CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY KANPUR



Four Year Undergraduate Programme (FYUP)

PHYSICS

Syllabus of

4 YEAR B.Sc. (HONOURS)

4 YEAR B.Sc. (HONOURS WITH RESEARCH)

AND

4+1 YEAR (B.Sc. HONOURS/ B.Sc. HONOURS WITH RESEARCH + M.Sc.) IN PHYSICS

SESSION 2025-2026 ONWARDS

REVISED SYLLABUS OF PHYSICS BOS dated 17.06.2025

Curricular & Credit Framework for Four Year Undergraduate Programme (FYUP)

NATIONAL EDUCATION POLICY-2020

C.S.J.M. University, Kanpur

As Proposed by Board of Studies (Physics) C.S.J.M. University, Kanpur



Chhatrapati Shahu Ji Maharaj University, Kanpur

Uttar Pradesh State University (Formerly Kanpur University, Kanpur)



Minutes of the Meeting of Board of Studies (held on 17 Jun 2025)

A Meeting of the Board of Studies (BOS) for the subject Physics was held on 17 June 2025 at 1:00 PM via online mode (Google-meet), with video conferencing at the CSJM University Campus Kanpur. The agenda was to discuss and approve the course structure and syllabus of the B.Sc., B.Sc. (Hons.) and M.Sc. Physics programs.

The detailed course structure and syllabus for both programs had already been shared with all BOS members. These programs have been designed in accordance with the Curricular & Credit Framework for the Four Year Undergraduate Programme (FYUP). During the meeting, a presentation on the course structure and syllabus was delivered. After thorough discussion on each aspect of the syllabus, the following suggestions and recommendations were made by the BOS members:

- 1. Corrections were suggested for the course B011006T Laser Physics and Applications (Xth semester), and the syllabus has been revised accordingly.
- 2. Few corrections related to practicals were incorporated as per the members' suggestions.
- 3. All other minor recommendations were incorporated into the syllabus as advised by the Board members. The members unanimously approve the final syllabus.

The Meeting was attended by the Following BOS Members:

Convener

Prof. Rajesh Kumar Dwivedi, CSJM University, Kanpur

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External Members

1. Prof. K.N. Uttam, Allahabad University, Allahabad

2. Prof. D.K. Dwivedi, MMMTU Gorakhpur

3. Prof. Manoj Kumar Sharma, Lucknow University, Lucknow

July

Internal Members

1. Prof. Preeti Dwivedi, VSSD College, Kanpur

2. Prof. Vivek Dwivedi, BND College, Kanpur

3. Prof. Anurag Saxena, DAV College, Kanpur -

4. Dr Pradeep Gupta, DSN College, Unnac

5. Dr. Anju Dixit, CSJM University Campus, Rumpur

Anju Discit

Invited Members

1. Prof. Rajiv Kumar, DAV College, Kanpur

2. Prof. P. S. Dobal, VSSD College Kanpur

3. Prof. S. P. Singh, Christ Church College, Kanpur

4. Dr. Prabal Pratap Singh, CSJM University Campus, Kanpur

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Chhatrapati Shahu Ji Maharaj University, Kanpur



Uttar Pradesh State University (Formerly Kanpur University, Kanpur)

Four Year Undergraduate Programme (FYUP)

,	SEMESTE	R-WISE TI	TLES OF THE PAPERS IN U COURSE	UG PHYS	SICS
Yea r	Semester	Course Code	Paper Title	Theory / Practica l	Credit
			TIFICATE IN BASIC PHYS	SICS &	
	Т		CONDUCTOR DEVICES Mathematical Physics &	Theory	4
	I B010101T Mathematical Physics & Newtonian Mechanics			Theory	4
ear		B010102P	Mechanical Properties of Matter	Practical	2
First Year	II	B010201T	Thermal Physics &	Theory	4
irs		B0102011	Semiconductor Devices		
\(\)		B010202P	Thermal Properties of Matter & Electronic Circuits	Practical	2
	DI	PLOMA IN	APPLIED PHYSICS WITH	ELECTR	ONICS
Second Year	III	B010301T	Electromagnetic Theory & Modern Optics	Theory	4
		B010302P	Demonstrative Aspects of Electricity & Magnetism	Practical	2
econd	IV	B010401T	Perspectives of Modern Physics & Basic Electronics	Theory	4
S		B010402P	Basic Electronics Instrumentation	Practical	2
		B010403R	Research Project	Project	3
	1	DEG	REE IN BACHELOR OF SC		1
		B010501T	Classical & Statistical Mechanics	Theory	4
-	V	B010502T	Quantum Mechanics & Spectroscopy	Theory	4
ird Year		B010503P	Demonstrative Aspects of Optics & Lasers	Practical	2
Thir		B010601T	Solid State & Nuclear Physics	Theory	4
T	VI	B010602T	Analog & Digital Principles & Applications	Theory	4
		B010603P	Analog & Digital Circuits	Practical	2
			4 YEAR UG DEGREE (HO	NOURS)
	VII	B010701T	Mathematical Physics-I	Theory	4
ourth Year		B010702T	Classical Mechanics	Theory	4
Fourth Year		B010703T	Electromagnetic Theory	Theory	4
<u> </u>		B010704T	Quantum Mechanics-I	Theory	4

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	1	D010705D	D 4 17 1		D 4: 1	4
	77111	B010705P	Practical Lab	DI ' II	Practical	4
	VIII	B010801T	Mathematical		Theory	4
		B010802T	Solid State Pl		Theory	4
		B010803T	Statistical Me	chanics	Theory	4
		B010804T	Electronics		Theory	4
		B010805P	Practical Lab		Practical	4
			,	ONOURS WITH		
				narks in the first	1	1
	VII	B010701T	Mathematic al Physics-I		Theory	4
		B010702T	Classical	*(Honours with	Theory	4
			Mechanics	research		
		B010703T	Electromag	students Select	Theory	4
			netic Theory	any 3)		
		B010704T	Quantum		Theory	4
			Mechanics-I	All compulsory		
				for Regular 2Yr		
				MSc		
ar		B010705P	Practical		Practical	4
Fourth Year		B010706R	Research	To be evaluated	Project	4
rt			Project	in Sem 8		
l no	VIII	B010801T	Mathematic		Theory	4
<u>-</u>			al Physics-II	*(Honours with		
		B010802T	Solid State	research	Theory	4
		D010007	Physics	students Select	771	
		B010803T	Statistical	any 3)	Theory	4
		B010804T	Mechanics	All compulsory	T1	4
		B0108041	Electronics	for Regular 2Yr	Theory	4
				MSc		
				1,100		
		B010805P	Practical		Practical	4
		B010806R	Research		Project	4
			Project			
			Be	yond the Fourth	year	
			P.G	(M.Sc. in Physic	<u>s)</u>	
	IX	B010901T	Classical		Theory	4
			Electrodyna	*(Honours with		
<u>-</u>			mics And	research		
Kea			Plasma	students Select		
Fifth Year		D04.22.22	Physics	any 2)		
Fif		B010902T	Quantum		Theory	4
			Mechanics-	All compulsory		
		D010002T	II N. 1	for Regular 2Yr	TP1	4
		B010903T	Nuclear	MSc	Theory	4

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		Physics-I			
	B010904T	Electronics-	*Specialization (Select any one)	Theory	4
	B010905T	Condensed Matter Physics-I	, , , , , , , , , , , , , , , , , , , ,	Theory	4
	B010906P	Practical Lab		Practical	4
	B010907R	Research Project	To be evaluated in Sem 10	Project	4
X	B011001T	Atomic And Molecular Physics	*(Honours with research students Select	Theory	4
	B011002T	Nuclear Physics-II	any 1) Both compulsory for Regular 2Yr MSc	Theory	4
	B011003T	Electronics- II	* Specialization (Select the one	Theory	4
	B011004T	Condensed Matter Physics-II	chosen in Previous/ 9 th Sem)	Theory	4
	B011005T	Physics of Liquid Crystals		Theory	4
	B011006T	Laser Physics and application s	*Elective (Select any one)	Theory	4
	B011007T	Physics of Nano materials		Theory	4
	B011008T	Elements Of Atmospheri c and Space Science		Theory	4
	B011009P	Practical Lab		Practical	4
	B011010R	Research Project		Project	4

UG Physics Syllabus
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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.

FIRST YEAR

PROGRAMME SPECIFIC OUTCOMES (PSOs)

CERTIFICATE IN BASIC PHYSICS & SEMICONDUCTOR DEVICES

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, 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

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 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.

FOURTH YEAR

PROGRAMME SPECIFIC OUTCOMES (PSOs)

4-YEAR UG DEGREE (HONOURS)

A 4-year undergraduate degree (Hons) in Physics offers several advantages, including more in-depth specialization, a stronger foundation for research and advanced studies, and a wider range of career options, particularly in fields like research, technology, and education.

This Programme will Demonstrate comprehensive understanding of Mathematical Physics, classical mechanics, electromagnetism, quantum mechanics, statistical physics, and solid-state physics, including both theoretical foundations and practical applications. It will develop domain-specific expertise in advanced areas such as nuclear physics, astrophysics, condensed matter physics, material science, electronics, or nanotechnology, enabling pursuit of research, innovation, or higher studies.

OR

4-YEAR UG DEGREE WITH RESEARCH

FOURTH AND FIFTH YEAR

A 4-year undergraduate degree with a research component offers several advantages, including increased career opportunities, direct PhD admission eligibility, and enhanced employability. It also allows for a deeper understanding of the subject, prepares students for higher education, and can lead to more opportunities. Graduates from the 4-year program will find it easier to pursue advanced degrees abroad without having to complete additional bridge programs. The research components of the 4-year program also improve students' chances of securing scholarships and admissions to top international institutions.

FIRST YEAR DETAILED SYLLABUS FOR

CERTIFICATE

IN
BASIC PHYSICS & SEMICONDUCTOR DEVICES

Prog	ramme/Class: Certificate	Year: Fir	est	Semester: Firs	t	
		Subject: P	hysics			
Cour	se Code: B010101T	Course Title: Ma	thematical Physics	s & Newtonian Mechanics	S	
		Course Outco	mes (COs)			
 Recognize the difference between scalars, vectors, pseudo-scalars and pseudo-vectors. Understand the physical interpretation of gradient, divergence and curl. Comprehend the difference and connection between Cartesian, spherical and cylindrical coordinate systems Know the meaning of 4-vectors, Kronecker delta and Epsilon (Levi Civita) tensors. Study the origin of pseudo forces in rotating frame. Study the response of the classical systems to external forces and their elastic deformation. Understand the dynamics of planetary motion and the working of Global Positioning System (GPS). 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-Practic	al (in hours per wee	k): L-T-P: 4-0-0		
Unit	Topics				No. of Lectures	
		PART				
]	Basic Mathema	tical Physics		T	
I	in context with should be Coordinate rotation, reflect scalars and pseudo-vectors	rs (include physical exa	f modern science as Internal Evaluate bra basis for defining mples). Componer	nd technology, ion (CIE). g scalars, vectors, pseudo- nt form in 2D and 3D.		
	Geometrical and physical is product and triple product of	-	ion and displacemen			
II	Geometrical and physical interpretation of vector differentiation, Gradient, Divergence and Curl					
Ш	2D & 3D Cartesian, Sphe equations. Expressions for divergence and curl in different coordinate system	displacement vector, arc le ferent coordinate systems.	dinate systems, bas ngth, area element, Components of ve	volume element, gradient, locity and acceleration in	, 8	

IV	Introduction to Tensors Principle of invariance of physical laws w.r.t. different coordinate systems as the basis for defining tensors. Coordinate transformations for general spaces of nD, contravariant, covariant & mixed tensors and their ranks, 4-vectors. Index notation and summation convention. Symmetric and skew-symmetric tensors. Invariant tensors, Kronecker delta and Epsilon (Levi Civita) tensors, Fourier Series.	
	PART B	
	Newtonian Mechanics & Wave Motion	
V	Dynamics of a System of Particles Review of historical development of mechanics up to Newton. Background, statement and critical analysis of Newton's axioms of motion. Dynamics of a system of particles, centre of mass motion, and conservation laws & their deductions. Rotating frames of reference, general derivation of origin of pseudo forces (Coriolis & centrifugal) in rotating frame, and effects of Coriolis force. Foucault Pendulum (Demonstration of Earth rotation).	8
VI	Dynamics of a Rigid Body Angular momentum, Torque, Rotational energy and the inertia tensor. Rotational inertia for simple bodies (ring, disk, rod, solid and hollow sphere, solid and hollow cylinder, rectangular lamina). The combined translational and rotational motion of a rigid body on horizontal and inclined planes. Elasticity, relations between elastic constants, bending of beam and torsion of cylinder.	
	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).	
	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. A.W. Joshi, "Matrices and Tensors in Physics", New Age International Private Limited, 1995, 3e

PAR Examples

- 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

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 in 12th / Mathematics in 12th

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/
 - 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	ertificate 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 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. 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 statical 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. Modulus of rigidity by torsional vibration	
	7. Young's modulus and Poisson's ratio by Searle's method	
	8. Poisson's ratio of rubber by rubber tubing	
	9. Surface tension of water by capillary rise method	
	10. Surface tension of water by Jaeger's method	
	11. Coefficient of viscosity of water by Poiseuille's method	
	12. Acceleration due to gravity by bar pendulum	
	13. Frequency of AC mains by Sonometer	(0)
	14. Frequency of AC mains by Meldies Experiment	60
	15. Acceleration due to gravity by Katers pendulum	
	Online Virtual Lab Experiment List / Link	
	Virtual Labs at Amrita Vishwa Vidyapeetham	
1	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	

- 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 / Text Books 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=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

- 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.

Progr	ramme/Class: Certificate	Year: Fir	st	Semester: Second	d
		Subject: P	Physics		
Cour	se Code: B010201T	Course Title: T	Thermal Physics &	Semiconductor Devices	
		Course Outco	mes (COs)		
2. U 3. C 4. S 5. U 6. R 7. D	Design simple electronic circular stand the physical signs of the comprehend the kinetic mode tudy the implementations are stillity of AC bridges. Design simple electronic circular stands the applications of the component of the component stands are stands as a second standard stan	ficance of thermodynamical of gases w.r.t. various gased limitations of fundament ents of electronic devices.	al potentials. s laws. al radiation laws.		
	Credits:	4	Core	e Compulsory / Elective	
	Max. Marks:	25+75	N	Min. Passing Marks:	
	Total No. of	Lectures-Tutorials-Practic	al (in hours per wee	ek): L-T-P: 4-0-0	
Unit		Topics			No. of Lectures
		PART			
		Thermodynamics & Kir 0 th & 1 st Law of Ther	· · · · · · · · · · · · · · · · · · ·	ses	
I	State functions and termino energy, heat and work don between C _P and C _V . Heat	ology of thermodynamics. 2 e. Work done in various the	Zeroth law and tem hermodynamical pr	•	
п	Different statements of sec Entropy changes in various unattainability of absolute feasibility of a process and Thompson effect.	thermodynamical processor. Thermodynamical po	y, entropy and its pes. Third law of the tentials, Maxwell's	ermodynamics and relations, conditions for	8
Ш	Kinetic model and deductive velocities and its experimental (no derivation) and its app	ental verification. Degrees	ation of Maxwell s of freedom, law	of equipartition of energy	7
IV	Blackbody radiation, speci Derivation of Planck's law Boltzmann law and Wien's	v, deduction of Wien's d	of energy density istribution law, Ra		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, Maximum Power Transfer 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).	7
	Semiconductors & Diodes	
VI	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 reverse biased diode. Diode fabrication. PN junction diode and its characteristics, static and dynamic resistance. Principle, structure, characteristics and applications of Zener, Light Emitting diode, Point Contact and Photo diodes. Half and Full wave rectifiers, calculation of ripple factor, rectification and voltage regulation. Basic idea about filter circuits and voltage regulated power supply.	8
	Transistors	
VII	Bipolar Junction PNP and NPN transistors. Study of CB, CE & CC configurations w.r.t. active, cutoff & saturation regions; characteristics; current, voltage & power gains; transistor currents & relations between them. Idea of base width modulation, base spreading resistance & transition time. DC Load Line analysis and Q-point stabilization.	8
	Electronic Instrumentation	
VIII	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.	7

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. 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", McGraw 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. A. Sudhakar, S.S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 2015, 5e
- 6. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, 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 in 12th / Chemistry in 12th

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

Open to all

Suggested Continuous Internal Evaluation (CIE) Methods

20 marसिंदां क्षाप्र / 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/
 - 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.

Progra	amme/Class: Certificate	Year: Fir	st	Semester: Secon	d
		Subject: P	hysics		
Cours	e Code: B010202P	Course Title: Ther	mal Properties of I	Matter & Electronic Circ	cuits
		Course Outco	mes (COs)		
detern	nine the thermal and elect		nent precision and n simulation techniq Core	perfection is achieved th	rough Lab
	Total No. of	Lectures-Tutorials-Practic	al (in hours per wee	ek): L-T-P: 0-0-4	
Unit		Topics			No. of Lectures
		Lab Experime	ent List		
	 Coefficient of therma Coefficient of therma Value of Stefan's cor Variation of thermo- Temperature coeffici A.C. Bridges: Variou Thevenin's and North Characteristics of PN Characteristics of Lig Characteristics of Ph Characteristics of Ph Characteristics of a Ph Characteristics of a Ph Characteristics of a Ph Characteristics of a Ph 	emf across two junctions of ent of resistance by Platinu is experiments based on me on's, Maximum Power Tran Junction diode her diode ght Emitting Diodes oto diode NP/NPN transistor CB con NP/NPN transistor CE con NP/NPN transistor CC con & full wave rectifiers	ductor by Lee and of a thermocouple will make thermocouple will make thermocouple assurement of L and assert theorems	Charlton's disc method th temperature ometer	60
		Online Virtual Lab Expe	riment List / Link		
	Thermal Properties of Ma Virtual Labs at Amrita Visl https://vlab.amrita.edu/?sub	nwa Vidyapeetham			
	 Heat transfer by rad Heat transfer by co Heat transfer by na The study of phase Black body radiation Newton's law of co Lee's disc apparatu Thermo-couple: Se 	nduction tural convection change on: Determination of Stefan oling s	's constant		

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", McGraw Hill, 2015, 5e

Books published in Hindi & Other Reference / Text Books 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=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

- 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

Progr	ramme/Class: Diploma	Year: Seco	ond	Semester: Third	
		Subject: P	hysics		
Cour	se Code: B010301T	Course Title: I	Electromagnetic Th	neory & Modern Optics	
		Course Outco	mes (COs)		
1. B	Setter understanding of elect	rical and magnetic phenom	enon in daily life.		
1	o troubleshoot simple probl				
3. Comprehend the powerful applications of ballistic galvanometer.4. Study the fundamental physics behind reflection and refraction of light (electromagnetic waves).					
	• •		• ,	,	
	tudy the working and applic		•		
	lecognize the difference bet		ofer's class of diffra	ction.	
	Comprehend the use of polar				
8. S	tudy the characteristics and				
	Credits:	4	Core	Compulsory / Elective	
	Max. Marks: 25+75 Min. Passing Marks:				
	Total No. of	Lectures-Tutorials-Practic	al (in hours per wee	k): L-T-P: 4-0-0	
Unit	Topics				No. of Lectures
		<u>PART</u> Electromagne			
I	Electrostatics Electric force between charges, General expression for Electric field in terms of linear, surface and volume charge densities, divergence & curl of Electric field, Gauss law and its applications to				8
	Magnetostatics		<u> </u>		
п	Lorentz force, Bio-Savart's law and its applications, divergence and curl of Magnetic field, Magnetic force between two current elements, Ampere's circuital law (applications included),				8
		Time Varying Electron	O		
Ш	Faraday's laws of electromagnetic induction and Lenz's law. Self and mutual induction (applications included). Theory and working of moving coil ballistic galvanometer, Displacement current, equation of continuity and Maxwell's correction in Ampere's circuital law, Derivation and physical significance of Maxwell's equations.				
		Electromagneti	c Waves		
IV	and isotropic dielectrics, l	ensity and Poynting vector Poynting's theorem, Bound romagnetic waves, law of e).	lary conditions, Ret	flection and refraction of	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 double-refraction, dichroic 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 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), Ruby laser and He-Ne gas laser. Holography	7		

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. 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

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

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/

- 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.

Progr	amme/Class: Diploma	Year: Seco	nd	Semester: Thir	d
		Subject: P	hysics		
Cours	se Code: B010302P	Course Title: Dem	onstrative Aspects	s of Electricity & Magnet	ism
		Course Outco	mes (COs)		
deterr	nine the electric and mag	ost striking impact on the inetic properties. Measuren Experiments give an insight	nent precision and	perfection is achieved the	hrough La
	Credits	: 2	Core	e Compulsory / Elective	
	Max. Marks:	25+75	N	Min. Passing Marks:	
	Total No. o	f Lectures-Tutorials-Practic	al (in hours per wee	ek): L-T-P: 0-0-4	
Unit		Topics			No. of Lecture
	 Variation of magneti Variation of magneti Ballistic Galvanome High resistance by L Ballistic Galvanome Ballistic Galvanome Comparison of two r Carey Foster Bridge Deflection and Vibra component of earth's 	rging in RC and RCL circuic field along the axis of sing cifield along the axis of Helter: Ballistic constant, current eakage method ter: Low resistance by Kelviter: Self inductance of a coil esistances using a potention Resistance per unit length attion Magnetometer: Magnets magnetic field zontal component of earth's	gle coil mholtz coil nt sensitivity and v in's double bridge i by Rayleigh's menter. and low resistance tic moment of a ma	method thod agnet and horizontal	60
l		Online Virtual Lab Expe	riment List / Link		
	Virtual Labs at Amrita Visi https://vlab.amrita.edu/?sub	• •			
	 Tangent galvanom Magnetic field alor Deflection magnet Van de Graaff gen Barkhausen effect Temperature coeff Anderson's bridge Quincke's method 	ng the axis of a circular coil ometer erator	carrying current		

- 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 / Text Books 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=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 (B010301T)

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

- 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	1	
		Subject: P	Physics		
Cour	se Code: B010401T	Course Title: Persp	ectives of Modern	Physics & Basic Electron	ics
		Course Outco	omes (COs)		
1. R	ecognize the difference bet	ween the structure of space	& time in Newtoni	an & Relativistic mechanics	S.
	Inderstand the physical sign	-	f Lorentz transform	ation equations.	
	Comprehend the wave-partic	•			
	Develop an understanding of	-		cs.	
	tudy the comparison between	•	es.		
	tudy the classification of an comprehend the use of feedb	•			
	*		ana with ita annliaa	tions	
o. C	Comprehend the theory and v				
	Credits:	4	Core	Compulsory / Elective	
	Max. Marks:	25+75	N	Min. Passing Marks:	
	Total No. of	Lectures-Tutorials-Practic	al (in hours per wee	ek): L-T-P: 4-0-0	
Unit		Topics			No. of
					Lectures
		PART			
		Perspectives of M	<u>*</u>		I
	Structure of space & time	Relativity-Experiment	_	n inartial frames Galilaan	
I	transformations. Newtonia				
1	locate the Absolute Fram	•		-	1 ′
	Einstein's postulates of spe		eriment und signif	icunce of the half result.	
	Emistem s postulates of spe	Relativity-Relativisti	c Kinematics		
	Structure of space & tim	•		of Lorentz transformation	
	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);				
II	Transformation of Length (Length contraction); Transformation of Time (Time dilation);				8
	Transformation of Veloc	ity (Relativistic velocity	addition); Transfo	ormation of Acceleration;	,
	Transformation of Mass (Variation of mass with ve	elocity). Relation b	etween Energy & Mass	
	(Einstein's mass & energy	relation) and Energy & Mor	mentum.		
		Inadequacies of Class	ical Mechanics		
	Particle Properties of Wav	•	•	-	
III	effect and their explanation				8
	Wave Properties of Particles: Louis de Broglie's hypothesis of matter waves and their experimental				
	verification by Davisson-G	-		t.	
	No. 11. Division	Introduction to Quant		337 1	
TT 7	Matter Waves: Principal of linear superposition, Mathematical representation, Wavelength, Concept of Wave group, Group velocity, Phase velocity and relation between Group & Phase			7	
IV	velocities. Wave Function: Functional form, Normalisation of wave function, Orthogonal &				
		ns and Probabilistic interpr		_	

	PART B				
	Basic Electronics & Introduction to Fiber Optics				
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. Discussion of Emitter-Follower configuration.				
VI	Classification of amplifiers based on Mode of operation (Class A, B, AB, C & D), Stages (single & multi stage, cascade & cascade connections), Coupling methods (RC, Transformer, Direct & LC couplings), Nature of amplification (Voltage & Power amplification). Theory & working of RC coupled voltage amplifier (Uses of various resistors & capacitors, and Frequency response) and Transformer coupled power amplifier. Calculation of Amplifier Efficiency (power efficiency) for Class A Series-Fed, Class A Transformer Coupled, Class B Series-Fed and Class B Transformer Coupled amplifiers, Use of heat sink & Power dissipation.	7			
	Feedback & Oscillator Circuits				
VII	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. 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 and Wein Bridge oscillator. Qualitative discussion of Reactive Network feedback oscillators (Tuned oscillator circuits): Hartley & Colpitt oscillators.	8			
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, qualitative discussion of fiber losses and applications of optical fibers.	8			
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. 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", McGraw 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

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

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/

- 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.

Progr	amme/Class: Diploma	Year: Seco	nd	Semester: Fourt	h
		Subject: P	hysics		
Cours	ee Code: B010402P	Course Ti	itle: Basic Electron	nics Instrumentation	
		Course Outco	mes (COs)		
instru achiev	Electronics instrumentation ments are used to study a wed through Lab Experimental a basis for modeling.	nd determine the electronints. Online Virtual Lab Ex	ic properties. Meas periments give an	surement precision and peinsight in simulation techn	erfection i
	Credits:			Compulsory / Elective	
	Max. Marks:			Min. Passing Marks:	
	Total No. of	Lectures-Tutorials-Practic	al (in hours per wee	ek): L-T-P: 0-0-4	No. of
Unit		Topics			Lectures
	7. Frequency response of	r r r s ower of single stage RC coupled a of single stage Transformer odback on frequency respon gger llator	coupled amplifier	umplifier	
	, ,	Online Virtual Lab Expe	riment List / Link		
	Virtual Labs an initiative o	f MHRD Govt. of India			
	1. Diode as Clippers 2. Diode as Clampers 3. BJT as switch and Virtual Labs an initiative o	Load Lines f MHRD Govt. of India			60
	4. RC frequency resp	onse			
	Virtual Labs at Amrita Vis https://vlab.amrita.edu/inde	• •			
	5. Hartley oscillator6. Colpitt oscillator				

Virtual Labs at Amrita Vishwa Vidyapeetham

http://vlab.amrita.edu/index.php?sub=59&brch=269

- 7. Fiber Optic Analog and Digital Link
- 8. Fiber Optic Bi-directional Communication
- 9. Wavelength Division Multiplexing
- 10. Measurement of Bending Losses in Optical Fiber
- 11. Measurement of Numerical Aperture
- 12. Study of LED and Detector Characteristics

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", McGraw 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

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

Suggestive Digital Platforms / Web Links

- 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 Vishwa Vidyapeetham, https://vlab.amrita.edu/index.php?sub=1&brch=201
- 4. Virtual Labs at Amrita Vishwa Vidyapeetham, http://vlab.amrita.edu/index.php?sub=59&brch=269
- 5. Digital Platforms / Web Links of other 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

05 marks for Class Interaction

Suggested Equivalent Online Courses

- 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

Prog	ramme/Class: Degree	Year: Thi	rd	Semester: Fifth	
		Subject: P	hysics		
Cour	Course Code: B010501T Course Title: Classical & Statistical Mechanics				
		Course Outco	mes (COs)		
 Understand the concepts of generalized coordinates and D'Alembert's principle. Understand the Lagrangian dynamics and the importance of cyclic coordinates. Comprehend the difference between Lagrangian and Hamiltonian dynamics. Study the important features of central force and its application in Kepler's problem. Recognize the difference between macrostate and microstate. Comprehend the concept of ensembles. Understand the classical and quantum statistical distribution laws. Study the applications of statistical distribution laws. 					
	Credits	4	Core	Compulsory / Elective	
	Max. Marks:	25+75	N	Iin. Passing Marks:	
	Total No. of	Lectures-Tutorials-Practic	al (in hours per wee	ek): L-T-P: 4-0-0	
Unit	Topics			No. of Lectures	
		<u>PART</u> Introduction to Cla			
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.				
		Lagrangian Fo	malism		
П	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	
		Hamiltonian Fo	rmalism		
III	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.				
IV	Central Force Definition and properties (with prove) of central force. Equation of motion and differential equation				

	PART B		
	Introduction to Statistical Mechanics		
	Macrostate & Microstate		
V	Macrostate, Microstate, Number of accessible microstates and Postulate of equal a priori. Phase	1 h	
•	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.		
	Concept of Ensemble		
VI	Problem with time average, concept of ensemble, postulate of ensemble average and Liouville's	6	
VI	theorem (proof included). Micro Canonical, Canonical & Grand Canonical ensembles.		
	Thermodynamic Probability, Postulate of Equilibrium and Boltzmann Entropy relation.		
	Distribution Laws		
	Statistical Distribution Laws: Expressions for number of accessible microstates, probability &	ability &	
	number of particles in ith state at equilibrium for Maxwell-Boltzmann, Bose-Einstein & Fermi-		
VII	Dirac statistics. Comparison of statistical distribution laws and their physical significance.	10	
	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.		
	Applications of Statistical Distribution Laws		
	lication of Bose-Einstein Distribution Law: Photons in a black body cavity and derivation of		
VIII	Planck's Distribution Law.		
	Application of Fermi-Dirac Distribution Law: Free electrons in a metal, Definition of Fermi energy,	8	
	Determination of Fermi energy at absolute zero, Kinetic energy of Fermi gas at absolute zero and		
	concept of Density of States.		

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

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/

- 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.

Progr	ramme/Class: Degree	Year: Thin	·d	Semester: Fifth	
Subject: Physics					
Cours	se Code: B010502T	Course Title	: Quantum Mecha	anics & Spectroscopy	
		Course Outco	mes (COs)		
2. S 3. U 4. D 5. C 6. S 7. S	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.				
	Credits:	4	Core	Compulsory / Elective	
	Max. Marks:	25+75	N	fin. Passing Marks:	
	Total No. of	Lectures-Tutorials-Practica	al (in hours per wee	k): L-T-P: 4-0-0	
Unit	Topics			No. of Lectures	
		<u>PART</u>			
	I	Introduction to Qua			
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	
		Eigen & Expectati	on 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.				6	
		•	· .		
ш	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, Derivation & interpretation of equation of continuity in Schrodinger representation, and Equation of motion of an operator in Schrodinger representation, Ehrenfest Theorem				

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. 1D Harmonic oscillator. Quantum tunnelling. 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	
	Vector Atomic Model	
V	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
	Spectra of Alkali & Alkaline Elements	
VI	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
	X-Rays & X-Ray Spectra	
VII	Nature & production Continuous X-ray spectrum & Duane-Hunt's law Characteristic X-ray	7
	Molecular Spectra	
VIII	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
	Community of Deciding	

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

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 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 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/
 - 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.

Lab Experiment List 1. Fresnel Biprism: Wavelength of sodium light 2. Newton's Rings: Wavelength of sodium light 3. Plane Diffraction Grating: Resolving power 4. Resolving power of telescope 5. Plane Diffraction Grating: Spectrum of mercury light 6. Spectrometer: Refractive index of the material of a prism using sodium light 7. Spectrometer: Dispersive power of the material of a prism using mercury light 8. Polarimeter: Specific rotation of sugar solution 9. Photocell 10. Wavelength of Laser light using diffraction by single slit 11. Wavelength of Laser light using a plane diffraction grating 12. Wavelength of Laser light using Youngs double slit experiment 13. Measurement of wavelength of He-Ne laser using a steel scale 14. Measurement of intensity distribution in a single slit diffraction pattern produced by	Programme/Class: Degree Year: Third Semester		Semester: Fifth			
Course Outcomes (COs) Experimental physics has the most striking impact on the industry wherever the instruments are used to study an determine the optical properties. Measurement precision and perfection is achieved through Lab Experiment 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 Lab Experiment List 1. Fresnel Biprism: Wavelength of sodium light 2. Newton's Rings: Wavelength of sodium light 3. Plane Diffraction Grating: Resolving power 4. Resolving power of telescope 5. Plane Diffraction Grating: Spectrum of mercury light 6. Spectrometer: Refractive index of the material of a prism using sodium light 7. Spectrometer: Dispersive power of the material of a prism using mercury light 8. Polarimeter: Specific rotation of sugar solution 9. Photocell 10. Wavelength of Laser light using diffraction by single slit 11. Wavelength of Laser light using a plane diffraction grating 12. Wavelength of Laser light using Youngs double slit experiment 13. Measurement of wavelength of He-Ne laser using a steel scale 14. Measurement of intensity distribution in a single slit diffraction pattern produced by			Subject: P	Physics		
Experimental physics has the most striking impact on the industry wherever the instruments are used to study at determine the optical properties. Measurement precision and perfection is achieved through Lab Experiment Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling. Credits: 2	Course	e Code: B010503P	Course Title:	Demonstrative As	pects of Optics & Lasers	
determine the optical properties. Measurement precision and perfection is achieved through Lab Experiment Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling. Credits: 2			Course Outco	omes (COs)		
Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling. Credits: 2 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 Lab Experiment List 1. Fresnel Biprism: Wavelength of sodium light 2. Newton's Rings: Wavelength of sodium light 3. Plane Diffraction Grating: Resolving power 4. Resolving power of telescope 5. Plane Diffraction Grating: Spectrum of mercury light 6. Spectrometer: Refractive index of the material of a prism using sodium light 7. Spectrometer: Dispersive power of the material of a prism using mercury light 8. Polarimeter: Specific rotation of sugar solution 9. Photocell 10. Wavelength of Laser light using diffraction by single slit 11. Wavelength of Laser light using a plane diffraction grating 12. Wavelength of Laser light using Youngs double slit experiment 13. Measurement of wavelength of He-Ne laser using a steel scale 14. Measurement of intensity distribution in a single slit diffraction pattern produced by						
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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 Lecture Lab Experiment List 1. Fresnel Biprism: Wavelength of sodium light 2. Newton's Rings: Wavelength of sodium light 3. Plane Diffraction Grating: Resolving power 4. Resolving power of telescope 5. Plane Diffraction Grating: Spectrum of mercury light 6. Spectrometer: Refractive index of the material of a prism using sodium light 7. Spectrometer: Dispersive power of the material of a prism using mercury light 8. Polarimeter: Specific rotation of sugar solution 9. Photocell 10. Wavelength of Laser light using diffraction by single slit 11. Wavelength of Laser light using a plane diffraction grating 12. Wavelength of Laser light using Youngs double slit experiment 13. Measurement of wavelength of He-Ne laser using a steel scale 14. Measurement of intensity distribution in a single slit diffraction pattern produced by	Online		 			y .
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4 Unit Topics Lab Experiment List 1. Fresnel Biprism: Wavelength of sodium light 2. Newton's Rings: Wavelength of sodium light 3. Plane Diffraction Grating: Resolving power 4. Resolving power of telescope 5. Plane Diffraction Grating: Spectrum of mercury light 6. Spectrometer: Refractive index of the material of a prism using sodium light 7. Spectrometer: Dispersive power of the material of a prism using mercury light 8. Polarimeter: Specific rotation of sugar solution 9. Photocell 10. Wavelength of Laser light using diffraction by single slit 11. Wavelength of Laser light using a plane diffraction grating 12. Wavelength of Laser light using Youngs double slit experiment 13. Measurement of wavelength of He-Ne laser using a steel scale 14. Measurement of intensity distribution in a single slit diffraction pattern produced by		Credits	2	Core	Compulsory / Elective	
Topics Lab Experiment List 1. Fresnel Biprism: Wavelength of sodium light 2. Newton's Rings: Wavelength of sodium light 3. Plane Diffraction Grating: Resolving power 4. Resolving power of telescope 5. Plane Diffraction Grating: Spectrum of mercury light 6. Spectrometer: Refractive index of the material of a prism using sodium light 7. Spectrometer: Dispersive power of the material of a prism using mercury light 8. Polarimeter: Specific rotation of sugar solution 9. Photocell 10. Wavelength of Laser light using diffraction by single slit 11. Wavelength of Laser light using a plane diffraction grating 12. Wavelength of Laser light using Youngs double slit experiment 13. Measurement of wavelength of He-Ne laser using a steel scale 14. Measurement of intensity distribution in a single slit diffraction pattern produced by		Max. Marks:	25+75	N	Min. Passing Marks:	
Lab Experiment List 1. Fresnel Biprism: Wavelength of sodium light 2. Newton's Rings: Wavelength of sodium light 3. Plane Diffraction Grating: Resolving power 4. Resolving power of telescope 5. Plane Diffraction Grating: Spectrum of mercury light 6. Spectrometer: Refractive index of the material of a prism using sodium light 7. Spectrometer: Dispersive power of the material of a prism using mercury light 8. Polarimeter: Specific rotation of sugar solution 9. Photocell 10. Wavelength of Laser light using diffraction by single slit 11. Wavelength of Laser light using a plane diffraction grating 12. Wavelength of Laser light using Youngs double slit experiment 13. Measurement of wavelength of He-Ne laser using a steel scale 14. Measurement of intensity distribution in a single slit diffraction pattern produced by		Total No. of	Lectures-Tutorials-Practic	al (in hours per wee	ek): L-T-P: 0-0-4	
1. Fresnel Biprism: Wavelength of sodium light 2. Newton's Rings: Wavelength of sodium light 3. Plane Diffraction Grating: Resolving power 4. Resolving power of telescope 5. Plane Diffraction Grating: Spectrum of mercury light 6. Spectrometer: Refractive index of the material of a prism using sodium light 7. Spectrometer: Dispersive power of the material of a prism using mercury light 8. Polarimeter: Specific rotation of sugar solution 9. Photocell 10. Wavelength of Laser light using diffraction by single slit 11. Wavelength of Laser light using a plane diffraction grating 12. Wavelength of Laser light using Youngs double slit experiment 13. Measurement of wavelength of He-Ne laser using a steel scale 14. Measurement of intensity distribution in a single slit diffraction pattern produced by	Unit		Topics			No. of Lecture
 Newton's Rings: Wavelength of sodium light Plane Diffraction Grating: Resolving power Resolving power of telescope Plane Diffraction Grating: Spectrum of mercury light Spectrometer: Refractive index of the material of a prism using sodium light Spectrometer: Dispersive power of the material of a prism using mercury light Polarimeter: Specific rotation of sugar solution Photocell Wavelength of Laser light using diffraction by single slit Wavelength of Laser light using a plane diffraction grating Wavelength of Laser light using Youngs double slit experiment Measurement of wavelength of He-Ne laser using a steel scale Measurement of intensity distribution in a single slit diffraction pattern produced by 		Lab Experiment List				
I I YY NY 1		 Newton's Rings: W Plane Diffraction C Resolving power o Plane Diffraction C Spectrometer: Refr Spectrometer: Disp Polarimeter: Species Photocell Wavelength of Last Wavelength of Last Wavelength of Last Measurement of St 	Vavelength of sodium light Grating: Resolving power of telescope Grating: Spectrum of merculactive index of the material persive power of the material fic rotation of sugar solution er light using diffraction by the light using a plane diffraction by the light using Youngs doubt wavelength of He-Ne last	of a prism using so al of a prism using a row single slit action grating ale slit experiment er using a steel sc	mercury light ale	

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

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 / Text Books 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 Vishwa Vidyapeetham, 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

Passed Semester III, Theory Paper-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 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 (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.

Progr	ramme/Class: Degree	Year: Thi	rd	Semester: Sixth	
		Subject: P	hysics		
Cours	se Code: B010601T	Course	Title: Solid State &	Nuclear Physics	
		Course Outco	mes (COs)		
2. C 3. S 4. R 5. S 6. U 7. C	Inderstand the crystal geometomprehend the power of X-tudy various properties base accognize the importance of tudy the salient features of Inderstand the importance of comprehend the working and Inderstand the classification	ray diffraction and the conced on crystal bindings. Free Electron & Band theo nuclear forces & radioactive f nuclear models & nuclear dapplications of nuclear access.	ries in understandir e decays. reactions.	ng the crystal properties.	
	Credits:	4	Core	Compulsory / Elective	
	Max. Marks:	25+75	N	Min. Passing Marks:	
	Total No. of	Lectures-Tutorials-Practic	al (in hours per wee	ek): L-T-P: 4-0-0	
Unit		Topics			No. of Lectures
		PART	<u>`A</u>		
	I	Introduction to Sol	<u>*</u>		I
I	Lattice, Basis & Crystal Symmetry operations, Poin lattices. Lattice planes and Zinc Sulphide, Sodium Chl	nt group & Space group. 2 Miller indices. Simple crys	on vectors, Primiti D & 3D Bravais l tal structures - HCF	attice. Parameters of cubic	
Tray 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		
Ш	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-				7

	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.		
IV	Lattice heat capacity, Dulong-Petit's law and Einstein's theory of lattice heat capacity.	9	
1	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 & Classification of solids on the basis of band theory.		
	PART B		
	Introduction to Nuclear Physics		
	Nuclear Forces & Radioactive Decays		
	General Properties of Nucleus: Mass, binding energy, radii, density, angular momentum, magnetic		
	dipole moment vector and electric quadrupole moment tensor.		
V	Nuclear Forces: General characteristic of nuclear force and Deuteron ground state properties.	9	
	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.		
	Nuclear Models & Nuclear Reactions		
	Nuclear Models: Liquid drop model and Bethe-Weizsacker mass formula. Single particle shell		
VI	model (the level scheme in the context of reproduction of magic numbers included).	9	
	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.		
	Accelerators & Detectors		
	Accelerators: Theory, working and applications of Van de Graaff accelerator, Cyclotron and		
VII	Synchrotron.	6	
	Detectors: Theory, working and applications of GM counter, Semiconductor detector, Scintillation		
	counter and Wilson cloud chamber.		
	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,	6	
	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.		
	Suggested Readings		
	Calledon Indiana		

PART A

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

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 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/
 - 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.

Prog	ramme/Class: Degree	Year: Thi	rd	Semester: Sixth	
		Subject: P	hysics		
Cour	Course Code: B010602T Course Title: Analog & Digital Principles & Applications				
		Course Outco	mes (COs)		
l. S	Study the drift and diffusion	of charge carriers in a semio	conductor.		
2. U	Inderstand the Two-Port mo	del of a transistor.			
	Study the working, properties				
	Comprehend the design and o	_	ſs.		
	Understand various number s				
	Familiarize with binary arithm				
	Study the working and prope				
3. (Comprehend the design of co	mbinational and sequential	circuits.		
	Credits:	4	Core	Compulsory / Elective	
	Max. Marks:	25+75	N	Ain. Passing Marks:	
	Total No. of	Lectures-Tutorials-Practice	al (in hours per wee	ek): L-T-P: 4-0-0	
Unit	+	Topics			No. of
					Lectures
		PART			
		Analog Electro			I
		Semiconductor		1 1 % 1 1 1 1	
	Expressions for Fermi energy	•		•	
T	Drift of charge carriers (n charge carries in a semicon	•	Jillusion of charge	e carries and life time of	9
I			Junatian aanaaitan	as (diffusion & transition)	9
	Expressions for Barrier po for depletion layer in a		•	· · ·	
	resistance for PN junction.	3	`	1 /	
	resistance for 1 to junction.	Transistor Mo	* *	LIOIIS	
	Transistor as Two-Port N		8	ats of voltage & current	
	Quantitative discussion of		•	· ·	
II	h-parameters for CB, CE	-	-	~	1 X
	equivalent model and estim	ŭ	•		
	& power).	ation of input impedance,	output Impedance	and Sum (current, votage	
	1 /	Field Effect Tra	nsistors		
	JFET: Construction (N channel & P channel); Configuration (CS, CD & CG); Operation in different				
	regions (Ohmic or Linear	· · · · · ·	,	· -	
	`	Shorted Gate Drain Current, Pinch Off Voltage & Gate Source Cut-Off Voltage); Expression for			
	Drain Current (Shockley			• • •	
Ш	Resistance, Mutual Condu	- '	,	· · · · · · · · · · · · · · · · · · ·	
	configuration (Self Bias &		•	, -	
	Comparison (N & P channel	-		<i>)</i> -	
	MOSFET: Construction ar	· · · · · · · · · · · · · · · · · · ·	Γ (N channel & P	channel) and E-MOSFET	-
		Characteristics (Drain &	`	, and the second	
	(N channel & F channel),	Characteristics (Diam &	Transfer) of D-IVI	OSFET and E-MOSFET,	

	Other Devices	
IV	SCR: Construction; Equivalent Circuits (Two Diodes, Two Transistors & One Diode-One Transistor); Working (Off state & On state); Characteristics; and its Applications. UJT: Construction; Equivalent Circuit; Working (Cut-off, Negative Resistance & Saturation regions); Characteristics (Peak & Valley points); and its Applications.	5
	PART B	
	Digital Electronics	
	Number System	
	Number Systems: Binary, Octal, Decimal & Hexadecimal number systems and their inter	
V	conversion.	6
	Binary Codes: BCD, Excess-3 (XS3), Parity, Gray & ASCII Codes and their advantages	
	& disadvantages. Data representation.	
	Binary Arithmetic	
VI	Binary Addition, Decimal Subtraction using 9's & 10's complement, Binary Subtraction using 1's	5
	& 2's compliment, Multiplication and Division.	
	Logic Gates	
	Truth Table, Symbolic Representation and Properties of OR, AND, NOT, NOR, NAND, EX-OR &	
VII	EX-NOR Gates. Implementation of OR, AND & NOT gates (realization using diodes & transistor).	9
	De Morgan's theorems. NOR & NAND gates as Universal Gates. Application of EX-OR & EX-	
	NOR gates as pairty checker. Boolean Algebra. Karnaugh Map.	
	Combinational & Sequential Circuits	
VIII	Combinational Circuits: Half Adder, Full Adder, Parallel Adder, Half Subtractor, Full Subtractor.	
	Data Processing Circuits: Multiplexer, Demultiplexer, Decoders & Encoders. Sequential Circuits: SR, T, D, JK & M/S JK Flip-Flops, Shift Register (SISO, SIPO, PISO &	10
	PIPO), and Asynchronous & Synchronous counters, Modified counters.	
	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", McGraw 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

PART B

- 1. D. Leach, A. Malvino, Goutam Saha, "Digital Principles and Applications", McGraw Hill, 2010, 7e
- 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

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 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 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/
 - 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: Sixth			
	Subject: Physics				
Course Code: B010603P Course Title: Analog & Digital Circuits					
Course Outcomes (COs)					

Analog & digital circuits have the most striking impact on the industry wherever the electronics 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

nit	Topics	No. of Lectures
	Lab Experiment List 1. To study the characteristics of a tunnel diode 2. Hybrid parameters of transistor 3. Characteristics of FET 4. Characteristics of MOSFET 5. Characteristics of SCR 6. Characteristics of UJT 7. FET Conventional Amplifier 8. FET as VVR and VCA 9. Study and Verification of AND gate using TTL IC 7408	- Eccures
	 10. Study and Verification of OR gate using TTL IC 7432 11. Study and Verification of NAND gate and use as Universal gate using TTL IC 7400 12. Study and Verification of NOR gate and use as Universal gate using TTL IC 7402 13. Study and Verification of NOT gate using TTL IC 7404 14. Study and Verification of Ex-OR gate using TTL IC 7486 15. To plot F-D distribution function in the neighborhood of Fermi energy for different temperature values 	60
	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. Unijunction Transistor (UJT) and relaxation oscillator	

Virtual Labs an initiative of MHRD Govt. of India

https://de-iitr.vlabs.ac.in/List%20of%20experiments.html

- 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 4x1 multiplexer and 1x4 demultiplexer using logic gates
- 13. Design and verify the 4-Bit Synchronous or Asynchronous Counter using JK Flip Flop
- 14. Verify Binary to Gray and Gray to Binary conversion using NAND gates only
- 15. Verify the truth table of 1-Bit and 2-Bit comparator using logic gates

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", McGraw 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
- 6. D. Leach, A. Malvino, Goutam Saha, "Digital Principles and Applications", McGraw 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", McGraw Hill, 2009, 4e

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

Suggestive Digital Platforms / Web Links

- 1. Virtual Labs an initiative of MHRD Govt. of India, http://vlabs.iitkgp.ac.in/ssd/#
- 2. Virtual Labs an initiative of MHRD 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

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.

Fourth YEAR DETAILED SYLLABUS

DEGREEIN BACHELOR OF SCIENCE WITH HONS.

Programme/Class: Degree	Year: Fourth	Semester: VII
Subj	ect : Physics	
Course Code: B010701T	Course Title: Mather	matical Physics-I

- 1. Gain knowledge about special type of matrices that are relevant in physics and then learn about tensors.
- 2. Get introduced to special functions like Gamma function, Beta function Delta function, Dirac Delta function, Bessel functions and their recurrence relations.
- 3. Learn different ways of solving second order differential equations and familiarized with singular points and Frobenius method.
- 4. Learn the fundamentals and applications of Fourier series, Fourier and Laplace transforms, their inverse transforms etc. These mathematical concepts are widely used in various physics derivations.
- 5. Knowledge about special type of matrices that are relevant in physics and then learn about tensors.

	Credit: 4 Core Compulsory/Elective				
Marks: 25 +75	Min. Passing Marks				
Total No. of Lectures-Tutorials -P:)-0			
	• • • • • • • • • • • • • • • • • • • •	No. of Lectures			
Mathe	ematical Physics-I				
(regular) functions, The Cauchy- Riemann and branch points, Line integral in companylor's and Laurent's expansions, Liouvi	equations, Entire function, Branch cuts plex plane, Cauchy's integral formula, ille's theorem, singularities, Zeroes and	15			
Linear Differential Equation and spesingularities of a linear differential equation differential equations (Hyper- geometric, Equations Orthonormality, Rodrigue's form Associated Legendre, Bessel Hermite and I	n Power series, solution of second order Bessel, Legendre, Laguerre and Hermite nula and other properties of Legendre,	15			
Linear Vector Space: A brief review of line Schwarz inequality, linear operators, Linear Theorem. Eigenvalues and eigenvectors, and	ear algebra, matrices, Cayley-Hamilton djoint of a linear operator, Hermitian or	15			
theory, random variables, binomial, Poisson theorem, Hypothesis Testing and Data transformations, Contravariant and covaria mixed tensors, symmetric and skew symmetric	n and normal distributions. Central limit a Analysis in Statistics. Coordinate ant vectors, Contravariant, covariant and metric tensors, fundamental operations	15			
	Topic Mathe Complex Analysis: Continuity and difference (regular) functions, The Cauchy- Riemann and branch points, Line integral in comparations and Laurent's expansions, Liouve poles Residue theorem and contour intellemma, Problems on the above topics. Linear Differential Equation and spusingularities of a linear differential equation differential equations (Hyper- geometric, Fequations Orthonormality, Rodrigue's form Associated Legendre, Bessel Hermite and Physics. Linear Vector Space: A brief review of line Schwarz inequality, linear operators, Linear Theorem. Eigenvalues and eigenvectors, a self-adjoint operators and their properties, discrete and continuous. Probability statistics and Elementary To theory, random variables, binomial, Poisso theorem, Hypothesis Testing and Data transformations, Contravariant and covariant mixed tensors, symmetric and skew symmith tensors, metric tensor, conjugate tensors	Topics Mathematical Physics-I Complex Analysis: Continuity and differentiability of complex functions, Analytic (regular) functions, The Cauchy- Riemann equations, Entire function, Branch cuts and branch points, Line integral in complex plane, Cauchy's integral formula, Taylor's and Laurent's expansions, Liouville's theorem, singularities, Zeroes and poles Residue theorem and contour integration of simple functions, Jordan's lemma, Problems on the above topics. Linear Differential Equation and special Function: Ordinary point and singularities of a linear differential equation Power series, solution of second order differential equations (Hyper- geometric, Bessel, Legendre, Laguerre and Hermite equations Orthonormality, Rodrigue's formula and other properties of Legendre, Associated Legendre, Bessel Hermite and Laguerre polynomials, its applications in Physics. Linear Vector Space: A brief review of linear vector spaces, Inner product, norm, Schwarz inequality, linear operators, Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors, adjoint of a linear operator, Hermitian or self-adjoint operators and their properties, unitary operators, ortho-normal basis – discrete and continuous. Probability statistics and Elementary Tensor Analysis: Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem, Hypothesis Testing and Data Analysis in Statistics. Coordinate transformations, Contravariant and covariant vectors, Contravariant, covariant and mixed tensors, symmetric and skew symmetric tensors, fundamental operations with tensors, metric tensor, conjugate tensors, and associated tensors, Examples of			

- Advanced Engineering Mathematics: Erwin Kreyszig 1.
- Applied Mathematics for Engineer & Physicists: Louis A. Pipes & Lawrence R Harvill 2.
- Mathematical Methods for Physicists: G. Arfken 3.
- 4. Mathematical Physics: V. Balakrishnan

- 5. Mathematical Physics: B.D. Gupta
- Mathematical Physics: B.S. Rajput 6.
- Mathematical Physics: H.K. Das & Rama Verma 7.

Programme/Class: Degree	Year: Fourth	Semester: VII			
Su	Subject : Physics				
Course Code: B010702T Course Title: Classical Mechanics					
C					

- 1. This paper enables the students to understand the Lagrangian and Hamiltonian approaches in classical Mechanics.
- 2. The classical background of Quantum mechanics and get familiarized with poisson brackets and Hamilton-Jacobi equation.
- 3. Kinematics and dynamics of rigid body in detail and ideas regarding Euler's equation of Motion.
- 4. Theory of small oscillations in detail along with basis of free vibrations.
- 5. This paper enables the students to understand the Lagrangian and Hamiltonian approaches in classical Mechanics.

Credit: 4 Core Compulsory/Elective				
Max.	Marks: 25+75	Min. Passing Marks		
	Total No. of Lectures-Tutorials -P	Practical (in hours per week): L-T-P: 4-0-		
Unit		Topics	No. of Lectures	
	Classic	eal Mechanics		
1	Review of Newtonian mechanics, Mechanical Classification of Constraints, Generalized principle of virtual work, D'Alembert Prin momenta, Cyclic Co-ordinates, Conservation	Co- ordinates, Virtual displacement and ciple, Lagrange's Equations, Generalized	15	
2	Central forces, definition and characteristics orbits, Keplar's laws and equation, closure a variation- Euler- Lagrange Equation, Appl distance problem, Geodesics of a Sphere, multipliers, Hamilton's principle, Lagrange Problems based on Lagrange's equations, Problems based on Lagrange's equations,	r, Two body problems, General analysis of and stability of circular orbits Calculus of ication of Variational Principle, Shortest Variation under constraints- Lagrange's e's equations from Hamilton's principle,	15	
3	Hamilton's equations and Problems ba Generating function, Conditions for canonic Brackets and their properties, Invariance transformation. Symmetry invariance and N	sed on it, Canonical Transformation, cal transformation and problems, Poisson e of Poisson Bracket under canonical	15	
4	Hamilton-Jacobi Equations, Hamilton's prin and Angle Variables, The rigid body mo Moment of Inertia, Euler's Equation of mo Motion of heavy symmetrical Top, Theory of	otion- Euler Angles, Inertia Tensor and otion, Torque free motion of a rigid body,	15	
	Sugge	sted Readings		

- Classical Mechanics: Herbert Goldstein, Addison-Wesley. 1.
- 2. Introduction to Classical Mechanics: David Morin, Cambridge University Press
- Mathematical methods of Classical Mechanics: V.I. Arnold, Springer 3.
- 4. Classical Mechanics: G. Aruldhas, PHI learning Private Ltd.

Programme/Class: Degree	Year: Fourth	Semester: VII
Sub	ject : Physics	
Course Code: B010703T	Course Title: Electro	omagnetic Theory
	_	

- 1. Apply Maxwell's equations in both vacuum and material media to analyze static and dynamic electromagnetic fields, including the concept of displacement current and Maxwell's correction to Ampere's Law.
- 2. Derive and apply boundary conditions for electric and magnetic fields at interfaces and utilize Poynting's theorem to understand energy and momentum conservation in electromagnetic systems.
- 3. Formulate electromagnetic phenomena using scalar and vector potentials, understand the wave equation, and analyze the implications of gauge freedom, including Coulomb and Lorenz gauges.
- 4. Evaluate the behavior of plane electromagnetic waves in various media (vacuum, dielectric, conductor, and plasma), and analyze reflection, refraction, and polarization using Fresnel's equations and the concept of dispersion.
- 5. Analyze wave propagation in rectangular and cylindrical waveguides, identify TE and TM modes, determine cutoff frequencies, and compute power transmission and attenuation characteristics.
- 6. Describe the operation of cavity resonators and calculate radiation fields due to electric and magnetic dipoles, understanding their applications in antenna theory and electromagnetic radiation.

Credi	Credit: 4 Core Compulsory/Elective		
Max.	Max. Marks: 25+75 Min. Passing Marks		
	Total No. of Lectures-Tutorials -P:	ractical (in hours per week): L-T-P: 4-0-	0
Unit	To	ppics	No. of Lectures
	Flectroma	agnetic Theory	
1	I Maxwell's Equations in vacuum and matter, Maxwell's correction to Ampere's law for non-steady currents and concept of Displacement current, Boundary conditions for electromagnetic fields, Poynting's theorem, Conservation of energy and momentum for a system of charged particles and electromagnetic field.		
2	Vector and scalar potentials, Maxwell's E Potentials, Electromagnetic wave equation Potentials and Concept of Gauge. Gauge T Gauge, Transformation Properties of Elect Rotation, Spatial Inversion and Time-Revers	Transformations: Coulomb and Lorenz tromagnetic Fields and Sources under	15
3	Propagation of Electromagnetic Plane Wave Conducting Medium and Plasma, Reflect Electromagnetic Waves, Fresnel Formulae angle, Frequency Dispersion Characteristics and Anomalous Dispersion, Kramer Kronig	s in Vacuum, Non-conducting Medium, tion, Refraction and Polarization of , Total internal reflection and critical of Dielectrics and Conductors; Normal	15
4	Basic concept of waveguide, Propagation of Waveguides, TE and TM Modes, Cut off free Modal Analysis of guided modes in a cylind Radiation due to electric and magnetic dipol	Electromagnetic Waves in Rectangular quency, Energy Flow and Attenuation. rical waveguide, Cavity resonator, es.	15
Suggested Readings			

Introduction to Electrodynamics: David J. Griffiths (Prentice-Hall of India, New Delhi).

1.

- 2. Classical Electrodynamics: John David Jackson (Wiley India).
- 3. Theory and Problems of Electromagnetics: Joseph A. Edminster (Tata Mc Graw Hill).
- 4. Electricity and Magnetism: E.M. Purcell (Berkeley Physics Course, Vol II, Mc Graw-Hill).
- 5. Foundations of Electromagnetic Theory: J. R. Reitz, F. J. Milford and R. W. Christy (Pearson).

Programme/Class: Degree	Yea	r: Fourth	Semester: VII
Subject : Physics			
Course Code: B010704T Course Title: Quantum Mechanics-I			

- 1. Linear vector spaces, Hilbert space, concepts of basis and operators and bra and ket notation.
- 2. Both Schrodinger and Heisenberg formulations of time development and their applications.
- 3. Theory of angular momentum and spin matrices, orbital angular momentum and Clebsh Gordan Coefficient, space time matrices and conservation laws, Theory of identical particles.

Core Compulsory/Elective

- 4. Theory of scattering and calculations of scattering cross section, optical theorem, partial wave analysis.
- 5. Linear vector spaces, Hilbert space, concepts of basis and operators and bra and ket notation.

Max.	Max. Marks: 25+75 Min. Passing Marks		
	Total No. of Lectures-Tutorials -Pr	ractical (in hours per week): L-T-P: 4-0-	.0
Unit	Тор	ics	No. of Lectures
	Quantu	ım Mechanics-I	
1	Mathematical properties of linear vector of Hermitian operators, eigenvalues and eigenvalues. Postulates of quantum mechanics Position and momentum representations Commuting operators. Generalised uncertaintiery transformation. Expectation values. I	vectors. Orthonormality, completeness, s. Matrix representation of operators. – connection with wave mechanics. ainty principle. Change of basis and	15
2	Schrodinger picture, Heisenberg picture, He limit, Solution of simple harmonic oscilla general view of symmetries and conserv Mechanics: hydrogen-like atoms and sphe continuous and discrete, time translation. properties, pure and mixed density matrice time-evolution, reduced density matrix.	eisenberg equation of motion, classical tor problem by the operator method, ation laws, Symmetries in Quantum erical harmonics. Spatial translation – arity, time reversal, Density matrices -	15
3	Commutation relations of angular momentum Ladder operators and their matrix represent Pauli matrices. Identical particles: Many-pa symmetric and anti- symmetric wave function of angular momenta. Clebsch- Gordan coefficient	ntations. Spin angular momentum and article systems, Exchange degeneracy, ons. Pauli exclusion principle. Addition	15
4	Identical Particles: Symmetric and anti-Symprinciple	metric wave functions, Pauli exclusion	15
1.	Sugges Quantum Mechanics: B.H. Bransden & C.J.	ited Readings Joachain (Pearson, 2000)	1

Quantum Mechanics: Concepts and Applications: Nouredine Zettili (Wiley, 2016)

Introduction to Quantum Mechanics: David J Griffiths (Pearson, 2015)

Principles of Quantum Mechanics: R. Shankar (3rd Ed., Springer, 2008)

Quantum Mechanics - Theory and Applications: Ajoy Ghatak (Trinity, 2015)

2.

3.

4.

5.

Credit: 4

- 6. Modern Quantum Mechanics: J.J. Sakurai (Addison-Wesley, 1993)
- 7. Quantum Mechanics: Eugen Merzbacher (3rd Ed., Wiley, 1997)

Programme/Class: Degree	Year: Fourth	Semester: VII
Subject : Physics		
Course Code: B010705P Course Title: Practical Lab		al Lab

- 1. Understand and analyze the working and performance of a regulated power supply, including voltage regulation and ripple reduction.
- 2. Measure inductance and capacitance accurately, and analyze the behavior of LCR circuits in both series and parallel configurations under resonant conditions.
- 3. Plot and interpret the I-V characteristics of a Silicon Controlled Rectifier (SCR) and understand its applications in power control.
- 4. Understand the operation of a Uni-junction Transistor (UJT) and analyze its I-V characteristics, with focus on negative resistance behavior and triggering applications.
- 5. Analyze the characteristics of a MOSFET, understanding its regions of operation and use in analog and digital electronics.

Credi	t: 4	Core Compulsory/Elective	
Max.	Marks: 25+75	Min. Passing Marks	
	Total No. of Lectures-Tutorials -Pra	actical (in hours per week): L-T-P: 4-0)-0
Unit	To	pics	No. of Hours:
			120

Lab Experiment List

- 1. Measurement of inductance and capacitance and study of LCR series and parallel resonance circuits
- 2. Study of low pass. high pass and band pass filters
- 3. Measurement of inductance and capacitance using AC bridges
- 4. Measurement of Stephan's constant of radiation
- 5. Study of transistorized multivibrators
- 6. Energy band gap of semiconductor by reverse saturation current method
- 7. Study of L-C and R-C transmission line
- 8. Verifying RAM
- 9. FET common source amplifier with sine wave oscillator
- 10. SCR characteristics,
- 11. experiments using opto-electronic kit etc.
- 12. BH- curve

- 1. B.S. Arora Practical Physics
- 2. S.L. Gupta & V. Kumar Practical Physics
- 3. C.L. Arora B.Sc. Practical Physics
- 4. "Basic Electronics (Solid State)" B.L. Theraja

Programme/Class: Degree	Year: Fourth	Semester: VIII	
Subject : Physics			
Course Code: B010801T	Course Title: Mather	matical Physics-II	

- 1. Understanding of methods of determination of zeroes of linear and nonlinear algebraic and transcendental equations, convergence of solutions.
- 2. Know about Green Function and Fourier series etc.
- 3. Knowledge of numerical differentiation and integration.
- 4. To learn numerical solution of ordinary differential equation.

Credit: 4 Core Compulsory/Elective			
Max. Marks: 25+75 Min. Passing Marks			
	Total No. of Lectures-Tutorials -Pra	actical (in hours per week): L-T-P: 4-0)-0
Unit	Topics	S	No. of Lectures
	Mather	natical Physics-II	
1			15
2	In-homogeneous equations, Green's function for a free particle, Fourier series, Dirichlet's conditions, Even and odd functions, Parseval's identity for Fourier series Fourier integral, Dirac Delta Function, Properties and applications, Fourier and Laplace Transforms. Physical applications of the above topics.		15
3	Groups, subgroups, cosets, invariant subgrous isomorphism, Representations: reducible at Schur's lemma and orthogonality theorem product of representations, Continuous groups SU(2),SU(3).	nd irreducible, unitary representations, s, characters of representation, direct	15
4	Methods of numerical analysis: Finite differ Interpolation formulae, Errors and accur- iterative algorithms for solving equations Transform, Fast Fourier Transform with its trapezoid and Simpson's rule, Solution of Runge-Kutta method. Finite difference meth	acy tests in numerical analysis, the s and finding roots Discrete Fourier advantages in sciences integration by first order differential equation using	15

- 1. Advanced Engineering Mathematics: Erwin Kreyszig
- 2. Applied Mathematics for Engineer & Physicists: Louis A. Pipes & Lawrence R Harvill
- 3. Mathematical Methods for Physicists: G. Arfken
- 4. Mathematical Physics: V. Balakrishnan
- 5. Mathematical Physics: B.D. Gupta
- 6. Mathematical Physics: B.S. Rajput
- 7. Elementary Ideas of Group Theory: A.W. Joshi
- 8. A Friendly Introduction to Group Theory: David Nash
- 9. Group Theory: W.R. Scott
- 10. Introductory methods of Numerical Analysis: S.S. Sastry
- 11. An Introduction to Numerical methods and analysis: Jmes F. Eppeson

Programme/Class: Degree	Year: Fourth	Semester: VIII
Subj	ect : Physics	
Course Code: B010802T	Course Title: Solid S	tate Physics

- 1. Describe various crystal structures and identify symmetry elements such as rotation axes, mirror planes, inversion centers, screw axes, and glide planes.
- 2. Differentiate between different Bravais lattices and understand concepts like close-packed structures, Wigner-Seitz cells, and Miller indices.
- 3. Explain the principles of X-ray, electron, and neutron diffraction and their suitability for crystal structure determination.
- 4. Explain the formation of energy bands in periodic potentials using Bloch theorem, nearly free electron approximation, and tight-binding models.
- 5. Understand the fundamental concepts of superconductivity, including Meissner effect, energy gap, isotope effect, and London equations.

Credi	t: 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	
		tate Physics	T	
1	Crystal structure, symmetry elements in c	• • •	15	
	symmetry, inversion centre, screw axis, C			
	closed packed structures, diamond structure	e, Zinc blend structure, Weigner-Seitz		
	cell, Miller indices.			
2	Choice of x-ray, electron and neutron for o	•	15	
	diffraction, Reciprocal lattice, The Bragg	•		
	Brillouin zones of SCC, BCC and FCC			
	Geometrical structure factor, Laue metho	od, Rotating crystal method, Powder		
	method.			
3	Drude theory, DC conductivity, magneto-res	•	10	
	thermoelectric effects, Fermi-Dirac distribution, thermal properties of an electron			
	gas, Wiedemann- Franz law, critique of free-			
4	Electron in a periodic lattice, Bloch theorem		20	
	free electron approximation, tight bind	ing approximation, Fermi surfaces,		
	Cyclotron resonance.			
	Semiconductors: General properties and			
	impurities, intrinsic and extrinsic semicor	ductors, drift and diffusion currents,		
	mobility, Hall effect.			
	Superconductivity: Concept of superconductivity, Meissner effect, Type I and type			
	II superconductors, Energy gap, Isotope I	=		
	depth, Coherence length, Super-conductivity			
	Suggested Readings			

- 1. Charles Kittel:Solid StatePhysics
- 2. Caikin and Lubensky: Principles of Condensed Matter Physics
- 3. Aschroft and Mcrmin: Solid state physics
- 4. Azaroff: Introduction to Solids
- 5. Verma and Srivastava: Crystallography for Solid state Physics

Programme/Class: Degree	Year: Fourth	Semester: VIII
Subje	ect : Physics	
Course Code: B010803T	Course Title: Statisti	cal Mechanics

- 1. Explain statistical physics and thermodynamics as logical consequences of the postulates of Statistical mechanics, Apply the principles of statistical mechanics to selected problems.
- 2. Grasp the basis of ensemble approach in statistical mechanics to a range of situation.
- 3. To learn the fundamental differences between classical and quantum statistics.

Credit	t: 4	Core Compulsory/Elective	
Max.	Marks: 25 + 75	Min. Passing Marks	
	Total No. of Lectures-Tutorials -Pra	actical (in hours per week): L-T-P: 4-0)-0
Unit	Top	ics	No. of Lectures

Unit	Topics	No. of Lectures
	Statistical Mechanics	
1	Foundation of Statistical Physics: Phase space, microstates and macro states; Liouville's equation, Postulates of statistical mechanics, Review of probability concepts; Random walk problem in one dimension-binomial distribution, Specification of state of system, Concept of statistical equilibrium, Fundamental postulates of equal a priory probability.	15
2	Ensembles: Micro-canonical, Canonical and grand canonical ensembles and their comparative study, Partition function, Calculation of statistical quantities in terms of partition function (connection to thermodynamics), Entropy of mixing of gases (Ising partition function), Gibbs paradox and its resolution; Derivation of equation of state of classical ideal gas using partition function.	15
3	Quantum statistics: Ideal quantum gas, Indistinguishability, Maxwell-Boltzman, Bose-Einstein and Fermi-Dirac statistics, Photon statistics, Ideal Bose gas, Bose-Einstein condensation, Ideal Fermi gas, Correlation function.	10
4	Interacting systems and phase transitions: Interacting spin systems. The Ising model, Exact solution of Ising model in 1-dimension, mean-field solution in higher dimensions, Paramagnetic and ferromagnetic phases. Critical exponents. Order parameter, Landau theory.	10

- 1. Statistical Physics of Particles, Mehran Kardar (Cambridge University Press, 2007).
- 2. Statistical Mechanics, Kerson Huang (2ndEdition, Wiley-India, 2008).
- 3. Statistical Mechanics, R.K. Pathria (Butterworth-Heinemann, 1996).
- 4. Statistical Mechanics: An Advanced course with problems and solutions, Ryogo Kubo (North-Holland, 1965).

Programme/Class: Degree	Year: Fourth	Semester: VIII	
Subject : Physics			
Course Code: B010804T	Course Title: Elect	tronics	

- 1. Power bipolar junction transistor, Power MOSFET, Junction Transistor, Silicon controlled rectifier applications
- 2. Schottky Barrier FET (MES FET) avalanche and transit time Tunnel diode.
- 3. Electron Hole pair generation, Light emitting diode, Photoconductivity Cell, Photodiode applications
- 4. Complementary metal oxide semiconductor, Static random access memory

Credi	Credit: 4 Core Compulsory/Elective		
Max. Marks: 25+75 Min. Passing Marks			
	Total No. of Lectures-Tutorials -Pra	actical (in hours per week): L-T-P: 4-0)-0
Unit	t Topics		No. of Lectures
	Electro		
1	balanced output differential amplifier. DC analysis, AC analysis, inverting and non-inverting inputs, CMRR, constant current bias level translator. Block diagram of a typical Op-Amp analysis. Open loop configuration. inverting and non-inverting amplifiers. Op-Amp with negative feedback, voltage series feedback, effect of feedback on closed loop gain input persistance output resistance bandwidth and output offset voltage, voltage follower. Practical Op-Amp input offset voltage, input bias current, input offset current, total output offset voltage, CMRR frequency response.		
2	Adder, Subtractor, Summing amplifier, Integrator and differentiator, Logarithmic and anti logarithmic amplifier, Oscillators principles, oscillator types, frequency Stability, response, Phase shift, Weinbridge,LCtunable oscillators, Square wave and Triangular wave generators, VCO, Comparators, Schmitt trigger, V/F and F/V converter, A/D and D/A converters, Sample and hold circuit, multivibrators.		
3	Optoelectronic devices: Radiative and non- and emission in semiconductors, Electron- Ediode (LED) construction, working princi- quantum efficiency, high frequency limit, ed- in a tio n current in LED. Photodiodes, Ph- voltage, short circuit current, Fill factor.	15	
4	Fiber Optics: Structure and Classification, Index, light propagation through optical aperture, fiber fabrication techniques, Trans Attenuation pulse broadening mechanis dispersion. Fiber Loss.	fiber, acceptance angle andnumerical mission characteristics of optical fiber, m, intermodal dispersion, material	15
1	Sugges	sted Readings	

- 1. Ghatak and K. Thyagrajan Optical Electronics
- 2. M. S. Tyagi: Introduction to semiconductor devices
- 3. S. M. Sze:Physics and Technology of Semiconductor Devices

Programme/Class: Degree	Year: Fourth	Semester: VIII	
Subject : Physics			
Course Code: B010805P Course Title: Practical IAB			

- 1. Understand the concept of laser interference and diffraction to measure the wavelength of coherent light sources using simple tools.
- 2. Analyze diffraction phenomena and verify theoretical intensity distributions using laser light and photodetectors.
- 3. Apply the concept of optical path difference and fringe shift to determine thickness of transparent thin films.
- 4. Use deviation and birefringence principles to measure the thickness of anisotropic optical materials.

	The deviation and one imperior of interpret to interpret the three interprets of amount option of the interprets.			
Credit: 4 Core Compulsory/Elective				
Max.	Max. Marks: 25+75 Min. Passing Marks			
Total No. of Lectures-Tutorials -Practical (in hours per week): L-T-P: 4-0-0				
Unit	Unit Topics No. of Hours:			
	120		120	

List of Experiments

- 1. Thickness of quartz plate using constant deviation
- 2. Resolving power of prism
- 3. Young's Modulus and Poisson's ratio of glass by Comu's fringes
- 4. Michelson Interferometer
- 5. Febri-Perot Interferometer
- 6. Study of Voltage regulation of power supply using Zener diode and transistor.
- 7. Electronic spin resonance (ESR)
- 8. Study for multivibrator /transistorized multivibrator
- 9. Measurement of resistivity of semiconductor by four probe method and determination of band Gap
- 10. h- parameters, differential FET amplifier
- 11. Susceptibility
- 12. Operational amplifier application trainer

- 1. B.Sc./M.Sc. Practical Physics C.L. Arora (especially good for step-by-step lab work)
- 2. Practical Physics S.L. Gupta & V. Kumar
- 3. Advanced Practical Physics for Students B.L. Worsnop & H.T. Flint
- 4. Engineering Practical Physics B.S. Arora

DEGREE IN BACHELOR OF SCIENCE WITH RESEARCH

Programme/Class: Degree	Year: Fifth	Semester: IX	
Subject : Physics			
Course Code: B010901T Course Title: Classical Electrodynamics & Plasma			
Physics			
Comment On the comment			

- Explain the structure and classifications of Lorentz groups including homogeneous and inhomogeneous, proper, improper, orthochronous, and antichronous transformations.
- Formulate Maxwell's equations in covariant tensorial form using the field-strength tensor and its dual.
- Analyze the transformation behavior of electric and magnetic fields under Lorentz transformations and the role of canonical and symmetric stress tensors.
- Derive and apply the Lagrangian and Hamiltonian formulations for a relativistic charged particle in an electromagnetic field.
- Describe the fundamental properties of plasma and derive moment equations from the Boltzmann equation.

Credi	Credit: 4 Core Compulsory/Elective					
Max. Marks: 25+75 Min.		Min. Passing Marks				
	Total No. of Lectures-Tutorials -Practical (in hours per week): L-T-P: 4-0-0					
Unit	Topics		No. of Lectures			
	Classical Electrodynamics &	<u> </u>				
1	Homogeneous and inhomogeneous (Poinca		15			
	spacetime, Spacetime rotations, rapidity					
	antichronous Lorentz groups, Light cone	<u>*</u>				
	transformations, Spacelike, time like and	-				
	Four-tensors, four- velocity, four-momentum		1.7			
2	Covariant form of continuity equation, 2		15			
	tensor, dual field- strength tensor, Covariant formulation of Maxwell's field					
	equations with gauge invariance, Lorentz force equation in covariant form, Transformation of electromagnetic fields as tensor components, Proca Lagrangian					
	with Photon mass, Canonical approach	1				
	Hamiltonian formulation for a relativ					
	electromagnetic field, Canonical and Symmetric Stress Tensors, Solution of the					
	wave equation in covariant form.					
3	Retarded and advanced potentials, Lienard-	Wiechert potentials for a moving point	15			
	charge, Fields produced by a charge in unif					
	from an accelerated charge, Radiated powe generalization, Thomson scattering of radiati					
4	Elementary concepts of plasma, derivation of	of moment equations from Boltzmann's	15			
	equation. Plasma oscillation, Debye shie					
	plasma. Fundamental equations, hydroma	-				
	Alfven waves, wave propagation parallel and	d perpendicular to magnetic field.				
	Suggested Readings					

- 1. Classical Electrodynamics: John David Jackson (Wiley India).
- Introduction to Electrodynamics: David J. Griffiths (Prentice-Hall of India, New Delhi). 2.
- 3. An Introduction to Relativity: J. V. Narlikar (Cambridge Univ Press).
- Introducing Einstein's Relativity: Ray D'Inverno (Clarendon Press, Oxford) 4.
- Electromagnetic Field Theory for Engineers and Physicists: G. Lehner (Spinger). 5.
- Modern Electrodynamics: A. Zangwill (Cambridge University Press) 6.

Programme/Class: Degree	Year: Fifth	Semester: IX	
Subject: Physics			
Course Code: B010902T Course Title: Quantum Mechanics- II			

- 1. The primary goal of this course is to develop an understanding of some of the more advanced topics and techniques used in quantum mechanics.
- 2. Students should have knowledge about: Fundamental concepts and the mathematical formalism used in the general formulation of quantum mechanics (QM)
- 3. Understand the concept of cross section and Born approximation
- 4. Understand the significance of Relativistic wave equations

Credit: 4 Core Compulsory/Elective				
Max. Marks: 25+75 Min. Passing Marks		Min. Passing Marks		
	Total No. of Lectures-Tutorials -Pra	actical (in hours per week): L-T-P: 4-0)-0	
Unit	Topics		No. of Lectures	
	Quantum Mechanics- II			
1	Approximation Methods for Stationary Sy theory - (a)non- degenerate and (b) degenerand its applications.	15		
2	Time Dependent Perturbation theory, Trans Fermi Golden Rule, Applications, Semi-Clas	15		
3	Scattering: Non-relativistic scattering theory, differential and total scattering cross section, Born approximation method with examples of scattering by Coulomb, Gaussian, Square well and Yukawa potentials. Partial wave analysis, optical theorem, phase shift, example of scattering by square well potential.		15	
4	Relativistic QM: Klein-Gordon equation, matrices, Plane wave solution of Dirac equa electron, non-relativistic reduction to Dirac e	15		

- 1. Principles of Quantum Mechanics: R Shanker
- 2. Quantum Mechanics by B.H. Bransden & C.J. Joachain (Pearson Education, 2000)
- 3. Quantum Mechanics (vol 1): Tannoudji
- 4. Modern Quantum Mechanics by J.J. Sakurai (Addison-Wessley, 1993)
- 5. Quantum Mechanics: Concepts and Applications, Nouredine Zettili (Wiley 2nd edition 2009)
- 6. Quantum Mechanics: E Merzbacher
- 7. Introduction to Quantum Mechanics: Griffiths
- 8. Quantum Mechanics: Schiff
- 9. Quantum Mechanics: Liboff
- 10. Quantum Mechanics Theory and Applications: Ghatak and Loknathan
- 11. Relativistic Quantum Fields, Vol.II, J.D. Bjorken and S.D. Drell (McGraw-Hill, 1978)
- 12. Relativistic Quantum Fields, Vol.I, J.D. Bjorken and S.D. Drell (McGraw-Hill, 1964)

Programme/Class: Degree	Year: Fifth	Semester: IX		
Subject : Physics				
Course Code: B010903T Course Title: Nuclear Physics- I				

- 1. Describe the basic properties of nuclei such as mass, binding energy, spin, magnetic moment, and electric quadrupole moment.
- 2. Explain the Fermi theory of beta decay, differentiate between allowed and forbidden transitions, and analyze beta spectra using Kurie plots and Sergeant's law.
- 3. Differentiate between Fermi and Gamow-Teller transitions and extract the Fermi constant from beta-decay data.
- 4. Analyze gamma-ray emission processes, including multipolarity, selection rules, and theoretical transition probabilities using Weisskopf estimates.
- 5. Describe the basics of the optical model and mechanisms of direct nuclear reactions.

Credi	Credit: 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		
	Nuclear Phy	V			
1	Basic facts about nuclei, Mass and binding en	ergy, Semi-empirical mass formula,	15		
	Nuclear size determination using mu-mesic X-r	rays and scattering of fast electrons,			
	Nuclear spin and magnetic moment of nuclei,	Molecular beam resonance method,			
	Nuclear induction method, Electric quadrupole m	noment.			
2	Alpha decay, Alpha spectra, Selection rules, Gei	15			
	decay, Beta- spectra, Fermi's theory of beta				
	Allowed and forbidden transitions, Fermi and Ga	amow Teller Transition, Extraction of			
Fermi constant, Parity violation in beta-decay, Detection of neutrino.					
3	Gamma emission, Multi-polarity of gamma rays, Selection rules, Theoretical				
	prediction Transition probability, estimation of transition probability for single				
	particle (Weisskopf unit), Internal conversion, Angular correlation, Nuclear				
	isomerism, Mossbauer Effect and its applications.				
4	Nuclear reactions, Conservation laws, The Q-	equation and deduction of nuclear	15		
	energy, Compound nucleus, Bohr hypothesis, Re				
single level formula, Optical model, Simple discussion of direct reactions. Nuclear					
fission, Bohr-Wheeler theory of nuclear fission, Controlled chain reaction, Nuclear					
	reactors, Nuclear Fusion.				
	Community I Day 12 mm				

- 1. Nuclear Physics: Krane K.S., Wiley India Pvt. Ltd., (2008).
- 2. Nuclear physics principles and applications: Lilley J.S., John Wiley & sons Ltd.,
- 3. The Atomic Nucleus: Evans R. D. Tata McGraw Hill, 1955.
- 4. Atomic and Nuclear Physic: S N. Ghoshal, Vol. II.,2000.
- 5. Nuclear Physics: R. R. Roy and B. P. Nigam, Wiley-Eastern Ltd. 1983.
- 6. Introduction to Nuclear Physics: Wong, PHI.
- 7. Introduction to Nuclear and Particle Physics: A Das and T Ferbel.

Programme/Class: Degree	Year: Fifth	Semester: IX		
Subject : Physics				
Course Code : B010904T Course Title: Electronics I				

- 1. Explain the propagation of EM waves through ground, space, and sky waves; analyze wave behavior in transmission lines including coaxial cables using the line equation and concepts of characteristic impedance, reflection coefficient, and standing wave ratio (SWR).
- 2. Demonstrate understanding of fiber optics and wireless communication principles and their role in modern communication systems.
- 3. Analyze the working principles of different types of antennas, including linear dipole and antenna arrays; understand antenna matching techniques and basic antenna characterization.
- 4. Explain the working principle, operation, and applications of radar systems in communication and remote sensing.
- 5. Evaluate signal-to-noise ratio (SNR) and explore techniques for enhancing SNR in communication and instrumentation systems; understand noise reduction strategies in electronic circuits.
- 6. Understand the principles of phase-locked loops (PLLs), lock-in amplifiers, and sample-and-hold circuits and their application in precise signal processing.

Credit: 4		Core Compulsory/Elective	
Max. Marks: 25+75 Min. Passing Marks			
)-0		
Unit	Торі	cs	No. of Lectures
	Electro	onics I	
1			
2	operation and application. Noise: Introduction to Noise, types, Signal of SNR in instrumentation and communicircuits. Principles of phase locking and circuits.	cation. Noise reduction in electronic	15
3	Microprocessor: Introduction to microcomp devices. 8085 microprocessor, Architecture 1nternal data operation, Externally initial addressing modes, 8085 programming, V subtraction, multiplication and division of two	e, Microprocessor initiated operations, ated operations, Instruction set and Writing simple progmns of addition,	15
4	Microwave Devices & Communication: Kly Wave Tubes, Velocity modulation, Basic pri Reflex Klystrons, principles of operation of	strons, Magnetrons and Travelling inciples of two cavity Klystrons and	15

Tubes, wave Modes.			
Advantages and disadvantages of microwave transmission, loss in free space,			
propagation of microwaves, atmospheric effects on propagation, Fresnel zone			
problem, ground reflection. Fading sources, detectors, components, antennas used			

- 1. Digital Principles and Applications, A. P. Malvino and D. P. Leach, Tata McGraw Hill. Digital Integrated Electronics, Taub and Schilling, McGraw Hill Co.
- 2. Principles of Communication Systems, Taub and Schilling, McGraw Hill Co. Communication Systems, Simon Haykin, John Wiley & Sons, Inc.
- 3. Modem Digital and Analog Communication Systems, BP Lathi, Oxford Univ. Press
- 4. Microprocessor Architecture, Programming and Application with 8085, Ramesh S. Gaonkar, Willey-Eastern Ltd.
- 5. Electronic Communications, Dennis Roddy & John Coolen, Pearson Education.
- 6. Electronic Communication System, George Kennedy & Bernard Davis, McGraw Hill Pub.
- 7. Computer Networks. Andrew S. Tanenbaum, Prentice Hall Inc.

in microwave communication systems.

Programme/Class: Degree	Year: Fifth	Semester: IX	
Su	bject: Physics		
Course Code: B010905T	Course Title: Conde	nsed Matter Physics-I	
Course Outcomes			

- 1. Interpret the concept of Fermi surfaces and explain experimental techniques for their determination.
- 2. Explain quantum phenomena such as Landau quantization, de Haas-van Alphen effect, and the integral quantum Hall effect.
- 3. Understand the macroscopic and microscopic electric fields in dielectric materials and their relationship to polarization and dielectric constant.
- 4. Differentiate between ferroelectric, antiferroelectric, piezoelectric, and ferroelastic materials based on their physical behavior and symmetry properties.
- 5. Apply models of local fields and polarizability to describe dielectric behavior in various solid-state systems.

Credit: 4 Core Compulsory/Elective			
Max. Marks: 25+75 Min. Passing Marks			
	Total No. of Lectures-Tutorials -Pra	actical (in hours per week): L-T-P: 4-0)-0
Unit	Unit Topics		No. of Lectures
	Condensed	Matter Physics-I	
1	Transport Properties of Solids: Boltzmann t and semiconductors, Fermi surfaces –deter Alphen effect, Quantum Hall effect- Magnetoresistance.	ransport equation, resistivity of metals mination, Landau levels, de Hass van	15
2	Dielectric Properties of Solids: Dielectrics a field, local field at an atom, dielectric cons antiferroelectricity, piezoelectric crystals, fer	tant and polarizability, ferroelectricity,	15
3	Optical properties: Optical constants and the metals, plasmonic properties of metal	- · ·	15

-	4	Magnetism: Types of magnetic materials, Quantum theory of paramagnetism, Hund's rule, Ferromagnetism, antiferromagnetism: molecular field, Curie temperature. Domain theory, Magnetic Anisotropy, Magnetic interactions, Heitler-London method, exchange and superexchange, magnetic moments and crystal-field effects, spin-wave excitations and thermodynamics, antiferromagnetism, Magnetostriction.	15			
	G					

- 1. Solid State Physics, N. W. Ashcroft and N.D. Mermin(Ist Ed., Cengage Learning, 2003)
- 2. Elementary Excitations in Solids, D. Pines (CRC press, 1999)
- 3. The Wave Mechanics of Electrons in Metals, S. Raimes (North-Holland, 1970)
- 4. Lecture Notes on Electron Correlation & Magnetism, P. Fazekas (World Scientific, 1999)
- 5. Condensed Matter Physics, M. Marder (2nd Ed., John Wiley & Sons, 2010)
- 6. Principles of Condensed Matter Physics, P.M. Chaikin and T.C. Lubensky (Cambridge University Press, 1995)
- 7. Crystal Structure Analysis by Buerger
- 8. Elementary Solid State Physics by M. Ali Omar
- 9. Physics of Quasi Crystals by Steinhard and Oustlan
- 10. Quantum theory of Solids by Callaway

Programme/Class: Degree	Year: Fifth	Semester: IX	
	Subject : Physics		
Course Code: B010906P Course Title: Practical Lab			

- 1. Analyze crystal structures using powder X-ray diffraction data to determine lattice parameters and index diffraction peaks.
- 2. Evaluate carrier concentration and mobility in semiconductors through Hall effect measurements and analyze the type of majority carriers.
- 3. Correlate thermal and electrical properties of conductors using the Wiedemann–Franz law, and calculate the Lorentz number.
- 4. Verify Curie-Weiss behavior in ferroelectric materials and relate dielectric constant variations to phase transitions.
- 5. Investigate thermal relaxation behavior and validate theoretical models such as Debye relaxation in electrical components like light bulbs.
- 6. Analyze the characteristics of operational amplifiers (OP-AMPs) including input offset voltage, input bias current, CMRR, and slew rate.
- 7. Understand and evaluate the performance of transistorized differential amplifiers.
- 8. Use OP-AMPs as comparators and Schmitt triggers, and analyze their switching behavior and hysteresis
- 9. Study and explain the operation of Voltage-to-Frequency (V/F) and Frequency-to-Voltage (F/V) converters, exploring their applications in data conversion and sensing.

Credi	t: 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	Unit Topics No. of Hours:		
			120

Lab Experiment List (Condensed Matter Physics-I)

- 1. Determination of lattice parameter and indexing of powder photographs/ X-ray diffraction simulation
- 2. Study of dispersion curves of mono atomic lattice using given transmission lines.
- 3. Study of dielectric constant
- 4. Measurement of Hall coefficient of given semiconductor to estimate charge carrier Concentration.
- 5. Measurement of thermal and electrical conductivity of copper and determination of Lorentz number.
- 6. Measurement of thermal conductivity of poor conductor (Perspex)
- 7. Measurement of thermal diffusivity of brass
- 8. Verification of Curie-Weiss law for ferroelectric material
- 9. Measurement of thermal relaxation time of a serial light bulb and verification of Debye relaxation formula.
- 10. Magneto resistance

AND/OR

Lab Experiment List (Electronics-I)

- 1. To study OP-AMP characteristics
- 2. To study OP-AMP applications
- 3. To study transistorized dilferential amplifier.
- 4. To study OP-AMP as a Comparator and Schmitt Trigger.
- 5. Wave shaping circuits, data processing circuits, Active filters
- 6. To study the operation of V/F & F/V converter.
- 7. Fiber optic trainer
- 8. To study Wien Bridge, Phase-Shift and Colpitt Oscillators.
- 9. To study A stable, Mono-stable and Bi-stable multivibrators.
- 10. To study the operation of PLL and VCO.
- 11. To study BCD to 7 segment Decoder, BCD to Excess-3 code, Binary to Gray and Gray to Binary conversion.
- 12. To study 4 Bit R-2R ladder DAC and 4 Bit Counter type ADC.
- 13. To study 4 Bit Synchronous and Ripple Counter.

- 1. M.N. Avadhanulu and P.G. Kshirsagar, A Textbook of Engineering Physics (Experiments and Theory), S. Chand, 2020.
- 2. B.D. Cullity and S.R. Stock, Elements of X-ray Diffraction, 3rd Edition, Pearson Education, 2001.

Programme/Class: Degree	Year: Fifth	Semester: X	
Subject : Physics			
Course Code: B011001T Course Title: Atomic And Molecular Physics			

- 1. Explain the principles of quantum theory, spin-orbit interaction, and the spectroscopic description of atomic electronic states using term symbols and intensity rules.
- 2. Analyze the fine structure of hydrogen and alkali metal spectra, including the effects of penetrating and non-penetrating orbits, and apply empirical laws such as Rydberg-Schuster, Runge's Law, and the Ritz Combination Principle.
- 3. Evaluate atomic spectra of alkaline earth metals and interpret singlet and triplet terms using coupling schemes for two-electron systems, applying Hund's rules and Lande's interval rule.
- 4. Understand and distinguish between the Normal and Anomalous Zeeman Effects, Paschen-Back effect, Stark effect, hyperfine structure, isotope effect, and Lamb shift in atomic spectra.
- 5. Describe and analyze microwave, infrared, and Raman spectra of diatomic and polyatomic molecules, including selection rules, rotational-vibrational transitions, and isotopic shifts.
- 6. Apply the Franck-Condon principle to understand vibrational-electronic spectra, dissociation energies, and the breakdown of the Born-Oppenheimer approximation in molecular spectra.

Credit: 4 Core Compulsory/		Core Compulsory/Elective	
Max.	Max. Marks: 25+75 Min. Passing Marks		
)-0		
Unit	Topics		No. of Lectures
	Atomic And Mole		T
1	Introduction to Quantum theory, Spin-Orbit		15
	Spectroscopic Description of Atomic Electronic States – Term Symbols, Intensity		
	rules for fine structure doublet, Fine structur		
	alkali metals, Non-penetrating and penetr		
	Runge's Law, The Ritz Combination Princip	le, Optical spectra of alkaline earth	
2	elements, Singlet and triplet terms.		1.7
2	Coupling scheme for two electron system	-	15
	electron cases, Hund's rule, Lande's interval		
	Effect, Paschen-Back effect of one elect structure, Isotope effect in atomic spectra,		
	hyperfine structure, Lamb Rutherford Shift.	distinction between isotope effect and	
3	Microwave Spectroscopy – Rotational	spectra Diatomic and polyatomic	15
3	molecules, Infrared Spectroscopy – Vibrai	* · ·	
	vibrating rotator, Rotation- Vibration spe		
	Spectroscopy- Pure rotational Raman s		
	Structural determination from Raman Spec		
	branches, Isotopic shift	-	
4	Electronic Spectra of Diatomic molecules	s -Breakdown of Born Oppenheimer	15
	Approximation, Intensity of Vibrational -E	-	
	Principle, Dissociation energy and Dissociat	ion Products, Rotational Fine Structure	
	of Electronic-Vibration transitions,		
	Coherence-spatial and temporal, He-Ne gas	•	
	uses of lasers in Raman spectroscopy, P		
	(E.S.R), Nuclear Magnetic Resonance (N.M.	R) and their applications.	

- 1. Introduction to Atomic Spectra: H.E. White (McGraw Hill, 1934)
- 2. Atomic Spectra and Atomic Structure, G. Herzberg (Dover Publications, 2003)
- 3. Molecular Spectra and Molecular Structure, G. Herzberg (Van Nostrand, 1950)
- 4. Atoms, Molecules and Photons, W. Demtroder (Springer, 2006)
- 5. Fundamentals of Molecular Spectroscopy, C. N. Banwell (McGraw Hill, 1983)
- 6. Basic atomic & Molecular Spectroscopy, J. M. Hollas (Royal Society of Chemistry, 2002)
- 7. Principles of Lasers, O. Svelto (5th Ed., Springer, 2010)
- 8. Laser Spectroscopy, W. Demtroder (3rd Ed., Springer, 2003)
- 9. Molecular Quantum Mechanics, P Atkins & R. Friedman (Oxford Univ. Press, 2005)
- 10. Quantum Chemistry, I. N. Levine (7th Ed., Pearson, 2016)
- 11. Physics of Atoms and Molecules, B. H. Bransden and C. J. Jochain (2nd Ed., Pearson Education, 2003)
- 12. Molecular Spectroscopy by G.M. Barrow

Programme/Class: Degree	Year: Fifth	Semester: X	
Subject : Physics			
Course Code: B011002T Course Title: Nuclear Physics- II			
~	O 1		

- 1. Understand and analyze the nuclear two-body problem using the simple theory of the deuteron, and explain the spin dependence and non-central nature of nuclear forces.
- 2. Apply partial wave analysis to low-energy neutron-proton and proton-proton scattering, and interpret scattering parameters such as scattering length and effective range.
- 3. Discuss charge symmetry and charge independence of nuclear forces and explain the meson exchange theory of nuclear interactions.
- 4. Compare and contrast the liquid drop model and the shell model; explain magic numbers and the evidence for nuclear shell structure.
- 5. Use the extreme single-particle shell model and Nilsson model (qualitative) to predict nuclear properties such as spin, parity, and magnetic moments.
- 6. Describe the collective model of nuclei and analyze the rotational and vibrational spectra, energy levels, and band structure in different nuclei.

Credi	Credit: 4 Core Compulsory/Elective			
Max. Marks: 25+75 Min. Passing Marks				
	Total No. of Lectures-Tutorials -Pro-	actical (in hours per week): L-T-P: 4-0)-0	
Unit Topics		No. of Lectures		
	Nuclea	r Physics- II		
1	Nuclear two-body problem, Simple theory	of deuteron, Spin dependence and non-	15	
	central feature of nuclear forces, Partial way	ve analysis, Low energy n-p scattering,		
	Low energy p-p scattering, Existence of t	wo nucleon bound system, Scattering		
length and effective range theory, Charge symmetry and charge independence of				
	nuclear forces, Meson theory of nuclear forces.			
2	liquid drop model, Magic numbers and evic	dence of shell structure, Extreme single	15	
	particle shell model. Predictions of spin.	parity and electromagnetic moments.		

	Nilsson Model (Qualitative), Collective model, Rotational and Vibrational		
	Hamiltonian, Energy levels and band structure due to single particle; Vibrational		
	and rotational behaviour of different nuclei.		
3	Classification of elementary particles Exact conservation laws, Approximate	15	
	conservation laws: Isospin and Isospin wave functions for pion-nucleon system,		
	strangeness, parity, time reversal and charge conjugation, CP violation.		
4	Eight fold way, Quarks, Quark-Quark interaction, SU(3) quark model, Gellmann-	15	
	Nishijima formula, Magnetic dipole moment of baryons, Masses of hadrons. Basic		
	ideas about the standard model. Mass generation.		
	racas about the standard model. Wass generation.		

- Nuclear and Particle Physics: W. Burcham and M. Jobes. 1.
- Quarks and Leptons: Halzen and Martin, Jon Willey and Sons 2.
- Unitary symmetry and Elementary Particles: D.B.Lichtenberg. 3.
- Symmetry Principles in particle Physics: Emmerson. 4.
- 5. Introduction to High Energy Physics: Donald H. Perkins, University of Oxford.
- Nuclear Physics: S. N. Ghoshal, First edition, S. Chand Publication. 6.
- Nuclear & Particle Physics: An Introduction: B. Martin (Willey, 2006) 7.
- Introduction to Elementary Particles: D. Griffiths (Academic Press, 2nd Ed. 2008) 8.

Programme/Class: Degree	Year: Fifth	Semester: X	
Subject : Physics			
Course Code: B011003T Course Title: Electronics II			
Course Outcomes			

- 1. Explain the principles and techniques of amplitude modulation (AM), including DSBSC, SSB, and Vestigial Sideband modulation, and analyze their generation and demodulation methods.
- 2. Describe frequency and phase modulation techniques, analyze their spectral characteristics, and differentiate between FM and PM.
- 3. Design and analyze FM transmitter and receiver circuits, including modulators (varactor diode, reactance), and demodulators (Foster-Seeley discriminator, ratio detector, PLL).
- 4. Understand and apply concepts like automatic frequency control (AFC), pre-emphasis and deemphasis in FM systems.
- 5. Apply the sampling theorem to low-pass and bandpass signals and evaluate various pulse modulation techniques (PAM, PWM, PPM), including sampling methods and signal reconstruction.
- 6. Understand and implement quantization processes, and analyze digital pulse modulation techniques such as PCM, DPCM, Delta Modulation, and their adaptive variants.
- 7. Compare and analyze line encoding techniques (unipolar, polar, bipolar, Manchester) and their effect on signal transmission and bandwidth.
- 8. Explain and differentiate digital modulation techniques including ASK, FSK, BPSK, DPSK, QPSK, QAM, and MSK, and evaluate their performance in communication systems.

Credit	Credit: 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	
Electronics II			
1	Analog Communication Electronics: Ampl	litude modulation, generation of AM	15

	waves. demodulation of AM waves, DSBSC modulation, generation of DSBSC waves, coherent detection of DSBSC waves, SSB modulation, generation and detection of SSB Waves, Vestigial sideband modulation.	
2	Frequency modulation, Frequency spectrum for sinusoidal FM. Non-sinusoidal modulation, Phase modulation, equivalence and difference between PM & FM. Varactor diode modulators, Reactance modulator, FM transmitter, Armstrong indirect method, FM detectors, Foster-Seeley discriminator, Ratio detector., PLL demodulator, Automatic frequency control, pre-emphasis and de-emphasis, difference between FM & PM	15
3	Digital Communication: Sampling theorem, sampling of Low Pass and Band - pass signals, Pulse Modulation-PAM, PWM, PPM, Channel BW for a PAM signal, ideal sampling, Natural sampling, Flat-top sampling, Signal recovery through Holding. Quantization of signals; Quantization, PCM, Differential PCM, Delta Modulation, Adaptive Delta modulation, CVSD, Line encoding; unipolar, polar, bipolar, Manchester encoding.	15
4	Digital Modulation Techniques: Binary Amplitude Shift Keying (BASK), Phase Shift Keying (PSK) - Binary (BPSK), Differential (DPSK), Quadrature (QPSK) & M-ARY Quadrature Amplitude Shift Keying (QASK), QAM, Frequency Shift Keying (FSK), Minimum Shift keying (MSK).	15

- 1. Op-Amp & Linear Integrated Circuits, Ramakanth A. Gayakwad, Printice Hall of India.
- 2. Electronic Devices and Circuit Theory, Robert Boylested and Louis Nashdsky, Printice-Hill Inc.
- 3. Optoelectronics: Theory and Practice, Alien Chappal, McGraw Hill Book Co., NY.
- 4. Principles of Communication System- Taub and Schilling, McGraw Hill Co.
- 5. Communication Systems- Simon Haykin, John Wiley & Sons, Inc.
- 6. Electronic Communications, Dennis Roddy & John Coolen, Pearson Education.
- 7. Modern Digital and Analog Communication systems- B P Lathi, Oxford Univ Press
- 8. Electronic Communication system- R Blake, Cengage india edition
- 9. Communication System Engineering- Proakis and Salehi, PHI Learning
- 10. Advance Electronics Communications Systems, Wayne Tomasi, Pill, Edn.
- 11. Electronic Communication System, George Kennedy & Bernard Davis, McGraw HillPub

Programme/Class: Degree	Year: Fifth	Semester: X	
Subject : Physics			
Course Code : B011004T Course Title: Condensed Matter Physics II			
Course Outcomes			

- 1. Identify and explain various types of crystal imperfections including point defects (vacancies, interstitials, Schottky and Frenkel defects), dislocations, stacking faults, and grain boundaries.
- 2. Analyze mechanical deformation mechanisms in solids such as slip, critical resolved shear stress, Frank-Read sources, and the role of whiskers; describe techniques for observing dislocations and defects.
- 3. Describe the formation and structure of glasses, including radial distribution function, glass transition,

- and the electronic structure of amorphous semiconductors.
- 4. Interpret electronic transport mechanisms in amorphous solids, including mobility edges, density of states, and optical properties of disordered systems.
- 5. Understand the structure, polymerization mechanisms, and physical properties (optical, thermal, electrical, and dielectric) of polymers; explain the properties and significance of liquid crystals and quasi-crystals
- 6. Describe and apply surface and film characterization techniques such as SEM, TEM, STM, and AFM for structural and topographical analysis.
- 7. Apply the Boltzmann transport equation to thin films, describe different scattering mechanisms, understand surface states in semiconductors, localized vibrational states, and the concept of excitons.

Credi	t: 4	Core Compulsory/Elective		
Max.	Marks: 25 + 75	Min. Passing Marks		
	Total No. of Lectures-Tutorials -Pra	ctical (in hours per week): L-T-P: 4-0	-0	
Unit	Topics		No. of Lectures	
	Condensed Matt	•	1.7	
1	Imperfections in Crystal: Point imperfection		15	
	Frenkel defect. Colour centres, Dislocation	1		
	solids, Slip planes, Critical resolved shear s			
	source, Stacking faults, Grain boundaries,			
	Whiskers, Observations of dislocation and ot		1.7	
2	Exotic Solids: Glass formation, types of	•	15	
	distribution function and amorphous sem	·		
	amorphous solids, localized and extended st			
	and their determination, transport in ext	-		
	properties of amorphous semiconductors. S	- · · · · · · · · · · · · · · · · · · ·		
	mechanism, characterization techniques, opt			
3	properties of polymers, Liquid Crystals, Quan Nano structural materials: Introduction, Mo		15	
,	characterization techniques, Quantum size ef	13		
	C240, Fullerene, Graphene, Single wall an			
	formation, charactarization and applications,			
1	Thin films and surfaces: Study of surfaces:		15	
T	interferometry, Determination of film this		13	
	Elementary concepts of surface crystallograp	· · · · · · · · · · · · · · · · · · ·		
	film prepration methods, Boltzman transp	-		
	expression for electrical conductivity, Ele	-		
	semiconductors, localized viibrational states, Elementary idea of Excitons.			
		ted Readings		
1.	Introduction to Dislocations by D. Hull	5		
2.	Introduction to Solid State Theory by Madel	ung		
3.	Quantum theory of solid State by Callaway			
4.	Theoretical Solid State Physics by Huang			
5.	Quantumtheoryofsolidsby Kittel			
6.	PhysicsofThinFilms byK.L.Chopra			
7.	Multiple beam interferometry by Tolansky			
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Transmission Electron Microscopy by Thomas

Solid State Physics by C. Kittel

8.

9.

Programme/Class: Degree	Year: Fifth	Semester: X
Subject : Physics		
Course Code: B011005T	Course Title: Physics of Liquid Crystals	

- 1. Classify different types of liquid crystals, including thermotropic and lyotropic types.
- 2. Differentiate between various LC phases such as nematic, smectic (SmA, SmC), chiral nematic, discotic, bent-core, and polymeric LCs.
- 3. Interpret optical textures and polymorphism in liquid crystals using polarized light microscopy.
- 4. Understand the unique optical anisotropy (birefringence) and its relationship with molecular order.
- 5. Explain phase transitions using the Maier-Saupe theory and van der Waals model.

Credi	Credit: 4 Core Compulsory/Elective				
Max.	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		
	Physics of Liq	uid Crystals			
1	Classification of Liquid Crystals: Historic Crystals, Polymorphism in LC, Optical Te Calamitic Liquid Crystals: Nematic (N) Phase/Cholesteric Phase and Bent-Core Liquid Crystals, Polymer Crystals.	cal Outlook, Classification of Liquid extures, Thermotropic Liquid Crystals, ases, Smectic phases (SmA and SmC), e. A review of Discotic Liquid Crystals	15		
2	Theory of Liquid Crystal and Phase Tran critical phenomenon in liquid crystals, hard and Van der Waals theories for isotrop transitions; Landau theory: essential ingred nematic-smectic A/C transitions and other sm	particle model. Maier Saupe Theory ic-nematic and nematic- Smectic A ients, application to isotropic-nematic,	15		
3	Nematic Liquid Crystals: Elastic Contine Refractive Indices, Flows and hydrodyna (Planar and homeotropic), Field induced dif- for Switching. Estimation of Elastic Constant Birefrengance and Order Parameter.	mics, Alignment of Liquid Crystals rector reorientation, Threshold Voltage	15		
4	Application of Liquid Crystals: Display working of LC displays, Nematic Liquid Non -Display Applications: Temperature Ser Shutters, Tunable Photonic Crystals, Biomed	Crystals Switches, 7-segment display. nsor, Spatial Light Modulators, Optical	15		
	Suggested Readings				

- 1. Liquid Ctystals, S. Cbandrashekhar, Cambridge University Press, Second Edition, 1992. Liquid Crystals, lam-Oloon Khoo, Willey, Second Edition, 2007.
- 2. Introduction to Liquid Crystals, PJ Collings and M. Hird, Taylor Francis, Bristol, PA 1997.
- 3. J. Prost J. The physics of Liquid Crystals, Clarendon Press, Oxford, 1993.
- 4. Liquid Crystal Devices: Physics and Applications, VG Chigrinov Artech House, Boston, London, 1999.

Programme/Class: Degree	Year: Fifth	Semester: X		
Subject : Physics				
Course Code: B011006T Course Title: Laser Physics and applications				
Course Outcomes				

- 1. The students will learn about introductory concepts of lasers and interaction of radiation with matter and various types of lasers and laser spectroscopy and their applications.
- 2. Provide students with a basic understanding of laser operation
- 3. Describe how pulsed laser beams can be obtained from a laser cavity.
- 4. Describe optical components that can be used to tailor the properties of the laser
- 5. Understand the laser applications in daily life.

Credit: 4		Core Compulsory/Elective	
Max. Marks: 25+75 Min. Passing Marks		·	
	Total No. of Lectures-Tutorials -Pro-	actical (in hours per week): L-T-P: 4-0)-0
Unit	Topics		No. of Lectures
	Laser Physics	and applications	
1	Laser Characteristics: Spontaneous and stitheory of radiation, theory of some optical pand emission, line broadening mechanisms inversion, laser pumping, Optical resonato condition for Lasing, three level and four monochromaticity.	mulated emission, Einstein's quantum processes, kinetics of optical absorption s, Basic principle of lasers, population r, losses in cavity, Q-factor, threshold	15
2	Laser Systems: Solid state lasers- the ruby Diode laser, quantum well laser; Gas lasers dye lasers; and Excimer lasers.	15	
3	Advances in laser Physics: Production of a switching, Methods of Q-switching, mode amplification of short pulses. Non-linear harmonic generation, third harmonic generation and self-focusing of linear parametric generation and self-focusing of linear parametric generation.	locking, Methods of Mode Locking, optics: Harmonic generation, second ation, Phase matching, optical mixing,	15
4	Laser Applications: laser applications in ma Military applications of Lasers, astronomy and Interferometery, Lasers in Science and and its applications, lasers in communication fibers, numerical aperture, propagation of lig	15	
	ee	sted Readings	
1.	Lasers by A. E. Siegmann. University scien		
2.	Laser Physics by P. W. Milonni and J. H. El	perly	
3.	Laser Spectroscopy by W. Demtroder		
4.	Principles of Laser by O. Swelto		

Programme/Class: Degree	Year: Fifth	Semester: X	
Subject : Physics			
Course Code: B011007T Course Title: Physics of Nano materials		: Physics of Nano materials	

Lasers, Theory and Applications by K. Thyagarajan and A. K. Ghatak

5.

- 1. Describe various crystal structures and interpret their geometric and physical significance.
- 2. Explain band theory, free electron theory, and density of states in solids.
- 3. Analyze diffusive transport and common scattering mechanisms in bulk materials.
- 4. Analyze how dimensionality affects density of states and band gap in low-dimensional systems.
- 5. Describe the optical response of semiconductor and metallic nanomaterial

Credi	Credit: 4 Core Compulsory/Elective				
Max.	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		
	Physics o	of Nano materials			
1	Physics of the Solid State: Crystal structure solids, Idea of band structure, Density of scattering mechanisms, Surfaces, Interfaces	f state in bands, Diffusive transport,	15		
2	Quantum Nature of Nanoworld: Characteristic or Critical lengths in mes scattering length, coherence length etc; Idea Quantum dots; One and Two dimensional Quantum confinements, Variation of dedimensionality, Optical properties of sem Surface Plasmon Resonance in Metal N (Fullerenes, Carbon Nanotubes and Grap Applications.	soscopic systems e.g. mean free path, of quantum well, Quantum wire & and electron systems: general properties, ensity of states andband gap with niconductor and metal nanomaterials, Nanoparticles. Carbon Nanostructures	15		
3	Nano fabrication: Synthesis of nanomateria and Bottom-up Approaches; Ball Milling. I physical and chemical vapour deposition (Hydrothermal and Solvo-thermal synthesinanomaterial etc.	Lithography, etching. epitaxial growth, (PVD & CVD) methods, Microwave,	15		
4	Characterization of Nano materials: Struct Determination of Particle size, Crystallog Microscopy (Scanning and Transmission microscopy, Scanning tunneling microscopy Spectroscopy, Infrared and Raman Spectroscopy	raphy, atomic and surface structures, electron microscopy, atomic force y); Spectroscopy (X-ray Photoelectron	15		
	Sugges	stad Raadings			

- 1. Introduction of Nanotechnology by Charles P Poole Jr and F J Owens Wiley India
- 2. Nanotechnoology for Microelectronics and optoelectronics by JMM Duart, RJM Palmand F A Rueda Elsevier
- 3. Introduction to Solids by Kittel
- 4. Physics of semiconductor nanostructure by KP Jain, Narosa
- 5. Physics of low dimensional semiconductors by John H. Davies
- 6. Nano particles and nanostructured films: Preparation, Characterization and Application, Ed. J. H. Fendler, John Wiley

Programme/Class: Degree		Year: Fifth	Semester: X	
Subject : Physics				
Course Code: B011008T		Course Title: Elements of Atmospheric and Space		
	Science			
Course Outcomes				

- 1. Describe the chemical composition and physical constituents of the lower atmosphere.
- 2. Analyze diurnal and seasonal variations of temperature, pressure, and humidity.
- 3. Explain the formation and characteristics of sunspots.
- 4. Understand the Babcock model of the solar magnetic cycle and sunspot generation.
- 5. Describe the structure and extent of the heliosphere and the solar magnetic field.

Credit: 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	Торі	ics	No. of Lectures			
Elements of Atmospheric and Space Science						
1	Lower atmosphere: Composition, constitue		15			
	variations of Temperature, Pressure and Hu					
	climate.					
2	Ionosphere and magnetosphere: structure an	nd formation, Density profile of upper	15			
	atmosphere. Storm – substorm phenomena.					
3	Structure of the Sun: Solar interior, solar atmosphere, photosphere, chromosphere,		15			
	corona; Sunspots and their properties, Babco	ock model of sunspot formation.				
4	Solar cycle and solar activity: Solar Wind,		15			
	(CMEs); heliosphere and solar magnetic	e field. Space Weather: causes and				
	consequences.					
Suggested Readings						

- 1. Meteorology: Understanding the Atmosphere: Steven A. Ackerman and John A. Knox
- 2. An introduction to Meteorology: S. Petterssen, McGraw-Hill Book Company, USA
- 3. Element of Space Physics: R.P. Singhal, Prentice Hall of India, New Delhi
- 4. Astrophysics of the Sun: Harold Zirin, Cambridge University Press, Cambridge, U.K.
 - 5. Guide to the Sun: Kenneth J. H. Philips, Cambridge University Press, U.K.

Programme/Class: Degree	Year: Fifth	Semester: X				
Subject: Physics						
Course Code: B011009P	Course Title: Practi	cal Lab				

- 1. Analyze and determine the polarizability of non-polar liquids and dipole moment of polar liquids, understanding molecular interactions in electric field
- 2. Measure the magnetic susceptibility of paramagnetic substances using Quincke's method, gaining practical knowledge of magnetic properties and their temperature dependence.
- 3. Determine the dielectric constant of solid materials (e.g., wax) **using** Lecher wire, applying concepts of dielectric media and electromagnetic wave propagation.
- 4. Understand and experimentally evaluate signal losses in optical fibers, identifying factors affecting attenuation and transmission quality.
- 5. Demonstrate amplitude modulation (AM) and understand modulation index, bandwidth, and power considerations.
- 6. Demonstrate frequency modulation (FM) and analyze the frequency deviation and bandwidth requirements.

Credit: 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 Hours:		
			120		
T1 / 0D 1 / (C 1 135 // D) 1 T1					

List of Experiments (Condensed Matter Physics-II)

- 1. Measurement of polarizability of nonpolar liquid and dipole moment of polar liquid.
- 2. Determination of Lande's g factor of DPPH using Electron Spin Resonance spectrometer
- 3. Determination of magnetic susceptibility of paramagnetic substance by Quincke's method
- 4. Measurement of dislocation density of a crystal by etching
- 5. Determination of magnetoresistance
- 6. Specific of solids, internal friction
- 7. Study of thermoluminescence

AND/OR

List of Experiments (Electronics-II)

- 1. To study losses in an Optical Fibre.
- 2. To measure Numerical Aperture (NA) of an optical fibre.
- 3. Addition, Subtraction, Multiplication and Division using 8085 microprocessor.
- 4. Signal Sampling and Generation in PAM.
- 5. Study of amplitude modulation and demodulation
- 6. Study of frequency modulation and demodulation
- 7. Pulse modulation and demodulation,
- 8. Study of flip-flop, counter, register circuits.
- 9. Performing operations using A/D & D/A converters
- 10. Study of basic operations using linear ic trainer.
- 11. Study of Gunn diode
- 12. Experiments based on microwaves
- 13. Study of Electronic devices

- 1. Ramakant A. Gayakwad Op-Amps and Linear Integrated Circuits, 4th Edition, Pearson Education, 2002.
- 2. Boylestad & Nashelsky Electronic Devices and Circuit Theory, 11th Edition, Pearson, 2012.
- 3. H.S. Kalsi Electronic Instrumentation, 3rd Edition, McGraw-Hill, 2010.