAILED SYLLABUS FOR

CERTIFICATE

IN

BASIC PHYSICS & SEMICONDUCTOR DEVICES

YEAR	SEME-STER	PAPER	PAPER TITLE	UNIT TITLE (Periods Per Semester)
CERTIFICATE IN BASIC PHYSICS & SEMICONDUCTOR DEVICES				
FIRST YEAR	**SEMESTER I**	Theory Paper-I	**Mathematical Physics & Newtonian Mechanics** Part A: Basic Mathematical Physics Part B: Newtonian Mechanics & Wave Motion	**Part A** I: Vector Algebra (7) II: Vector Calculus (8) III: Coordinate Systems (8) IV: Introduction to Tensors (7) **Part B** V: Dynamics of a System of Particles (8) VI: Dynamics of a Rigid Body (8) VII: Motion of Planets & Satellites (7) VIII: Wave Motion (7)
		Practical Paper	**Mechanical Properties of Matter**	Lab Experiment List Online Virtual Lab Experiment List/Link
	SEMESTER II	Theory Paper-I	**Thermal Physics & Semiconductor Devices** Part A: Thermodynamics & Kinetic Theory of Gases Part B: Circuit Fundamentals & Semiconductor Devices	**Part A** I: 0^{th} & 1^{st} Law of Thermodynamics (8) II: 2^{nd} & 3^{rd} Law of Thermodynamics (8) III: Kinetic Theory of Gases (7) IV: Theory of Radiation (7) **Part B** V: DC & AC Circuits (6) VI: Semiconductors & Diodes (9) VII: Transistors (9) VIII: Electronic Instrumentation (6)
		Practical Paper	**Thermal Properties of Matter & Electronic Circuits**	Lab Experiment List Online Virtual Lab Experiment List/Link

Programme/Class: **Certificate**	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:

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

Unit	Topics	No. of Lectures
	PART A **Basic Mathematical Physics**	
I	*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).* **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

	Introduction to Tensors	
IV	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	
	Dynamics of a System of Particles	
V	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
	Dynamics of a Rigid Body	
VI	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
	Motion of Planets & Satellites	
VII	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
	Wave Motion	
VIII	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

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

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://heccontent.upsdc.gov.in/SearchContent.aspx 4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8
This course can be opted as an Elective by the students of following subjects
Open to all
Suggested Continuous Internal Evaluation (CIE) Methods
20 marks for Test / Quiz / Assignment / Seminar/ Research Orientation assignment 05 marks for Class Interaction
Course Prerequisites
Physics in 12th / Mathematics in 12th
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.

Programme/Class: **Certificate**	Year: **First**	Semester: **First**

Subject: **Physics**

Course Code: **B010102P**	Course Title: **Mechanical Properties of Matter**

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:

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 source with 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	

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

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

Suggestive Digital Platforms / Web Links

1. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74
2. Digital platforms of other virtual labs

This course can be opted as an Elective by the students of following subjects

Botany / Chemistry / Computer Science / Mathematics / Statistics / Zoology

Suggested Continuous Internal Evaluation (CIE) Methods

15 marks for Record File (depending upon the no. of experiments performed out of the total assigned experiments)
05 marks for Viva Voce
05 marks for Class Interaction

Course Prerequisites

Opted / Passed Semester I, Theory Paper-1 (B010101T)

Suggested Equivalent Online Courses

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.

Programme/Class: **Certificate**	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.

Credits: **4**	Core Compulsory / Elective
Max. Marks: **25+75**	Min. Passing Marks:

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	
	0^{th} & 1^{st} Law of Thermodynamics	
I	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
	2^{nd} & 3^{rd} Law of Thermodynamics	
II	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
	Kinetic Theory of Gases	
III	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
	Theory of Radiation	
IV	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

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

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
This course can be opted as an Elective by the students of following subjects
Open to all
Suggested Continuous Internal Evaluation (CIE) Methods
20 marks for Test / Quiz / Assignment / Seminar /Research Orientation assignment 05 marks for Class Interaction
Course Prerequisites
Physics in 12th / Chemistry in 12th
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.

Programme/Class: **Certificate**	Year: **First**	Semester: **Second**
Subject: **Physics**		
Course Code: **B010202P**	Course Title: **Thermal Properties of Matter & Electronic Circuits**	

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:

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. 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)	60
	Online Virtual Lab Experiment List / Link	
	Thermal Properties of Matter: 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	

Semiconductor Devices:

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

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

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

This course can be opted as an Elective by the students of following subjects

Botany / Chemistry / Computer Science / Mathematics / Statistics / Zoology

Suggested Continuous Internal Evaluation (CIE) Methods

15 marks for Record File (depending upon the no. of experiments performed out of the total assigned experiments)
05 marks for Viva Voce
05 marks for Class Interaction

Course Prerequisites

Opted / Passed Semester II, Theory Paper-I (B010201T)

Suggested Equivalent Online Courses

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.

SECOND YEAR

DETAILED SYLLABUS FOR

DIPLOMA

IN

ADVANCED PHYSICS WITH ELECTRONICS

YEAR	SEME-STER	PAPER	PAPER TITLE	UNIT TITLE (Periods Per Semester)
DIPLOMA IN APPLIED PHYSICS WITH ELECTRONICS				
SECOND YEAR	**SEMESTER III**	Theory Paper-1	**Electromagnetic Theory & Communication Systems** Part A: Electromagnetic Theory Part B: Communication Systems & Introduction to Fiber Optics	**Part A** I: Electrostatics (8) II: Magnetostatics (8) III: Time Varying Electromagnetic Fields (7) IV: Electromagnetic Waves (7) **Part B** V: Communication System (7) VI: Basics of Amplitude Modulation (8) VII: Introduction to Angle Modulation (7) VII: Introduction to Fiber Optics (8)
		Practical Paper	**Demonstrative Aspects of Electricity & Magnetism**	Lab Experiment List Online Virtual Lab Experiment List/Link
	SEMESTER IV	Theory Paper-1	**Perspectives of Modern Physics & Modern Optics** Part A: Perspectives of Modern Physics Part B: Physical Optics & Lasers	**Part A** I: Relativity-Experimental Background (7) II: Relativity-Relativistic Kinematics (9) III: Inadequacies of Classical Mechanics (7) IV: Introduction to Quantum Mechanics (7) **Part B** V: Interference (8) VI: Diffraction (8) VII: Polarisation (7) VIII: Lasers (7)
		Practical Paper	**Demonstrative Aspects of Optics & Lasers**	Lab Experiment List Online Virtual Lab Experiment List/Link

Programme/Class: **Diploma**	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:

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

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

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

This course can be opted as an Elective by the students of following subjects

Open to all

Suggested Continuous Internal Evaluation (CIE) Methods
20 marks for Test / Quiz / Assignment / Seminar /Research Orientation assignment 05 marks for Class Interaction
Course Prerequisites
Passed Semester I, Theory Paper-1 (B010101T)
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.

Programme/Class: **Diploma**	Year: **Second**	Semester: **Third**

Subject: **Physics**

Course Code: **B010302P**	Course Title: **Demonstrative Aspects of Electricity & Magnetism**

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:

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. 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	60

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

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

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
This course can be opted as an Elective by the students of following subjects
Botany / Chemistry / Computer Science / Mathematics / Statistics / Zoology
Suggested Continuous Internal Evaluation (CIE) Methods
15 marks for Record File (depending upon the no. of experiments performed out of the total assigned experiments) 05 marks for Viva Voce 05 marks for Class Interaction
Course Prerequisites
Opted / Passed Semester III, Theory Paper-1 (B010301T)
Suggested Equivalent Online Courses
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.

Programme/Class: **Diploma**	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:

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	
	Relativity-Experimental Background	
I	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
	Relativity-Relativistic Kinematics	
II	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
	Inadequacies of Classical Mechanics	
III	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
	Introduction to Quantum Mechanics	
IV	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

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

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

This course can be opted as an Elective by the students of following subjects

Open to all

Suggested Continuous Internal Evaluation (CIE) Methods

20 marks for Test / Quiz / Assignment / Seminar /Research Orientation assignment
05 marks for Class Interaction

Course Prerequisites
Passed Semester I, Theory Paper-1 (B010101T)
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.

Programme/Class: **Diploma**	Year: **Second**	Semester: **Fourth**
Subject: **Physics**		
Course Code: **B010402P**	Course Title: **Demonstrative Aspects of Optics & Lasers**	

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:

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. 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	60
	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

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

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

This course can be opted as an Elective by the students of following subjects

Botany / Chemistry / Computer Science / Mathematics / Statistics / Zoology

Suggested Continuous Internal Evaluation (CIE) Methods

15 marks for Record File (depending upon the no. of experiments performed out of the total assigned experiments)
05 marks for Viva Voce
05 marks for Class Interaction

Course Prerequisites

Opted / Passed Semester IV, Theory Paper-1 (B010401T)

Suggested Equivalent Online Courses

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.

THIRD YEAR

DETAILED SYLLABUS FOR

DEGREE

IN

BACHELOR OF SCIENCE

YEAR	SEME-STER	PAPER	PAPER TITLE	UNIT TITLE (Periods Per Semester)
DEGREE IN BACHELOR OF SCIENCE				
THIRD YEAR	SEMESTER V	Theory Paper-1	**Classical & Statistical Mechanics** Part A: Introduction to Classical Mechanics Part B: Introduction to Statistical Mechanics	**Part A** I: Constrained Motion (6) II: Lagrangian Formalism (9) III: Hamiltonian Formalism (8) IV: Central Force (7) **Part B** V: Macrostate & Microstate (6) VI: Concept of Ensemble (6) VII: Distribution Laws (10) VIII: Applications of Statistical Distribution Laws (8)
		Theory Paper-2	**Digital Electronics & Microprocessor** Part A: Digital Electronics Part B: Microprocessor	**Part A** I: Number System (7) II: Binary Arithmetic (6) III: Logic Gates (8) IV: Combinational & Sequential Circuits (9) **Part B** V: Microprocessor Architecture (6) VI: 8085 BUS Organization (7) VII: Memory & I/O Interfacing (8) VIII: Programming in 8085 (9)
		Practical Paper	**Digital Electronics Instrumentation**	Lab Experiment List Online Virtual Lab Experiment List/Link
	SEMESTER VI	Theory Paper-1	**Quantum Physics & Spectroscopy** Part A: Introduction to Quantum Mechanics Part B: Introduction to Spectroscopy	**Part A** I: Operator Formalism (5) II: Eigen & Expectation Values (6) III: Uncertainty Principle & Schrodinger Equation (7) IV: Applications of Schrodinger Equation (12) **Part B** V: Vector Atomic Model (10) VI: Spectra of Alkali & Alkaline Elements (6) VII: X-Rays & X-Ray Spectra (7) VIII: Molecular Spectra (7)
		Theory Paper-2	**Solid State & Nuclear Physics** Part A: Introduction to Solid State Physics Part B: Introduction to Nuclear Physics	**Part A** I: Crystal Structure (7) II: Crystal Diffraction (7) III: Crystal Bindings (7) IV: Lattice Vibrations (9) **Part B** V: Nuclear Forces & Radioactive Decays (9) VI: Nuclear Models & Nuclear Reactions (9) VII: Accelerators & Detectors (6) VIII: Elementary Particles (6)
		Practical Paper	**Exploration of Communication Systems**	Lab Experiment List Online Virtual Lab Experiment List/Link

Programme/Class: **Degree**	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:

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 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.	9
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.	8
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.	7

	PART B **Introduction to Statistical Mechanics**	
V	**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.	6
VI	**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.	6
VII	**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. 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.	10
VIII	**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).	8

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

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

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

This course can be opted as an Elective by the students of following subjects

Chemistry / Computer Science / Mathematics / Statistics

Suggested Continuous Internal Evaluation (CIE) Methods
20 marks for Test / Quiz / Assignment / Seminar 05 marks for Class Interaction
Course Prerequisites
Passed Semester I, Theory Paper-1 (B010101T)
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.

Programme/Class: **Degree**	Year: **Third**	Semester: **Fifth**

Subject: **Physics**

Course Code: **B010502T**	Course Title: **Digital Electronics & Microprocessor**

Course Outcomes (COs)

1. Understand 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:

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

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

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

This course can be opted as an Elective by the students of following subjects

Open to all

Suggested Continuous Internal Evaluation (CIE) Methods

20 marks for Test / Quiz / Assignment / Seminar
05 marks for Class Interaction

Course Prerequisites
Passed Semester II, Theory Paper-I (B010201T)
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.

Programme/Class: **Degree**	Year: **Third**	Semester: **Fifth**
Subject: **Physics**		
Course Code: **B010503P**	Course Title: **Digital Electronics Instrumentation**	

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:

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. 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	
	Digital Electronics: 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	60

Introduction to Microprocessor:
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

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

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

This course can be opted as an Elective by the students of following subjects

Chemistry / Computer Science / Mathematics / Statistics

Suggested Continuous Internal Evaluation (CIE) Methods

15 marks for Record File (depending upon the no. of experiments performed out of the total assigned experiments)
05 marks for Viva Voce
05 marks for Class Interaction

Course Prerequisites

Opted / Passed Semester V, Theory Paper-2 (B010502T)

Suggested Equivalent Online Courses
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.

Programme/Class: **Degree**	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:

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 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.	5
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 & Schrodinger Equation** 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. 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.	7

IV	**Applications of Schrodinger Equation** Application to 1D Problems: Infinite Square well potential (Particle in 1D box), 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).	12
	PART B **Introduction to Spectroscopy**	
V	**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.	10
VI	**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
VII	**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
VIII	**Molecular 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. Rotational-Vibrational spectra; transition rules; fundamental band & hot band; O, P, Q, R, S branches.	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

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

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://heccontent.upsdc.gov.in/SearchContent.aspx 4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8
This course can be opted as an Elective by the students of following subjects
Chemistry / Computer Science / Mathematics / Statistics
Suggested Continuous Internal Evaluation (CIE) Methods
20 marks for Test / Quiz / Assignment / Seminar 05 marks for Class Interaction
Course Prerequisites
Passed Semester IV, Theory Paper-1 (B010401T)
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.

Programme/Class: **Degree**	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:

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

	Lattice Vibrations	
IV	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**	
	Nuclear Forces & Radioactive Decays	
V	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
	Nuclear Models & Nuclear Reactions	
VI	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
	Accelerators & Detectors	
VII	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
	Elementary Particles	
VIII	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

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

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://heccontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

This course can be opted as an Elective by the students of following subjects

Chemistry / Computer Science / Mathematics / Statistics

Suggested Continuous Internal Evaluation (CIE) Methods

20 marks for Test / Quiz / Assignment / Seminar
05 marks for Class Interaction

Course Prerequisites

Opted / Passed Semester VI, Theory Paper-1 (B010601T)

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.

Programme/Class: **Degree**	Year: **Third**	Semester: **Sixth**

Subject: **Physics**

Course Code: **B010603P**	Course Title: **Exploration of Communication Systems**

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:

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. 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	60

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

This course can be opted as an Elective by the students of following subjects

Chemistry / Computer Science / Mathematics / Statistics

Suggested Continuous Internal Evaluation (CIE) Methods

15 marks for Record File (depending upon the no. of experiments performed out of the total assigned experiments)
05 marks for Viva Voce
05 marks for Class Interaction

Course Prerequisites

Passed Semester III, Theory Paper-1 (B010301T)

Suggested Equivalent Online Courses

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.

Under Graduate

Minor Elective Subject – Physics

First Year

It is expected that the syllabus will help to develop an interest in the learners to create Physics as a discipline in learners the abilities, useful concepts of Physics in daily/real-life situations for making learning of Physics subject relevant, meaningful and interesting. The learner is expected to realize the interface of Physics with other disciplines or other faculty (other than science background) student at university level.

General Physics -I

Unit I: Mechanics: Physical World, Need for measurements Scalar and vector quantities Displacement, Velocity, Acceleration, Projectile Motion, Laws of Motion, concept of force Pressure, Moment of Inertia, Work, Energy & Power, Friction and its effects, Mass, Weight, Thrust, Archimedes Principle, Law of Gravitation, Artificial Satellites, Indian satellites history.

Unit II: Waves and Oscillations: Types of Waves, Progressive and Stationary waves, Simple Harmonic Motion, Resonance, Beats, Periodic motion, Time period, frequency, mechanical waves Range Of Hearing, Ultrasound Wave, RADAR SONAR.

Unit III: Thermal Properties: Types of Matter, Heat, temperature, thermal expansion; thermal expansion of solids, liquids and gases, change of state, latent heat, Heat transfer; conduction, convection and radiation, Humidity, Green House effect, Heat engine and refrigerator Blackbody radiation.

Unit IV: Electronics: Conductor, Insulator, Semiconductor, Diode, Transistor, Photonics, Superconductivity, LCD, LED, LASER, MASER, SOLAR CELL basics of Nanotechnology, Robotics, Elements of a communication system,

Under Graduate
Second Year

General Physics -II

Unit I: Electricity and Magnetism: Conductors and insulators, Electric Current and Electric Potential, Ohm's Law and Resistance, Resistors in Series and Parallel, capacitors, Potentiometer, Ammeter, Voltmeter, Galvanometer.

Unit II: Optics: Introduction to light, Reflection of Light, Refraction of Light, Spherical Lenses, Scattering of Light— blue colour of the sky and reddish appearance of the sun at sunrise and sunset., The Human Eye, correction of eye defects (myopia and hypermetropia) using lenses, Microscopes and astronomical telescopes

Unit III: Atoms and Nuclei: Alpha - particle scattering experiment; Rutherford's model of atom; Bohr model Composition and size of nucleus, atomic masses, isotopes, isobars; isotones Radioactivity – alpha, beta and gamma particles/rays and their properties;

Unit IV: Modern physics and Sources of energy: Photoelectric effect, Matter waves – wave nature of particles,photons, X-rays its applications, Conventional Sources of Energy, Non-conventional Sources of Energy, Sources of Energy and Environment.