DEPARTMENT OF HIGHER EDUCATION
U.P. GOVERNMENT, LUCKNOW

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

UG PHYSICS SALLYBUS

PROF. RAJENDRA SINGH (RAJJU BHAIYA) UNIVERSITY,
MIRZAPUR ROAD, NAINI, PRAYAGRAJ-211010
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Name	Designation	Affiliation
Steering Committee		
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Dr. Sanjay Jain	Associate Professor, Dept. of Statistics	St. .John's College, Agra

Syllabus Developed by:

S.No.	Name	Designation	Department	College/University
1.	Dr. Gaurang Misra	Associate Professor	Physics	Agra College Agra
2.	Dr. Naresh Kumar Chaudhary	Associate Professor	Physics& Electronics	Dr. R. M. .L. A. University, Faizabad
3.	Dr. Vikram Singh	Assistant Professor	Physics	St. John's College ,Agra

SEMESTER-WISETITLESOFTHEPAPERSINUGPHYSICSCOURSE

YEAR	SEME-STER	COURSE CODE	PAPERTITLE	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	1
	II	**B010201T**	Thermal Physics & Semiconductor Devices	Theory	4
		B010202P	Thermal Properties of Matter & Electronic Circuits	Practical	1
DIPLOMA-IN APPLIED PHYSICS WITH ELECTRONICS					
SECOND YEAR	III	**B010301T**	Electro-magnetic Theory & Modern Optics	Theory	4
		B010302P	Demonstrative Aspects of Optics & Lasers	Practical	1
	IV	**B010401T**	Perspectives of Modern Physics & Basic Electronics	Theory	4
		B010402P	Basic Electronics Instrumentation	Practical	1
DEGREE-IN BACHELOR OF SCIENCE					
THIRD YEAR	V	**B010501T**	Classical & Statistical Mechanics	Theory	5
		B010502T	Quantum Mechanics & Spectroscopy	Theory	4
		B010503P	Demonstrative Aspects of Electricity & Magnetism	Practical	1
	VI	**B010601T**	Solid State & Nuclear Physics	Theory	5
		B010602T	Analog & Digital Principles & Applications	Theory	4
		B010603P	Analog & Digital Circuits	Practical	1

SUBJECT PREREQUISITES

To study this subject, a student must have had the subjects **Physics & Mathematics** in class12th.

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 emphasisis 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 processs 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 OUT COMES (PSOs)	
CERTIFICATE IN BASIC PHYSICS & SEMICONDUCTOR DEVICES	
FIRSTYEAR	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 thermo striking impact on the industry where ever 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, Modern Optics 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. A deeper insight in Electronics is provided to address the 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	
THIRDYEAR	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 at 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 Analog & Digital Principles and Applications. It presents an integrated approach to analog electronic circuitry and digital electronics. 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**	**PAPERTITLE**	**PREREQUISITE ForPaper**	**ELECTIVE ForMajor Subjects**
CERTIFICATE IN BASIC PHYSICS & SEMICONDUCTOR DEVICES					
FIRSTYEAR	**SEMESTER I**	Theory Paper-1	Mathematical Physics & Newtonian Mechanics	Physics in 12th / Mathematics in12th	YES Open to all
		Practical Paper-2	Mechanical Properties of Matter	Opted / Passed Sem.I,Th.Paper-1	YES Bot./Chem./Comp. Sci./ Math./Stat./Zool.
	SEMESTER II	Theory Paper-3	Thermal Physics &Semiconductor Devices	Physics in 12th/ Chemistryin12th	YES Open to all
		Practical Paper-4	Thermal Properties of Matter & Electronic Circuits	Opted / Passed Sem.II,Th.Paper-1	YES Bot./Chem./Comp. Sci./ Math./Stat./Zool.
DIPLOMA IN APPLIED PHYSICS WITH ELECTRONICS					
SECOND YEAR	**SEMESTER III**	Theory Paper-1	Electromagnetic Theory & Modern Optics	Passed Sem.I,Th.Paper-1	YES Open to all
		Practical Paper-2	Demonstrative Aspects of Optics & Lasers	Opted / Passed Sem.III,Th.Paper-1	YES Bot./Chem./Comp. Sci./ Math./Stat./Zool.
	SEMESTER IV	Theory Paper-3	Perspectives of Modern Physics & Basic Electronics	Passed Sem.I,Th.Paper-1	YES Open to all
		Practical Paper-4	Basic Electronics Instrumentation	Opted / Passed Sem.IV,Th.Paper-1	YES Bot./Chem./Comp. Sci./ Math./Stat./Zool.
DEGREE IN BACHELOR OF SCIENCE					
THIRDYEAR	**SEMESTER V**	Theory Paper-1	Classical &Statistical Mechanics	Passed Sem.I,Th.Paper-1	YES Chem./Comp. Sci./Math./Stat.
		Theory Paper-2	Quantum Mechanics& Spectroscopy	Passed Sem.IV,Th.Paper-1	YES Chem./Comp. Sci./Math./Stat.
		Practical Paper-3	Demonstrative Aspects of Electricity & Magnetism	Passed Sem.III,Th.Paper-1	YES Chem./Comp.Sci./Math./Stat.
	SEMESTER VI	Theory Paper-1	Solid State &Nuclear Physics	Passed Sem.V,Th.Paper-2	YES Chem./Comp. Sci./Math./Stat.
		Theory Paper-2	Analog & Digital Principles & Applications	Passed Sem.IV,Th.Paper-1	YES Open to all
		Practical Paper-3	Analog & Digital Circuits	Opted/ Passed Sem.VI,Th.Paper-2	YES Chem./Comp. Sci./ Math./Stat.

FIRSTYEAR

DETAILED SYLLABUS FOR

CERTIFICATE

IN

BASIC PHYSICS & SEMICONDUCTOR DEVICES

YEAR	SEME-STER	PAPER	PAPERTITLE	UNITTITLE (Periods Per Semester)
CERTIFICATE IN BASIC PHYSICS & SEMICONDUCTOR DEVICES				
FIRSTYEAR	**SEMESTERI**	Theory Paper-1	**Mathematical Physics & Newtonian Mechanics** Part A: Basic Mathematical Physics Part B: Newtonian Mechanics &Wave Motion	**Part A** I: Vector Algebra (9) II: Vector Calculus (11) III: Coordinate Systems (6) IV: Frames of References (4) **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-2	**Mechanical Properties of Matter**	Lab Experiment List Online Virtual Lab Experiment List/Link
	SEMESTER II	Theory Paper-3	**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}LawofThermodynamics (8) III: Kinetic Theory of Gases (7) IV: Theory of Radiation (7) **Part B** V: DC & AC Circuits (7) VI: Semiconductors & Diodes(8) VII: Transistors (8) VIII: Electronics Instrumentation (7)
		Practical Paper-4	**Thermal Properties of Matter & Electronic Circuits**	Lab Experiment List Online Virtual Lab Experiment List/Link

Programme/Class: **Certificate**	Year: **First**	**Paper: 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. Understand 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. Understand the different features of Simple Harmonic Motion (SHM) and wave propagation.

Credits:**4**	Core Compulsory/ Elective
Max.Marks:**25+75**	Min.PassingMarks:35
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):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 Physiciest, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE)*** ▪ **Vector Algebra** 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.	9
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.	11
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	6

IV	**Frames of References** Components of velocity and acceleration in different coordinate systems. Examples of non-inertial coordinate system and pseudo-acceleration.	4
	PART B **Newtonian Mechanics & Wave Motion**	
V	**Dynamics of a System of Particles** Review of historical development of mechanics up to Newton. Background, statement and critical analysis of Newton's axioms of motion. Dynamics of a system of particles, centre of mass motion, and conservation laws & their deductions.	8
VI	**Dynamics of a Rigid Body** Angular momentum, Torque, Rotational energy. Rotational inertia for simple bodies (ring, disk, rod, solid and hollow sphere, solid and hollow cylinder, rectangular lamina). Elasticity: relations between elastic constants, bending of beam and torsion of cylinder.	8
VII	**Motion of Planets & Satellites** Two particle central force problem, reduced mass, relative and centre of mass motion. Newton's law of gravitation, gravitational field and gravitational potential. Kepler's laws of planetary motion . Motions of geo-synchronous & geo-stationary satellites and basic idea of Global Positioning System (GPS).	7
VIII	**Wave Motion** Differential equation of simple harmonic motion and its solution, use of complex notation, damped and forced oscillations, Quality factor. Composition of simple harmonic motion, Lissajous figures. Differential equation of wave motion. Plane progressive waves in free space and fluid media, . Principle of superposition of waves, stationary waves, phase and group velocity.	7

Suggested Readings

PARTA

1. Murray Spiegel,Seymour Lipschutz, Dennis Spellman, "Schaum's Outline Series: Vector Analysis",McGraw Hill, 2017, 2e
2. A.W.Joshi, "Matricesand Tensors in Physics",New Age International Private Limited,1 995, 3e

PARTB

1. Charles Kittel, Walter D.Knight, Malvin A.Ruderman, Carl A.Helmholz, Burton J.Moyer, "Mechanics (In SI Units): Berkeley Physics Course Vol 1", Mc Graw 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.Youngand 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

Books published in Hindi & Other Reference/Text Books maybe suggested / added to this list by individual 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
Course Prerequisites
Physics in12th/Mathematics in12th
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
Suggested Equivalent Online Courses
1. Swayam-GovernmentofIndia,https://swayam.gov.in/explorer?category=Physics 2. National ProgrammeonTechnologyEnhancedLearning(NPTEL),https://nptel.ac.in/course.html 3. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy 4. edX, https://www.edx.org/course/subject/physics 5. MIT OpenCourseWare-MassachusettsInstituteofTechnology,https://ocw.mit.edu/courses/physics/
Further Suggestions
• Other Digital Platforms/Web Links and Equivalent Online Course smay be suggested/addedt ot he respective lists by individual Universities. • **In End-Semester University Examinations, equal weightage should be given to PartA (units Ito IV) And Part B (units V to VIII) while framing the questions.**

Programme/Class: **Certificate**	Year: **First**	Paper: **Second**
Subject: **Physics**		
CourseCode:**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 study and 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.PassingMarks:35

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):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 A C. main`s by Sonometer 13. Height of a building by Sextant 14. Study the waveform 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 flywheel 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,"AdvancedPracticalPhysicsforStudents",Methuen&Co.,Ltd.,London,1962,9e 2. S.Panigrahi,B.Mallick,"EngineeringPracticalPhysics",CengageLearningIndiaPvt.Ltd.,2015,1e 3. R.K.Agrawal,G.Jain,R.Sharma,"PracticalPhysics",KrishnaPrakashanMedia(Pvt.)Ltd.,Meerut,2019 4. S.L.Gupta,V.Kumar,"PracticalPhysics",PragatiPrakashan,Meerut,2014,2e ***Books published in Hindi & Other Reference/Text Books maybe suggested / added to this list by individual Universities.***
Suggestive Digital Platforms/Web Links
1. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74 2. Digital Platforms/Web Links of other virtual labs may be suggested/added to this lists by individual Universities.
Course Prerequisites
Opted/Passed Semester I, Theory Paper-1 (B010101T)
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
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 (say6) to be performed by each student per semester from the Lab Experiment List. • The institution may suggest a minimum number of experiments (say3) to be performed by each student per Semester from the Online Virtual Lab Experiment List/Link.

Programme/Class: **Certificate**	Year: **First**	**Paper: Third**
Subject: **Physics**		
CourseCode:**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 thermo-dynamical 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 electronics devices.
7. Design simple electronic circuits.
8. Understand the applications of various electronic instruments.

Credits:**4**	Core Compulsory/ Elective
Max.Marks:**25+75**	Min.PassingMarks:35

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

Unit	Topics	No. of Lectures
	PART A **Thermodynamics & Kinetic Theory of Gases**	
I	**0^{th} & 1^{st} Law of Thermodynamics** Point and Path function and terminology of thermodynamics. Zeroth law and temperature.Quasi -- static process, Reversible and irreversible process, Thermal and Thermodynamic equlibrium First law of thermodynamics, internal energy, heat and work done. Work done in various thermodynamical processes. Isothermal, diabetic ,isobaric and isochoric process, Enthalpy, relation between C_P and C_V.Carnot's engine, efficiency and Carnot's theorem.	8
II	**2^{nd} & 3^{rd} Laws of Thermodynamics** Different statements of second law, Clausius inequality, entropy and its physical significance. Entropy changes in various thermodynaamical processes. Third law of thermodynamics and unattainability of absolute zero. Thermodynamical potentials, Maxwell's relations, conditions for feasibility of a process and equilibrium of a system. Clausius-Clapeyron equation, Joule-Thompson effect.	8
III	**Kinetic Theory of Gases** Kinetic model and deduction of gas laws. Derivation of Maxwell laws of distribution of Velocities and its experimental verification. Degrees of freedom, law of equipartition of energy (no derivation) and its application to specific heat of gases (mono, di and poly atomic).	7
IV	**Theory of Radiation** Black body radiation, and 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-Thevenin's and Norton's theorems. AC Bridges –measurement of Inductance (Maxwell's, and Owen's bridges) and Measurement of capacitance (Schering's, and Wein's bridges).	7
VI	**Semiconductors & Diodes** "P and N" type semi conductors, 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 bias diode. Diode fabrication. PN junction diode and its characteristics , static and dynamic resistance. Principal 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.	8
VII	**Transistors** PNP & NPN Bi-polar Junction transistors. Study of CB, CE & CC configurations w.r.t. active, cut off & saturation regions; characteristics; current, voltage & power gains; transistor currents & relations between them. DC Load Line analysis and Q-point stabilization .Voltage Divider Bias circuit for CE amplifier. Qualitative discussion of RC coupled amplifier (frequency response not included).	8
VIII	**Electronic Instrumentation** Multimeter: Principles of measurement of DC voltage and DC current, AC voltage and AC current and resistance. Specifications of a multimeter and their significance. Cathode Ray Oscilloscope: Block diagram of basic CRO. 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, Lissajous figure and frequency ratio.	7

Suggested Readings

PART A

1. M.W.Zemansky,R.Dittman,"HeatandThermodynamics",McGrawHill,1997,7e
2. F.W.Sears,G.L.Salinger,"Thermodynamics,Kinetictheory&Statisticalthermodynamics",NarosaPublishing House, 1998
3. Enrico Fermi, "Thermodynamics" ,Dover Publications, 1956
4. S.Garg,R.Bansal,C.Ghosh,"ThermalPhysics",McGrawHill,2012,2e
5. Meghnad Saha, B.N.Srivastava,"A Treatiseon Heat",Indian Press, 1973, 5e

PART B

1. R.L.Boylestad,L.Nashelsky,"ElectronicDevicesandCircuitTheory",Prentice-HallofIndiaPvt.Ltd.,2015,11e
2. J.Millman,C.C.Halkias,SatyabrataJit,"ElectronicDevicesandCircuits",McGrawHill,2015,4e
3. B.G.Streetman,S.K.Banerjee,"SolidStateElectronicDevices",PearsonEducationIndia,2015,7e
4. J.D.Ryder,"ElectronicFundamentalsandApplications",Prentice-HallofIndiaPrivateLimited,1975,5e
5. A.Sudhakar,S.S.Palli,"CircuitsandNetworks:AnalysisandSynthesis",McGrawHill,2015,5e
6. S.L.Gupta,V.Kumar,"HandBookofElectronics",PragatiPrakashan,Meerut,2016, 43e

Books published in Hindi & Other Reference/Text Books may be suggested / added to this list by individual 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
Course Prerequisites
Physics in12th/ Chemistry in12th
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
Suggested Equivalent Online Courses
1. Swayam - Government of India,https://swayam.gov.in/explorer?category=Physics 2. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html 3. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy 4. edX,https://www.edx.org/course/subject/physics 5. MIT Open Course Ware-Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/
Further Suggestions
• Other Digital Platforms/Web Links and Equivalent Online Courses may be suggested/ added to the respective lists by individual Universities. • **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**	**Paper: Fourth**
Subject: **Physics**		
CourseCode:**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 study and Determine the thermal and electronic properties. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments give an insight insimulation techniques and provide a basis for modeling.

Credits:**2**	Core Compulsory/ Elective
Max. Marks: **25+75**	Min. Passing Marks:35

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

Unit	Topics	No. of Lectures
	Lab Experiment List	60
	1. Mechanical Equivalent of Heat by Callender and Barne's method 2. Coefficient of thermal conductivity of copper by Searle's apparatus 3. Coefficient of thermal conductivity of rubber 4. Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method 5. Value of Stefan's constant 6. Verification of Stefan's law 7. Variation of thermo-emf across two junctions of a thermo couple 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. Characteristics of PN Junction, Zener, Tunnel, Light Emitting and Photo diode 13. Characteristics of a transistor (PNP and NPN) in CE, CB and CC configurations 14. Half wave & full wave rectifiers and Filter circuits 15. Unregulated and Regulated power supply 16. Various measurements with Cathode Ray Oscilloscope (CRO)	
	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: See-beck effects	

	Semiconductor Devices: Virtual Labs an initiative of MHRD Govt. of india. http://vlabs.iitkgp.ac.in/be/# 9. Familiarisation with resistor 10. Familiarisation with capacitor 11. Familiarisation with inductor 12. Ohm's Law 13. RC Differentiator and integrator 14. VI characteristics of a diode 15. Half & Full wave rectification 16. Capacitative rectification 17. Zener Diode voltage regulator 18. BJT common emitter characteristics 19. BJT common base characteristics 20. Studies on BJT CE amplifier	

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. R.L.Boylestad, L.Nashelsky, "Electronic Devices and Circuit Theory" ,Prentice-Hall of India Pvt. Ltd.,2015,11e
4. A.Sudhakar, S.S.Palli, "Circuits and Networks: Analysis and Synthesis" ,Mc Graw Hill, 2015,5e

Books published in Hind i& Other Reference/Text Books may be suggested / added to this list by individual Universities.

Suggestive Digital Platforms/WebLinks

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.ac.in/be/#
3. Digital Platforms/Web Links of other virtual labs may be suggested/added to this lists by individual Universities.

Course Prerequisites

Opted/Passed Semester II, Theory Paper-1 (B010201T)

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

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 (say6) 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	PAPERTITLE	UNITTITLE (Periods Per Semester)
DIPLOMA IN APPLIED PHYSICS WITH ELECTRONICS				
SECOND YEAR	**SEMESTER III**	Theory Paper-1	**Electromagnetic Theory & Modern Optics** Part A: Electromagnetic Theory Part B:PhysicalOptics & Lasers	**Part A** I: Electrostatics(8) II: Magnetostatics(8) III: Time Varying Electromagnetic Fields(7) IV: Electromagnetic Waves(7) **Part B** V: Interference(8) VI: Diffraction(8) VII: Polarisation(7) VII: Lasers(7)
		Practical Paper-2	**Demonstrative Aspects of Optics & Lasers**	Lab Experiment List Online Virtual Lab Experiment List/Link
	SEMESTER IV	Theory Paper-3	**Perspectives of Modern Physics & Basic Electronics** Part A:Perspectives of Modern Physics Part B:Basic Electronics	**Part A** I: Relativity-Experimental Background (7) II: Relativity-Relativistic Kinematics (8) III: Inadequacies of Classical Mechanics(8) IV: Introduction to Quantum Mechanics(7) **Part B** V: Transistor Biasing(7) VI: Amplifiers (11) VII: Feedback Circuits (6) VIII: Oscillator Circuits(6)
		Practical Paper-4	**Basic Electronics Instrumentation**	Lab Experiment List Online Virtual Lab Experiment List/Link

Programme/Class: **Diploma**	Year: **Second**	**Paper: First**
Subject: **Physics**		
Course Code: **B010301T**	Course Title: **Electromagnetic Theory & Modern Optics**	

Course Outcomes (COs)

1. Better understanding of electrical and magnetic phenomenon in daily life.
2. To trouble shoot simple problems related to electrical devices.
3. Comprehend the power full applications of ballistic galvanometer.
4. Study the fundamental physics behind reflection and refraction of light (electromagnetic waves).
5. StudytheworkingandapplicationsofMichelsonandFabry-Perotinterferometers.
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:35

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, and polarization.	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 field in matter, magnetization.	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.	7
IV	**Electromagnetic Waves** Electromagnetic wave in free space,- 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 **Physical Optics &Lasers**		
V	**Interference** Conditions for interference and spatial & temporal coherence. Division of Wavefront-Fresnel's Biprism. Division of Amplitude-Parallel thin film, wedge shaped film and Newton's Ring experiment, Michelson Interferometer.	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, and "n" slits and Diffraction Grating. Resolving Power of Optical Instruments- Rayleigh's criterion and resolving Power of telescope, microscope & grating.	8
VII	**Polarisation** Polarisation by dia-chronic crystals, birefringence, Phenomena of double refraction Nicol prism, Malus law , Brewester law retardation plates and Babinet's compensator. Analysis of polarized light. Optical Rotation-Fresnel's explanation of optical rotation and Half Shade & Bi-quartz 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). Intensity of Laser.	7

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 CourseVol2",McGrawHill,2017, 2e
3. Richard P.Feynman,RobertB.Leighton,MatthewSands,"TheFeynmanLecturesonPhysics-Vol.2", Pearson Education Limited, 2012
4. D.C.Tayal, "Electricity and Magnetism" ,Himalaya Publishing House Pvt.Ltd.,2019,4e

PART B

1. FrancisA.Jenkins,HarveyE.White,"FundamentalsofOptics",McGrawHill,2017,4e
2. SamuelTolansky,"AnIntroductiontoInterferometry",JohnWiley&SonsInc.,1973,2e
3. A.Ghatak,"Optics",Mc Graw Hill,2017,6e

Books published in Hindi & Other Reference/Text Books may be suggested / added to this list by individual 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-DTHChannel,https://www.swayamprabha.gov.in/index.php/program/current_he/8

Course Prerequisites

Passed Semester I, Theory Paper-1(B010101T)

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
Suggested Equivalent Online Courses
1. Swayam-Government of India,https://swayam.gov.in/explorer?category=Physics 2. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html 3. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy 4. edX, https://www.edx.org/course/subject/physics 5. MIT Open Course Ware-Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/
Further Suggestions
• Other Digital Platforms/Web Links and Equivalent Online Courses may be suggested/added to the respective lists by individual Universities. • **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**	**Paper: Second**
Subject: **Physics**		
Course Code: **B010302P**	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 study and determinetheopticalproperties.Measurementprecisionandperfectionisachievedthrough Lab Experiments. OnlineVirtualLabExperimentsgiveaninsightinsimulationtechniquesandprovideabasisfor modeling.

Credits:**2**	Core Compulsory/ Elective
Max.Marks:**25+75**	Min.PassingMarks:35

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 **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 Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/index.php?sub=1&brch=281 7. Spectrometer: Refractive index of the material of a prism 8. Spectrometer: Dispersive power of a prism 9. Spectrometer: Determination of Cauchy's constants 10. Diffraction Grating	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. R.K.Agrawal, G.Jain, R.Sharma,"Practical Physics" ,Krishna Prakashan Media (Pvt.)Ltd.,Meerut,2019 4. S.L.Gupta, V.Kumar, "Practical Physics" ,Pragati Prakashan, Meerut, 2014,2e ***Books published in Hindi & Other Reference/TextBooks may be suggested / added to this list by individual Universities.***
Suggestive Digital Platforms/Web Links
1. Virtual Labs at Amrita Vishwa Vidyapeetham,https://vlab.amrita.edu/?sub=1&brch=189 2. Virtual Labs at Amrita VishwaVidyapeetham,https://vlab.amrita.edu/index.php?sub=1&brch=281 3. Digital Platforms/Web Links of other virtual labs may be suggested/added to this lists by individual Universities.
Course Prerequisites
PassedSemesterIII,TheoryPaper-1(B010301T)
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 as signed experiments) 05 marks for Viva Voce 05 marks for Class Interaction
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**	**Paper: Third**
Subject: **Physics**		
Course Code: **B010401T**	CourseTitle: **Perspectives of Modern Physics & Basic Electronics**	

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 comparison between various biasing techniques.
6. Study the classification of amplifiers.
7. Comprehend the use of feedback and oscillators.
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: 35

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

Unit	Topics	No. of Lectures
	PART A **Perspectives of Modern Physics**	
I	**Relativity-Experimental Background** Structure of space & time in Newtonian mechanics and inertial & non-inertial frames. Galilean transformations. Galilean transformation. Attempts to locate the Absolute Frame: Michelson-Morley experiment and significance of their result. Einstein's postulates of special theory of relativity.	7
II	**Relativity-Relativistic Kinematics** Structure of space & time in Relativistic mechanics and derivation of Lorentz transformation equations. 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.	8
III	**Inadequacies of Classical Mechanics** Particle Properties of Waves: Spectrum of Black Body radiation, Photo-electric 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.	8
IV	**Introduction to Quantum Mechanics** Matter Waves: Mathematical representation, Wavelength, Concept of Wave group, Group (particle) velocity, Phase (wave) velocity and relation between Group & Phase velocities. Wave Function: Functional form, Normalisation of wave function, Orthogonal & Orthonormal Wave functions and Probabilistic interpretation of wave function based on Born Rule. Expectation value of wave function.	7

PART B **Basic Electronics**		
V	**Transistor Biasing** Faithful amplification & need for biasing. Stability Factors and its calculation for transistor biasing circuits for CE configuration: Fixed Bias (Base Resistor Method), Emitter Bias (Fixed Bias with Emitter Resistor), Collector to Base Bias (Base Bias with Collector Feedback) &, Voltage Divider Bias.	7
VI	**Amplifiers** Classification of amplifiers based on Mode of operation (Class A, B, &C), Stages (single & multi stage, cascade & cascode connections). Coupling methods (RC, Transformer, Direct & LC couplings), Nature of amplification (Voltage & Power amplification) and Frequency capabilities (AF, IF, RF & VF). Theory & working of RC coupled voltage amplifier (Uses of various resistors & capacitors, and Frequency response) and Transformer coupled power amplifier (calculation of Power, Effect of temperature, Use of heat sink & Power dissipation). Calculation of Amplifier Efficiency (power efficiency) for Class A, Series-Fed, Class A Transformer Coupled amplifier.	11
VII	**Feedback Circuits** Feedback Circuits: Effects of positive and negative feedback. Voltage Series, Voltage Shunt, Current Series and Current Shunt feedback connection types and their uses for specific amplifiers. Estimation of Input Impedance, Output Impedance, Gain, Stability, Distortion, Noise and Band Width for Voltage Series negative feedback and their comparison between different negative feedback connection types.	6
VIII	**Oscillator Circuits** Oscillator Circuits: Use of positive feedback for oscillator operation. Barkhausen criterion for self-sustained oscillations. Feedback factor and frequency of oscillation for RC Phase Shift oscillator. Qualitative discussion of Reactive Network feedback oscillators (Tuned Oscillator circuits): Hartley & Colpitt oscillators.	6

Suggested Readings

PARTA

1. A. Beiser, Shobhit Mahajan, "Concepts of Modern Physics: Special Indian Edition",McGrawHill,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

PARTB

1. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory" ,Prentice-Hall of India Pvt. Ltd.,2015,11e
2. J. Millman, C.C. Halkias, Satyabrata Jit,"Electronic Devices and Circuits", Mc Graw Hill,2015,4e
3. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices" ,Pearson Education India, 2015,7e
4. J.D. Ryder, "Electronic Fundamentals and Applications" ,Prentice-Hall of India Private Limited,1975,5e
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
7. S.L. Gupta, V. Kumar, "Hand Book of Electronics" ,Pragati Prakashan, Meerut, 2016,43e

Book spublished in Hindi & Other Reference/TextBooksmaybe suggested / added to this list by individual 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

Course Prerequisites

Passed Semester I, Theory Paper-1(B010101T)

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

Suggested Equivalent Online Courses

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

Further Suggestions

- Other Digital Platforms/Web Links and Equivalent Online Courses may be suggested/added to the respective lists by individual Universities.
- **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**	**Paper: Fourth**
Subject: **Physics**		
CourseCode:**B010402P**	Course Title: **Basic Electronics Instrumentation**	

Course Outcomes (COs)

Basic Electronics instrumentation has the most striking impact on the industry wherever the components / 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 insimulation techniques and Provide a basis for modeling.

Credits:**2**	Core Compulsory/ Elective
Max. Marks:**25+75**	Min. Passing Marks: 35

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

Unit	Topics	No. of Lectures
	Lab Experiment List	60
	1. Transistor Bias Stability 2. Comparative Study of CE, CB and CC amplifier 3. Clippers and Clampers 4. Study of Emitter Follower 5. Frequency response of single stage RC coupled amplifier 6. Frequency response of single stage Transformer coupled amplifier 7. Effect of negative feedback on frequency response of RC coupled amplifier 8. Study of Schmitt Trigger 9. Study of Hartley oscillator 10. Study of Wein`s Bridge oscillator	
	Online Virtual Lab Experiment List/Link	
	Virtual Labs an initiative of MHRD Govt. of India http://vlabs.iitkgp.ac.in/psac/# 1. Diode as Clippers 2. Diode as Clampers 3. BJT as switch and Load Lines Virtual Labs an initiative of MHRD Govt. of India http://vlabs.iitkgp.ac.in/be/# 4. RC frequency response Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/index.php?sub=1&brch=201 5. Hartley oscillator 6. Colpitt oscillator	

Suggested Readings

1. R.L.Boylestad,L.Nashelsky,"Electronic Devices and Circuit Theory",Prentice-Hall of India Pvt.Ltd.,2015, 11e
2. J.Millman, C.C. Halkias, Satyabrata Jit,"Electronic Devices and Circuits",Mc Graw Hill,2015,4e
3. B.G.Streetman, S.K.Banerjee,"Solid State Electronic Devices",Pearson Education India, 2015,7e
4. J.D.Ryder, "Electronic Fundamentals and Applications",Prentice-Hall of India Private Limited, 1975,5e
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
7. S.L.Gupta, V.Kumar, "Hand Book o fElectronics",Pragati Prakashan, Meerut, 2016,43e

Books published in Hindi & Other Reference/Text Books may be suggested/ added to this list by individual Universities.

SuggestiveDigitalPlatforms/WebLinks

1. Virtual Labs an initiative of MHRD Govt. of India, http://vlabs.iitkgp.ac.in/psac/#
2. Virtual Labs an initiative of MHRD Govt .of India, http://vlabs.iitkgp.ac.in/be/#
3. Virtual Labs at Amrita VishwaVidyapeetham,https://vlab.amrita.edu/index.php?sub=1&brch=201
4. Virtual Labs at Amrita VishwaVidyapeetham,http://vlab.amrita.edu/index.php?sub=59&brch=269
5. Digital Platforms/WebLinks o fother virtual labs may be suggested/added to this lists by individual Universities.

Course Prerequisites

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

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

05marks for Class Interaction

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 (say6) to be performed by each student per semester from the Lab Experiment List.
- The institution may suggest a minimum number of experiments (say3) to be performed by each student per Semester from the Online Virtual Lab Experiment List/Link.

THIRDYEAR

DETAILED SYLLABUS FOR

DEGREE

IN

BACHELOR OF SCIENCE

YEAR	SEME-STER	PAPER	PAPERTITLE	UNITTITLE (PeriodsPerSemester)
DEGREE INBACHELOROFSCIENCE				
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	**Quantum Mechanics& Spectroscopy** Part A:Introduction to Quantum Mechanics Part B:Introduction to Spectroscopy	**Part A** I:Operator Formalism(8) II: Eigen & Expectation Values(9) III: Uncertainty Principle (7) IV: Schrodinger Equation and its Applications(6) **Part B** V:VectorAtomic Model (10) VI: Spectra of Alkali & Alkaline Elements(6) VII: X-Rays & X-Ray Spectra (7) VIII: Molecular Spectra(7)
		Practical Paper-3	**Demonstrative Aspects of Electricity & Magnetism**	Lab Experiment List Online Virtual Lab Experiment List/Link
	SEMESTER VI	Theory Paper-4	**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)
		Theory Paper-5	**Analog & Digital Principles & Applications** Part A:Analog Electronic Circuits Part B:Digital Electronics	**Part A** I: Semiconductor Junction(9) II: Transistor Modeling (8) III: Field Effect Transistors(8) IV: Other Devices (5) **Part B** V: Number System (6) VI: Binary Arithmetic(5) VII: Logic Gates (9) VIII: Combinational & Sequential Circuits(10)
		Practical Paper-6	**Analog & Digital Circuits**	Lab Experiment List Online Virtual Lab Experiment List/Link

Programme/Class: **Degree**	Year: **Third**	**Paper: First**
Subject: **Physics**		
CourseCode:**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 cycli ccoordinates.
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:35

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.	7

	PART B **Introduction to Statistical Mechanics**	
V	**Macrostate & Microstate** Macrostate, Microstate, Number of accessible microstates and Postulates of equal a priori probability. 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, Postulates of Equilibrium and Boltzmann Entropy relation.	6
VII	**Distribution Laws** Statistical Distribution Laws: Expressions for number of accessible microstates, probability & number of particles in i^{th} 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, (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

PARTA

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" ,Mc Graw Hill,2017
3. R.G.Takwale, P.S. Puranik, "Introduction to Classical Mechanics", Mc Graw Hill,2017

PARTB

1. F.Reif,"Statistical Physics(In SI Units): Berkeley Physics CourseVol5", McGrawHill,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

Books published in Hindi & Other Reference/Text Books may be suggested / added to this list by individual 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

Course Prerequisites

Passed Semester I, Theory Paper-1 (B010101T)

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
Suggested Equivalent Online Courses
1. Swayam-Government of India,https://swayam.gov.in/explorer?category=Physics 2. National Programme on Technology Enhanced Learning(NPTEL),https://nptel.ac.in/course.html 3. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy 4. edX,https://www.edx.org/course/subject/physics 5. MIT Open Course Ware-Massachusetts Institute of Technology, https://ocw.mit.edu/courses/physics/
Further Suggestions
• Other Digital Platforms/Web Links and Equivalent Online Courses may be suggested/added to the respective lists by individual Universities. • **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**	Paper: **Second**
Subject: **Physics**		
Course Code:**B010502T**	Course Title: **Quantum Mechanics & 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:35

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:**4-0-0**

Unit	Topics	No. of Lectures
	PART A **Introduction to Quantum Mechanics**	
I	**Operator Formalism** Operators: 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.	8
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. Proof of the hermitian nature of various physical-dynamical operators.	9
III	**Uncertainty Principle** Uncertainty Principle: Commutativity & simultaneity (theorems with proofs). Non commutativity of operators as the basis for uncertainty principle and derivation of general form of uncertainty principle through Schwarz inequality. Uncertainty principle for various conjugate pairs of physical-dynamical parameters and its applications.	7

IV	**Schrodinger Equation & 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. Applicationto1D Problems: Infinite Square well potential (Particle in 1D box), Finite Square well potential, Potential step, Rectangular potential barrier and 1D Harmonic oscillator.	6
	PARTB **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). Stern-Gerlach experiment 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.	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.	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. Raman Spectra, Fluorescence and Phosphorescence, Electronic spectra: Franck Condon principle.	7

SuggestedReadings

PARTA

1. D.J. Griffiths, "Introduction to Quantum Mechanics",Pearson Education, India,2004,2e
2. E. Wichmann, "Quantum Physics (In SI Units): Berkeley Physics Course Vol4",McGraw Hill, 2017
3. Richard P.Feynman, Robert B.Leighton, Matthew Sands, "TheFeynman Lectures on Physics-Vol.3", Pearson Education Limited, 2012
4. R Murugeshan, Kiruthiga Sivaprasath, "Modern Physics", S.Chand Publishing, 2019,18e

PARTB

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

Books published in Hindi &Other Reference/TextBooks may be suggested / added to this list by individual 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
Course Prerequisites
Passed Semester IV, Theory Paper-1(B010401T)
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 forTest/Quiz/Assignment/Seminar 05marks for Class Interaction
Suggested Equivalent Online Courses
1. Swayam-Government of India,https://swayam.gov.in/explorer?category=Physics 2. National Programmeon Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html 3. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy 4. edX,https://www.edx.org/course/subject/physics 5. MIT Open Course Ware-Massachusetts Institute of Technology,https://ocw.mit.edu/courses/physics/
Further Suggestions • Other Digital Platforms/Web Links and Equivalent Online Courses may be suggested/added to the respective lists by individual Universities. • **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: **Third**
Subject: **Physics**		
Course Code:**B010503P**	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 study and 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:35

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

Unit	Topics	No. of Lectures
	LabExperimentList 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 AmritaVishwaVidyapeetham 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. Vande 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. R.K.Agrawal, G.Jain, R.Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.)Ltd., Meerut,2019 4. S.L.Gupta, V.Kumar, "Practical Physics", Pragati Prakashan, Meerut,2014,2e ***Books published in Hindi & Other Reference/TextBooks may be suggested / added to this list by individual Universities.***
Suggestive Digital Platforms/WebLinks
1. Virtual Labs at Amrita VishwaVidyapeetham,https://vlab.amrita.edu/?sub=1&brch=192 2. Digital Platforms/Web Links of other virtual labs may be suggested/added to this lists by individual Universities.
Course Prerequisites
Opted/Passed Semester III, Theory Paper-1(B010501T)
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
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 (say6) 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**	**Paper: Fourth**
Subject: **Physics**		
Course Code:**B010601T**	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:35

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.	7
II	**Crystal Diffraction** X-ray diffraction and Bragg's law. Experimental diffraction methods - Laue, Rotating crystal and Powder methods. 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.	7
III	**Crystal Bindings** Classification of Crystals on the Basis of Bonding - Ionic, Covalent, Metallic, van der Waals (Molecular) and Hydrogen bonded. Crystals of inert gases, Attractive interaction (van der Waals-London) & Repulsive interaction, Equilibrium lattice constant, Cohesive energy and Compressibility & Bulk modulus. Ionic crystals, Cohesive energy, Madelung energy and evaluation of Madelung constant.	7

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

Suggested Readings

PART A

1. Charles Kittel, "Introduction to Solid State Physics",Wiley India Private Limited, 2012,8e
2. A.J. Dekker, "Solid State Physics",Mac millan India Limited,1993
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", Mc Graw Hill,2017
3. S.N. Ghoshal, "Nuclear Physics", S.Chand Publishing,2019

Books published in Hindi & Other Reference/TextBooks may be suggested / added to this list by individual 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
Course Prerequisites
Passed Semester V, Theory Paper-2 (B010502T)
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
Suggested Equivalent Online Courses
1. Swayam-Government of India,https://swayam.gov.in/explorer?category=Physics 2. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html 3. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy 4. edX,https://www.edx.org/course/subject/physics 5. MIT Open Course Ware-Massachusetts Institute of Technology,https://ocw.mit.edu/courses/physics/
Further Suggestions
• Other Digital Platforms/Web Links and Equivalent Online Courses may be suggested/addedtothe respective lists by individual Universities. • **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**	Paper: **Fifth**
Subject: **Physics**		
Course Code:**B010602T**	Course Title: **Analog & Digital Principles & Applications**	

Course Outcomes (COs)

1. Study the drift and diffusion of charge carriers in a semiconductor.
2. Understand the Two-Port model of a transistor.
3. Study the working, properties and uses of FETs.
4. Comprehend the design and operations of SCRs and UJTs.
5. Understand various number systems and binary codes.
6. Familiarize with binary arithmetic.
7. Study the working and properties of various logic gates.
8. Comprehend the design of combinational and sequential circuits.

Credits:**4**	Core Compulsory/ Elective
Max. Marks:**25+75**	Min. Passing Marks:35

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

Unit	Topics	No. of Lectures
	PART A **Analog Electronic Circuits**	
I	**Semiconductor Junction** Expressions for Fermi energy, Electron density in conduction band, Hole density in valence band, Drift of charge carriers (mobility & conductivity), Diffusion of charge carries and Life time of charge carries in a semiconductor. Work function in metals and semiconductors. Expressions for Barrier potential, Barrier width and Junction capacitance (diffusion & transition) for depletion layer in a PN junction. Expressions for Current (diode equation) and Dynamic resistance for PN junction.	9
II	**Transistor Modeling** Transistor as Two-Port Network. Notation for dc & ac components of voltage & current. Quantitative discussion of, "Y" & "h" parameters and their equivalent two-generator model circuits "h"-parameters for CB, CE & CC configurations. Analysis of transistor amplifier using the hybrid equivalent model and estimation of Input Impedance, Output Impedance and Gain (current, voltage & power).	8
III	**Field Effect Transistors** JFET: Construction of (N & P channel); Configuration (CS, CD &CG); Operation in different regions (Ohmic or Linear, Saturated or Active or Pinch off & Break down); Important Terms (Shorted Gate Drain Current, Pinch Off Voltage & Gate Source Cut-Off Voltage); Expression for Drain Current (Shockley equation); Characteristics (Drain & Transfer); Parameters (Drain Resistance, Mutual Conductance or Transconductance & Amplification Factor); Biasing w.r.t. CS configuration (Self Bias & Voltage Divider Bias); Amplifiers (CS & CD or Source Follower); Comparison (N & P channels and BJTs & JFETs). MOSFET: Construction and Working of D-MOSFET (N channel &P channel) and E-MOSFET (N channel & P channel); Characteristics (Drain & Transfer) of DE-MOSFET and E-MOSFET; Comparison of JFFET and MOSFET.	8

IV	**Other Devices** SCR: Construction; Equivalent Circuits (Two Diodes, Two Transistors & One Diode-One Transistor); Working (Off state & On state); Characteristics; Applications (Static switch, Phase control system & Battery charger). UJT: Construction; Equivalent Circuit; Working (Cutoff, Negative Resistance & Saturation regions);Characteristics (Peak & Valley points); Applications (Trigger circuits, Relaxation Oscillators & Sawtooth generators).	5
	PART B **Digital Electronics**	
V	**Number System** Number Systems: Binary, Octal, Decimal & Hexa decimal number systems and their inter conversion. Binary Codes: BCD, Excess-3 (XS3), Parity, Gray, ASC II & EBCDIC Codes and their advantages & disadvantages. Data representation.	6
VI	**Binary Arithmetic** Binary Addition, Decimal Subtraction using 9's&10's complement, Binary Subtraction using1's & 2's compliment, Multiplication and Division.	5
VII	**Logic Gates** Truth Table, Symbolic Representation and Properties of OR,AND,NOT,NOR,NAND, EX-OR& EX-NOR Gates Implementation of OR, AND & NOT gates realization using diodes & transistor). DeMorgan's theorems. NOR & NAND gates as Universal Gates. Application of EX-OR & EX-NOR gates as pairty checker. Boolean Algebra .Karnaugh Map.	9
VIII	**Combinational & Sequential Circuits** Combinational Circuits: Half Adder, Full Adder, Half Substractor, Full Substractor. Data Processing Circuits: Multiplexer, Demultiplexer,. Sequential Circuits: SR, & JK Flip-Flop.	10

Suggested Readings

PART A

1. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt.Ltd.,2015,11e
2. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", Mc Graw Hill,2015,4e
3. B.G. Streetman, S.K.Banerjee, "Solid State Electronic Devices",Pearson Education India, 2015,7e
4. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited,1975,5e
5. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016,43e

PARTB

1. D. Leach, A.Malvino, Goutam Saha, "Digital Principles and Applications", Mc Graw 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", Mc Graw Hill,2009,4e

Books published in Hindi & Other Reference/TextBooks may be suggested / added to this list by individual 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
Course Prerequisites
Passed Semester IV, Theory Paper-1 (B010401T)
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
Suggested Equivalent Online Courses
1. Swayam-Government of India, https://swayam.gov.in/explorer?category=Physics 2. National Programmeon Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html 3. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy 4. edX,https://www.edx.org/course/subject/physics 5. MIT Open Course Ware-Massachusetts Institute of Technology,https://ocw.mit.edu/courses/physics/
Further Suggestions
• Other Digital Platforms/Web Links and Equivalent Online Courses may be suggested/added to the respective lists by individual Universities. • **In End-Semester University Examinations, equal weightage should be given to Part A(units I to IV) And PartB (units V to VIII)while framing the questions.**

Programme/Class: **Degree**	Year: **Third**	**Paper: Sixth**
Subject: **Physics**		
CourseCode:**B010603P**	Course Title: **Analog & Digital Circuits**	

Course Outcomes (COs)

Analog & digital circuits have the most striking impact on the industry wherever the electronics instruments areused 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:35

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

Unit	Topics	No. of Lectures
	Lab Experiment List	60
	1. Energy band gap of semiconductor by reverse saturation current method 2. Energy band gap of semiconductor by four probe method 3. Hybrid parameters of transistor 4. Characteristics of FET,MOSFET,SCR,UJT 5. FET Conventional Amplifier 6. FET as VVR and VCA 7. Study and Verification of AND gate using TTL IC7408 8. Study and Verification of OR gate using TTL IC7432 9. Study and Verification of NAND gate and use as Universal gate using TTL IC7400 10. StudyandVerificationofNORgateanduseasUniversalgateusingTTLIC7402 11. Study and Verification of NOT gate using TTL IC7404 12. Study and Verification of Ex-OR gate using TTL IC7486	
	Online Virtual Lab Experiment List/Link	
	Virtual Labs an initiative of MHRD Govt. of India http://vlabs.iitkgp.ac.in/ssd/# 1. ID-VD characteristics of Junction Field Effect Transistor (JFET) 2. Silicon Controlled Rectifier (SCR) characteristics 3. Uni junction Transistor (UJT) and relaxation oscillator	

	Virtual Labs an initiative of MHRD Govt. of India https://de-iitr.vlabs.ac.in/List%20of%20experiments.html 4. Verification and interpretation of truth table for AND,OR,NOT,NAND,NOR,Ex-OR, Ex-NOR gates 5. Construction of half and full adder using XOR and NAND gates and verification of its operation 6. To study and verify half and full subtractor 7. Realization of logic functions with the help of Universal Gates (NAND,NOR) 8. Construction of a NOR gate latch and verification of its operation 9. Verify the truth table of RS,JK,T and D Flip Flops using NAND and NOR gates 10. Design and Verify the 4-Bit Serial In-Parallel Out Shift Registers 11. Implementation and verification of decoder or demultiplexer and encoder using logic gates 12. Implementation of 4x1multiplexer and 1x4 demultiplexer using logic gates 13. Design and verify the 4-Bit Synchronous or Asynchronous Counter using JKFlipFlop 14. Verify Binary to Gray and Gray to Binary conversion using NAND gates only 15. Verify the truth table of 1-Bit and2-Bit comparator rusing logic gates	

Suggested Readings

1. R.L. Boylestad,L. Nashelsky, “Electronic Devices and CircuitT heory”,Prentice-Hall of India Pvt.Ltd.,2015,11e
2. J.Millman, C.C. Halkias, Satyabrata Jit, “Electronic Devices and Circuits”,Mc Graw Hill,2015,4e
3. B.G. Streetman,S.K. Banerjee, “Solid State Electroni cDevices”,Pearson Education India,2015,7e
4. J.D.Ryder, “Electronic Fundamentals and Applications”, Prentice-Hall of India Private Limited,1975,5e
5. S.L.Gupta, V.Kumar, “Hand Book of Electronics”, Pragati Prakashan, Meerut, 2016,43e
6. D.Leach, A.Malvino, Goutam Saha, “Digital Principles and Applications”, Mc Graw Hill,2010,7e
7. William H. Gothmann, “Digital Electronics: An Introduction to Theory and Practice”, Prentice-Hall of India Private Limited, 1982, 2e
8. R.P. Jain, “Modern Digital Electronics”, Mc Graw Hill,2009,4e

Books published in Hindi & Other Reference/TextBooks may be suggested / added to this list by individual Universities.

Suggestive Digital Platforms/WebLinks

1. Virtual Labs an initiative of MHRD Govt. of India,http://vlabs.iitkgp.ac.in/ssd/#
2. Virtual Labs an initiative o fMHRD Govt. of India,https://de-iitr.vlabs.ac.in/List%20of%20experiments.html
3. Digital Platforms/Web Links of other virtual labs may be suggested/added to this lists by individual Universities.

Course Prerequisites

Opted/Passed Semester VI, Theory Paper-2(B010602T)

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
05marks for Class Interaction

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 (say6) to be performed by each student per semester from the Lab Experiment List. • The institution may suggest a minimum number of experiments (say3) to be performed by each student per semester from the Online Virtual Lab Experiment List / Link.

https://