SANKALCHAND PATEL UNIVERSITY, VISNAGAR

Faculty of Science & Humanities

Structure, Teaching Scheme and Syllabus of

B. Sc. (Physics) Honours with Research

Sem-6 as per NEP-2020

Program Code: SC105

With effect from: 2023-24

SEMESTER-6

Branch Name:	B.Sc. Physics
Program Code:	SC105
Course Name:	Mathematical Physics
Course Code:	16-PHM304-3C
Pre-requisite Course:	

Course Objectives:

1. To understand the basic concept of Mathematical physics
2. To know the basic concept of equation of classical mechanics
3. To understand the use of Schrödinger equations in various fields.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory (Marks)		Practical/Viva voce (Marks)		Total (Marks)
Lecture (L)	Tutorial (T)	Practical (P)	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	-	25	100

Subject Contents:

Unit	Content	Total Hours	Weightage
1	**Linear vector space** - Definition and examples, scalar product, dual vectors and Cauchy-Schwarz inequality, real and complex vector spaces, metric spaces. **Quantum states:** State vectors and wave-functions, The Hilbert space of state vectors, Dynamical variables and linear operators and their algebra. Projection operators. The quantum condition, self-adjointness Special operators such as Hermitian, Unitary etc. and their properties, Eigenvalues and eigenvectors, Expansion of identity, linear independence of vectors, generalized Eigen vectors, orthogonalization.	15	33%
2	**Introduction to group theory:** Definition and examples, group multiplication table, homomorphism and isomorphism, matrix representations – reducible and irreducible, classes and character, subgroups and cosets, Dihedral group, orthogonal groups and special unitary group, Illustrations of the group concept in various branches of physics.	15	34%
3	Introduction, Analytic functions, Contour integrals, Laurent series, The Residue theorem, Methods of finding residues ,Evaluation of definite integrals by use of the residue theorem, The Point at infinity; residues at infinity, Mapping. Green's function – definition, Three methods of constructing Green's function, Few examples.	15	33%

Basic Reference book:

1. Mathematical Methods for Physicists by G. Arfkenand Weber, Academic Press, 6th Ed (2005).
2. E text book of Quantum Mechanics, by Mathews &Venkatesan, TMH Publication (2010)
3. Mathematical Physics by P. K. Chattopadhyay (Wiley Eastern Limited, (1990).
4. Mathematical Methods in Physical Sciences by M. L. Boas, Second Edition, John Wiley & Sons, (1996)

<u>Physics Practical</u>:

1. Young Modulus 'y' by Koinds Method
2. G.M. counter (comparision of Intensity)
3. High Resistance 'R" by using Leakage method

List of Open Source Software/learning website:

1. https://youtu.be/bAK5Th9XRYw
2. https://youtu.be/Sycx0g46iws
3. https://youtu.be/GtXmS5YH7XM

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Describe the residue theorm for various conditions.	1 Remembering
CLO2	Discuss the linear vector space and quantum states.	2 Understanding
CLO3	Illustrate the group theory	3 Applying
CLO4	Explain various transforms functions.	4 Analyzing
CLO5	Decide the application of various transforms functions and residue theorm.	5 Evaluating
CLO6	Design oscillator circuits.	6 creating

Mapping of CLOs with Pos & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	2				3												2	
CLO2			2			1				1							1	
CLO3		2				2				1							1	
CLO4	2		2														2	
CLO5	1	2															2	
CLO6	3				2												3	

3: High, 2: Medium, 1: Low

Faculty of Science and Humanities
B.Sc. (Physics) (Semester - 6)
In Effect from Academic Year 2023-24

Branch Name:	B.Sc. Physics
Program Code:	SC105
Course Name:	Elements of Solid state Physics and Error Analysis
Course Code:	16-PHM305-3C
Pre-requisite Course:	

Course Objectives:

1. To understand the basic concept of Crystallography
2. To know the basic concept of crystal structure
3. To understand the use of Statiscally ensemble in various fields.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory (Marks)		Practical/ Viva voce (Marks)		Total (Marks)
Lecture (L)	Tutorial (T)	Practical (P)	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	-	25	100

Subject Contents:

Unit	Content	Total Hours	Weightage
1	Lattice vibrations, Vibration of mono-atomic lattice, First Brillouin zone, group velocity and continuum limit, Lattice with two atoms per primitive cell, Quantization of lattice vibrations, phonon momentum, inelastic scattering of neutrons by phonons.	13	30%
2	Elastic properties, Stress and Strain components, Dilation, Elastic compliance, Stiffness, Elastic energy density and the relationships, Elastic constants for cubic isotropic crystal, their reduction due to existence of potential of elastic forces, Elastic waves : Waves in [100], [110] and [111] direction, Experimental determination of elastic constants intrinsic carrier concentration, Impurity conductivity, Models for impurity semiconductors, Thermo-electric effect, Hall Effect.	17	35%
3	Types of measured quantities: Discrete quantities, Continuously distributed quantities, Histogram, Normalized histogram, Best estimate of true value of data, Standard deviation of the means, Gaussian distribution, Properties of Gaussian distribution, Determination of mean value for a Gaussian distribution, Determination of standard deviation for Gaussian distribution and problems, Chi-square test for goodness of fit, Criteria for goodness of fit, Determination of parameters in linear relationships, Graphical method, Method of least squares, Linear least square curve fitting.	15	35%

Basic Reference book:

1. Introduction to solid state Physics by c. kittle, wiley Prakashan
2. Solid state Physics by saxena, Pragati Prakashan
3. Elementary Solid State Physics by M. A. Omar (Addison-Wesley Publishing Company).
4. Solid State Physics: Structure and Properties of Materials by M. A. Wahab (Narosa Publishers).
5. Elements of Solid State Physics by J.P. Srivastava (Prentice Hall ofIndia)

Physics Practical:

1. To determine λ & dλ of sodium light using Michelson interferometer
2. V.I characteristics of solar cell
3. A study of Maxwell bridge

List of Open Source Software/learning website:

1. https://youtu.be/d_dasJl8GrA
2. https://www.youtube.com/watch?v=GPEE8JviDGU
3. https://www.youtube.com/watch?v=sxEqtjLC0aM

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom'sTaxonomyLevel
CLO1	Describe the various Lattice vibrations	1 Remembering
CLO2	Discuss the group velocity and continuum limit.	2 Understanding
CLO3	Use the miller indices to designate plane in unit cell.	3 Applying
CLO4	Explain Elastic properties, Stress and Strain components, Dilation, Elastic compliance, Stiffness, Elastic energy density	4 Analyzing
CLO5	Justify the usage of miller indices in crystallography.	5 Evaluating
CLO6	Design the crystal structure for various compounds by using of crystallography.	6 creating

Mapping of CLOs with Pos & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	2				1												2	
CLO2					2												1	
CLO3		3				2				1							2	
CLO4	1				2					1							2	
CLO5	1		2							1							1	
CLO6			3														3	

3: High, 2: Medium, 1: Low

Faculty of Science and Humanities
B.Sc. (Physics) (Semester - 6)
In Effect from Academic Year 2023-24

Branch Name:	B.Sc. Physics
Program Code:	SC105
Course Title:	Atomic & Molecular Spectroscopy and Statistical Mechanics
Course Code:	16-PHM306-3C
Pre-requisite Course:	

Course Objectives:

1. To understand the basic concept of radioactivity and nuclear reaction
2. To know the basic concept of atomic spectrum
3. To understand the use of nuclear instruments in various fields.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical/Viva voce (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	--	25	100

Subject Contents:

Unit	Topic	Total Hours	Weightage
1	**Atoms and Molecules**: Schrödinger equation for one-electron atoms – H-atom, the dipole selection rules. Fine structure of hydrogenic atoms, The Lamb shift and its determination, Hyperfine structure and isotopic shifts. Schrödinger equation for Two-electron atoms, the role of Pauli Exclusion Principle, Energy levels of He atom, Doubly excited states, Auto-ionization in Helium. Thomas-Fermi model for many-electron atoms. The Born-Oppenheimer approximation for molecule, electronic structure of diatomic molecules, LCAO approximation for H2+ ion.	15	34%
2	**Quantum Statistical Mechanics:** Density operators: properties of density matrix, the density Operators of various ensembles, Examples, Density matrix, Partition function of a system of free particles, monoatomic molecules, diatomic molecules. The ideal Bose gas, Bose-Einstein Condensate. The ideal Fermi Gas, Degenerate Fermi gas, Applications: Black body radiation, Relativistic Fermi gas at T= 0, White dwarf stars. Cluster expansion for a classical gas, expansion of the equation of state, Evaluation of virial coefficients.	15	34%
3	**Non-Equilibrium Statistical Mechanics:** Classification of phase transitions, Landau theory of second order phase transition, Examples of phase transitions, Ising model in one and two dimensions, Critical indices, Scaling laws, Boltzmann Transport Equation, Boltzmann H – theorem, Theory of Brownian motion, Diffusion equation.	15	33%

Reference Books:

1. Physics of Atoms and Molecules, by B. Bransden and C. J. Joachain (Pearso Publication, New Delhi).
2. Fundamentals of molecular spectroscopy, by C. N. Banvel.
3. Atomic Physics by J.B.Rajam (5th Edition -1960) S.Chand &Co
4. Lasers and Non-linear Optics, by B. B. Laud (New Age International P Ltd., India, 2ndedition, 1996) .

Physics Practical:

1. Susceptibility of $Fecl_3$ using quienk's method
2. To study the Characteristics of SCR
3. To study the Characteristics of Diac

List of Open Source Software/learning website:

1. https://youtu.be/Ml9xsYdLFwc
2. https://youtu.be/CefOcjpUP-A

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Describe Energy levels in He atoms	1 Remembering
CLO2	Discuss the atoms and molecules in term of quantum mechanics.	2 Understanding
CLO3	Solve Schrodinger equation in case of atoms.	3 Applying
CLO4	Explain non equilibrium statistical mechanics.	4 Analyzing
CLO5	Justify the various operators in quantum statistical mechanics.	5 Evaluating
CLO6	Design the laser by using various methods.	6 creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes																	Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1		1															1	
CLO2		2			5												2	
CLO3	2																2	
CLO4					2					1							1	
CLO5		2															2	
CLO6			3			1				3							3	

3: High, 2: Medium, 1: Low

Faculty of Science and Humanities
B.Sc. (Physics) (Semester - 6)
In Effect from Academic Year 2023-24

Branch Name:	B.Sc. Physics
Program Code:	SC105
Course Name:	Analog and digital electronics-II
Course Code:	16-PHE303-3C
Pre-requisite Course:	

Course Objectives:

1. To develop an actual understanding of the Amplifier.
2. To know the basic concept of Digital Electronics.
3. To understand the concept of Modulation.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**Theory (Marks)**		**Practical/ Viva voce (Marks)**		**Total (Marks)**
				University Assessment	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	
3	**--**	**2**	**4**	**50**	**25**	**--**	**25**	**100**

Subject Contents:

Sr. No	**Topic**	**Total Hours**	**Weightage (%)**
1	**(a) Feedback Amplifier** Feedback, Principle of Feedback Amplifiers, Advantages of Negative Feedback, Reasons for Negative Feedback. **(b) Transistor Oscillators (Sinusoidal):** Tuned Collector Oscillators, Hartley Oscillator, Colpitt's Oscillators (Circuit operation and alternative treatment only), Phase Shift oscillator, R-C-Oscillator, Wien Bridge Oscillator, Crystal Oscillator	16	35%
2	**(a) Modulation** Introduction, Expression for Amplitude modulated voltage, Wave form Amplitude modulated voltage, Side band produced in Amplitude modulated wave, Modulated power output, Frequency Modulation, Frequency deviation and carrier swing, Modulation index, Expression for frequency modulated wave, Phase modulation.**(b) Digital Electronics:** Simplification using Karnaugh Maps, Don't Care Conditions, BCD-to-7 Segment Decoder, Digital Comparator, Multiplexer, Demultiplexer.	17	36%
3	**(a) Regulated DC Power Supply** Transistor Series voltage Regulator, Negative Feedback Voltage Regulator, Transistor Shunt Regulator, Transistor Current Regulator, Glow-tube Voltage regulator.**(b) Thyristors and Optoelectrinic devices**: Lasers , Laser Action, Spontaneous and Stimulated Emission Probabilities and Condition of Population Inversion , P-N Junction Laser Diode .	12	31%

Reference Books:

1. Networks, Lines and Fields by J. D.Ryder. Pretice Hall.
2. Topics in Algebra, I N Herstein, Wiley Eastern Ltd.
3. Basic Algebra Vol I & II, N. Jacobson, Hindustan Publishing company.
4. A text book of Modern Algebra, Shanti Narayan, S. Chand & Co.

Physics Practical:

1. A syudy of Transform coupled amplifier using VTVM/CRO.
   (Voltage gain frequency response and band width)
2. A study of Hartley oscillator.
3. A study of full subtractor.

List of Open Source Software/learning website:

1. https://www.youtube.com/watch?v=c_QX170sPIg&list=PLXbLuD5WNA3KnewZiiGdTt
2. https://www.youtube.com/watch?v=YfhYE6_v6fI
3. https://www.youtube.com/watch?v=KM_HJmygBtA

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Describe the Feedback Amplifier.	1 Remembering
CLO2	Discuss the Transistor Oscillators.	2 Understanding
CLO3	Solve the numerical based on Digital Electronics	3 Applying
CLO4	Explain the Regulated Dc Power supply	4 Analyzing
CLO5	Justify the condition of population inversion	5 Evaluating
CLO6	Design a various Transistor Amplifers and Diode	6 creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1			2		3												2	
CLO2					2												1	
CLO3			2							3							2	
CLO4		2				2											2	
CLO5	3					2											3	
CLO6		3															2	

3: High, 2: Medium, 1: Low

Faculty of Science and Humanities
B.Sc. (Physics) (Semester - 6)
In Effect from Academic Year 2023-24

Branch Name:	B.Sc. Physics
Program Code:	SC105
Course Title:	Nano Physics
Course Code:	16-PHE303-3O
Pre-requisite Course:	

Course Objectives:

1. To develop an actual understanding of the Nanoparticles
2. To know the basic concept of Nanotechnology
3. To understand the concept of Nanophysics

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical/ Viva voce (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	-	25	100

Course Contents:

Unit	Topic	Total Hours	Weightage
1	**Introduction:** Pre- Nanotechnology, Origins of Concepts of Nano, Advances in Experimental Methods, Nanotechnology-Basics and Basis, Size of Nano, The Meaning of Nanotechnology, Four Generations of Nanotechnology Development, Technology of General Applicability, Multi-purpose Technology, Applications of Nanotechnology. **Nanochemistry:** Introduction, Basic Concepts, Classification of Nanomaterials, Techniques of Production or Methodology, Size Concerns. **Fullerenes:** Introduction, History of Discovery, Variations, Properties of Fullerenes.**Nanoparticles:**Introduction, History, Properties of Nanoparticles, Classification, Characterization,, Production of Nanoparticles, Morphology of Nanoparticles, Safety Issues.	15	34%
2	**Carbon Nanotube:** Introduction, Discovery, Description, 'TYPes of Carbon Nanotubes and Related Structures,Single-walled Nanotubes, Multi-walled Nanotubes, Introduction, Structure, Research, Self-assembled Monolayars, Applications. **Nanophysics:** Quantum Dot, Description, Quantum Confinement in Semiconductors, Optical Properties, Fabrication, Mass Production, Applications, Computing Field ,Biology, Cellular Imaging, Quantum Dots tor Thmour Thrgeting, Toxicity, Photovoltaic Devices, Light-emitting Devices, Quantum Wire, Carbon Nanotubes as Quantum Wires, Quantum Well, Fabrication, Applications, Quantum Point Contact, Fabrication, Properties, Applications.Nanocrystals, Nanocrystal solar cell.	15	33%
3	**Nanomedicine and Nanobiology:** Introduction, Bascic concepts and applications, Drug Delivery, Cancer Diagnosis and Therapy, Surgery, Invivo Therapy, Neuro-electronic Interfaces, Cell Repair Machines, Nanobiotechnological Devices: Nanoparticles , Dendrimers , Nanorobots, Nubot , Nanoshell , Other Applications of Nanobiotechnology **Biosensors :** Definition , Principles of Detection , Optical (Photometric)	15	33%

	Biosensor**,** Electrochemical Biosensor**,**Others, Applications , Nanobiosensors ,Nanonose,Types of Nanosensors,Applications of Nanobiosensors Nanobiosensors and Cancer , Point-of-Care Testing , Nano- DNA Technology , Tile-based Arrays· , Applications. Building Blocks of DNA , DNA Sensors , DNA Field-effect Transistor , Optical Biosensors, Nanosized Optical Biosensors, Nanopathology-, Interactions.		

Reference Books:

1. Nanotechnology by S.Shanmugam, MJP Publishers
2. Nanobiotechnology by Subbiah Balaji, MJP Publishers
3. Nanoscience and Technology by V S Muralidharan, A subramania, Ane Books PVT. Ltd

Physics Practical:

1. A study of Transform coupled amplifier using VTVM/CRO.
   (Voltage gain frequency response and band width)
2. A study of Hartley oscillator.
3. A study of full Subtractor.

List of Open-Source Software/learning website:

1. https://www.youtube.com/watch?v=tfN_IPH4IZ8
2. https://www.youtube.com/results?search_query=carbon+nanotubes
3. https://www.youtube.com/watch?v=z7aqJpKfPC0

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Describe the meaning of Nanotechnology	1 Remembering
CLO2	Discuss the classification of nanomaterials	2 Understanding
CLO3	Explain the carbon nanotube	3 Applying
CLO4	Justify the nanomedicine and nanobiology	4 Analyzing
CLO5	Give brief idea about biosensors	5 Evaluating
CLO6	Creating the nano particles	6 creating

Mapping of CLOs with POs

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1					1											2	
CLO2			2														1	
CLO3																	1	
CLO4	1					3											1	
CLO5		2			2												2	
CLO6			2											2			2	

3: High, 2: Medium, 1: Low

Faculty of Science and Humanities
B.Sc. (Physics) (Semester - 6)
In Effect from Academic Year 2023-24

Branch Name:	B.Sc. Physics
Program Code:	SC105
Course Name:	Advanced English
Course Code:	16-AEC301-3C
Pre-requisite Course:	Basics English Grammar and Composition up to T.Y. B.Sc.

Course Objectives:

1. To inculcate human values among the students through poems and prose.
2. To create an interest in literature and to develop language skills.
3. The students will become familiar with formal vocabulary that is common in academic texts.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory (Marks)		Practical/Viva voce(Marks)		
Lecture (L)	Tutorial (T)	Practical (P)	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Total (Marks)
2	--	--	2	25	25	--	--	50

Subject Contents:

Unit	Contents	Total Hours	Weightage (%)
1	**Vocalbulary & Grammer Link** Review of Confusing Words, Simple- Compound and Complex Sentences.	9	30
2	**Speaking** Group Discussion Group discussion as a part of selection process, group behavior & leadership Potential, Tips for Effective group discussion. **Group Discussion (GD) Topics on Current Affairs** The New Education Policy (NEP): Challenges in Implementation, India's Space Missions: From Chandrayaan to Gaganyaan, India's Role in G20 Leadership: Achievements and Challenges	6	20
3	**Reading and writing** **Writing Portion** **Essay Writing:** Electric Vehicles: The Future of Transportation, The Role of Artificial Intelligence in Shaping the Future, Impact of Western Culture on Indian Youth, How Technology is Transforming Education **Unseen Passages/Comprehension** Texts from journals, newspapers, research articles, and essays.	6	20
4	**TEXT** **Catalyst-Lesson 6 to 10**	9	30

Text Books:

1. Catalyst-Text Book,2020
2. Easy to learn English grammar by Dr.Jayesh Patel,2021

Reference Books:

1. Very Useful Verbs book (Enka Publication)2021
2. Contemporary English Grammar Structure & Composition,2020
3. Murphy R. Intermediate English Grammar(New Delhi: Cambridge University)2019

List of Open Source Software/learning website:

1. Englishpage.com
2. Epaper.timesofindia.com
3. Epaperindianexpress.com
4. https://www.youtube.com/watch?v=QdAgnyD4xhY

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom'sTaxonomyLevel
CLO1	Describe how public speaking can be used to advocate or create change	1 Remembering
CLO2	Explain the goals and benefits of public speaking	2 Understanding
CLO3	Use parallel structures correctly and effectively.	3 Applying
CLO4	Identify strategies for researching and supporting a speech	4 Analyzing
CLO5	Recognize when to use visual aids	5 Applying
CLO6	Describe how public speaking can be used to advocate or create change	6 Creating

Mapping of CLOs with Pos & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1				3		1		2			1				1			
CLO2			2	3	2	1	2			2	1	2						
CLO3			1	2				2	1						2			
CLO4							1				1							
CLO5					1		1			2		1			1			
CLO6			1															

3:High, 2:Medium, 1:Low