Rayat Shikshan Sanstha's

Sadguru Gadge Maharaj College, Karad

(Autonomous)

Revised Syllabus As per Maharashtra Gov. GR. dated-20April, 2023 for Implementing NEP-2020

M.Sc. II Syllabus w.e.f. June 2024

(Academic Year 2024-25)

NEP 2.0

NATIONAL EDUCATION POLICY (NEP-2020)

Syllabus For

M.Sc. Program

Physics

Syllabus to be implemented for A. Y. 2024-2025

Rayat Shikshan Sanstha's

Sadguru Gadge Maharaj College, Karad

(Autonomous)

Department of Physics

Structure and credit distribution for M. Sc. Program as per NEP -2020

Year	Level	SEM	Major		RM	OJT/FP	RP	Cum Cr.	Degree
			Mandatory	Elective					
I	6.0	I	MP (4) CM(4) P-Lab- I (4) P-Lab -II (2)	SSP-1 (4 credit)	RM-PH (4)	----	----	**22**	**PG Diploma (after 3 Yr Degree)**
		II	QM (4) CMP(4) P-Lab- III (4) P-Lab -IV (2)	SSP-2 (4 credit)	----	FP-PH (4)	----	**22**	
Cum. Cr. PG Diploma			**28**	**8**	**4**	**4**		**44**	
Exit option : PG Diploma (40-44 Credits) after three year UG Degree									
II	**6.5**	**III**	SM (4) AMP(4) P-Lab- V (4) P-Lab -VI (2)	SSP-3 (4 credit)	----	----	RP-PH (4)	**22**	**PG Degree after 3-Yr UG or PG Degree after 4 -Yr UG**
		IV	ED (4) NP(4) P-Lab- VII (4)	SSP- 4 (4 credit)	----	----	RP-PH (6)	**22**	
Cum. Cr. for 1 Yr PG Degree			**26**	**8**			**10**	**44**	
Cum. Cr. for 2 Yr PG			**54**	**16**	**4**	**4**	**10**	**88**	

Abbreviations: Yr: Year; Sem: Semester; OJT: On Job Training: Internship/Apprenticeship; FP: Field Projects; RM: Research Methodology; RP: Research Project; Cum. Cr.: Cumulative Credits; MP: Mathematical Physics; CM: Classical Mechanics; P-Lab- Practical Lab; QM: Quantum Physics; CMP: Condensed Matter Physics; SM: Statistical Mechanics; AMP: Atomic and Molecular Physics; ED: Electrodynamics; NP : Nuclear and Particle Physics; SSP: Solid State Physics

Rayat Shikshan Santha's

SADGURU GADGE MAHARAJ COLLEGE, KARAD

(An Autonomous Institute)

Department of Physics

M.Sc. II: Examination Pattern As Per NEP 2024-25

(Annual Total marks for Physics Subject: 1100) Total credit: 44= Sem III (22) + Sem IV (22)

Semester	Nature of Paper	Paper No.	Paper Code	Theory exam.				Practical Examination and Submission							Grand Total
				Theory exam. ESE (Passing Marks- 32)	Internal exam CCE I & II Offline/Online Test (Passing Marks-08)	Total (Passing Mark - 40) Max.	Total (Passing Mark - 40) Min.	Practical Paper Code	Practical Exam Paper Exam	Practical Exam Journal	Submission Oral/Edu.tour/ Case study /Day to Day performance/ Seminar	Total (Passing Marks-20) Max.	Total (Passing Marks-20) Min.		
Sem- III (LEVEL-6.0)	Major	IX	MJ-MPT23-301	80	20	100	40	MJ-MPP23-301 LAB-V	90	10	-	100	32	100	100
	Major	X	MJ-MPT23-302	80	20	100	40								
	Major Elective	XI	GE- MPT23-303	80	20	100	40	MJ-MPP23-302 LAB-VI	25 Tutorial	00	25 Seminar/CS	50	16	50	50
	RP	XII	RP-MPT23-304	80	20	100	40								
	Semester-III: Theory Total Marks			320	80	400	--	Practical Marks	115	10	25	150	--	150	150
Sem.- IV (LEVEL-6.5)	Major	XIII	MJ-MPT23-401	80	20	100	40	MJ-MPP23-401 LAB-III	90	10	-	100	32	100	100
	Major	XIV	MJ-MPT23-402	80	20	100	40								
	Major Elective	XV	GE- MPT23-403	80	20	100	40	RP-MPP23-402	00	00	00	50	16	50	50
	RP	XVI	RP-MPT23-404	80	20	100	40								
	Semester-II: Theory Total Marks			320	80	400	--	Practical Marks	90	10	00	150	--	150	150
Grand Total				640	160	800	--		205	20	25	300	--	1100	

SEE- Semester End Examination, CCE- College Compressive Evaluation, IKS-Indian Knowledge System, SEC- Skill Enhancement Course

M. Sc.- II

Semester - III					
Sr. No.	**Paper No.**	**Subject Code**	**Major**		Credit
			Mandatory	**Elective** (4 credit)	
1	**Paper-IX**	**MJ-MPT23 301**	**Statistical Mechanics (4 credit)**	**---**	
2	**Paper-X**	**MJ-MPT23 302**	**Atomic and Molecular Physics (4 credit)**	---	
3	**Paper-XI**	**GE-MPT23-303**	**----**	**Solid State Physics-3 [Thin solid films: Deposition and properties (4 credits)]**	
4	**Paper-XII**	**RP-MPT23-304**	**Solid State Physics Project Work - I(4 Cr.)**	**---**	
5	**Practical-V**	**MJ-MPP23-301**	**Practical Lab - V (4 credit)**	**----**	
6	**Practical –VI**	**MJ-MPP23-302**	**Practical Lab - VI (2 credit)**	**----**	**22**
			Credits 18	**4**	
			Semester - IV		
			Mandatory	**Elective** (4 credit)	
1	**Paper-XIII**	**MJ-MPT23-401**	**Electrodynamics (4 credit)**	**---**	
2	**Paper-XIV**	**MJ-MPT23-402**	**Nuclear and Particle Physics (4 credit)**	----	
3	**Paper-XV**	**GE-MPT23-403**	**----**	**Solid State Physics-4 Physical Properties of solids (4-cr.)**	
4	**Paper-XVI**	**RP-MPT23-404**	**Solid State Physics Project Work–I(6 Cr.)**	**----**	**22**
5	**Practical-VII**	**MJ-MPP23-401**	**Practical Lab - VII (4 credit)**	**----**	
			Credits 18	**4**	
				Total credit	**88**

M.Sc. II Sem. III & IV (w.e.f. June 2024)
Nature of Question Paper

Theory: Time -3 hours, **Marks**-80

Instructions: **1) Question No.1 & 2 are compulsory.**
2) Attempt any three questions from Q.3 to Q.7
3) Figure to right indicates full marks.

Question 1: Multiple choice questions (16 questions – each having 01 Mark)= 16 marks

Question 2: Short answer questions (Any 04 out of 06) = 16 marks

Question 3: a) Long Answer question for - 12 marks
b) Short answer questions for - 4 marks

Question 4: a) Long Answer question for - 12 marks
b) Short answer questions for - 4 marks

Question 5: a) Long Answer question for - 12 marks
b) Short answer questions for - 4 marks

Question 6: a) Long Answer question for - 12 marks
b) Short answer questions for - 4 marks

Question 7: a) Long Answer question for - 12 marks
b) Short answer questions for - 4 marks

Note: Equal weightage should be given to each unit.

M. Sc. - II
(Semester-III)

M.Sc. (Physics) NEP Semester-III
Course Code: MJ-MPT23-301
Paper title: Statistical Mechanics
Total Credits: 4-credits

Statistical Mechanics

Unit I: Contact between Statistics and Thermodynamics: (15)
Fundamental postulate of equilibrium statistical mechanics, Basic concepts – Phase space, ensemble, a priori probability, Liouville's theorem (Revision). Fluctuations of physical quantities, Statistical Equilibrium, Thermodynamic Laws and their consequences (in brief), Thermodynamic Functions – Entropy, Free energy, Internal Energy, Enthalpy (definitions), Maxwell's Equations (only equations), Contact between statistics and thermodynamics – Entropy in terms of microstates, Gibb's paradox, Sackkur-Tetrode formula.

Unit II: Classical Statistical Mechanics: (15)
Micro canonical Ensemble– Micro canonical distribution, Entropy and specific heat of a perfect gas, Entropy and probability distribution, Canonical Ensemble– Canonical Distribution, partition function, Calculation of free energy of an ideal gas, Thermodynamic Functions, Energy fluctuations. Grand Canonical Ensemble– Grand Canonical distribution, Thermodynamic Functions,Number and Energy fluctuations.

Unit III: Quantum Statistical Mechanics: (15)
Quantum Statistics: Distinction between MB, BE and FD distributions, Quantum distribution functions –Bosons and Fermions and their distribution functions, Boltzmann limit of quantum gases, Partition function, Ideal Bose gas, Bose -Einstein Condensation, Specific heat of solids (Einstein and Debye models) Phonon gas, Liquid He4: Second Sound, Ideal Fermi gas: Weakly and strongly degenerate, Fermi temperature, Fermi velocity of a particle of a degenerate gas , Electron gas: Free electron theory ofmetals, Pauli paramagnetism, white dwarfs, *Brownian motion*: Einstein-Smoluchowski theory, Langevin theory, Approach to equilibrium: Fokker-Planck equation, the fluctuation-dissipation theorem.

Unit IV: Phase Transitions, and Critical Phenomenon (15)
Phase Transitions, Conditions for phase equilibrium, First order Phase Transition: Clausius - Clayperon equation, Second order phase transition, The critical indices, Weakly Interacting Gases, Weiss Molecular theory of paramagnetism, The Ising Model of a Ferromagnetism

Reference books:
1) Statistical Mechanics Theory and Applications, S K Sinha, Tata McGraw-Hill, (1990).
2) Introduction to Statistical mechanics, B B Laud, Macmillan, N Delhi, (1981).
3) Statistical Mechanics by R K Pathria, Pergamon press (1972).
4) Statistical and thermal Physics F Reif, McGraw-Hill (1965).
5) Statistical Physics, L D Landau, and E M Lifshitz, Pergamon press (1958).

M.Sc. (Physics) NEP Semester-III
Course Code: MJ-MPT23-302
Paper title: Atomic & Molecular Physics
Total Credits: 4-credits

Atomic and Molecular Physics

Unit - I: Atomic Spectra **(**15)

Quantum states of an electron in an atom, electron spin, spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, ll-coupling, ss-coupling, LS or Russell - Saunder's coupling; the Pauli exclusion principle, Coupling schemes for two electrons, Γ- factors for LS coupling, Lande interval rule, jj coupling, branching rules, selection rules, Intensity relations.

Unit - II: Effect of magnetic and electric field on atomic spectra **(**15)

The magnetic moment of the atom, Zeeman effect for two-electrons, Intensity rules for Zeeman effect, Paschen-Back effect for two electrons, Stark effect of hydrogen, weak field Stark effect in hydrogen, strong field Stark effect in hydrogen, origin of hyperfine structure, Inner shell vacancy, X-ray and Auger transitions, Compton effect.

Unit - III: Molecular spectra **(**15)

Molecular physics – covalent, ionic and Vander Waal's interaction, Classification of molecules: linear, symmetric tops, spherical tops, asymmetric tops; rotational spectra: the rigid diatomic molecule, the non-rigid rotator, spectrum of a non-rigid rotator, techniques and instrumentation of microwave spectroscopy, chemical analysis by microwave spectroscopy, the vibrating diatomic molecule: the energy of a diatomic molecule, the simple harmonic oscillator, the anharmonic oscillator, the diatomic vibrating-rotator, vibrational rotational spectra, techniques and instrumentation of infra-red spectroscopy, chemical analysis by infra-red spectroscopy.

Unit - IV: Electronic, Nuclear and Raman spectra **(**15)

Revision on electronic spectra of diatomic molecules, electron spins resonance, nuclear magnetic resonance, chemical shift. Frank-Condon principle, dissociation energy and dissociation products, rotational fine structure of electronic-vibration, transitions. Born-Oppenheimer approximation, separation of electronic and nuclear motions in molecules, band structures of molecular spectra. Raman spectra: Pure rotational Raman spectra, vibrational Raman spectra, polarization of light and Raman effect, techniques, and instrumentation of Raman spectroscopy.

Reference books:

1) Introduction to Atomic Spectra – H.E. White, Mac-Graw Hill (1934).
2) Fundamentals of Molecular Spectroscopy, 4th Edition. – C.N. Banwell, Tata MacGraw Hill (2008).
3) Molecular Structure and Spectroscopy, G. Aruldhas, PHI Learning Pvt. Ltd. Spectra of diatomic Molecules, Vol. I – G. Herzberg, N.J.D. van Nostrand (1950).
4) Spectroscopy, Vol. I, II and III – B.P. Straughan and S. Walker, Chapman, and Hall (1976).
5) Introduction to Molecular Spectroscopy – G.M. Barrow, McGraw Hill (1962).
6) Molecular Spectroscopy – J.M. Brown, Oxford University Press (1998).

M.Sc. (Physics) NEP Semester-III
Course Code: MJ-MPP23-301
Paper title: SOLID STATE PHYSICS LAB –V
Total Credits: 4-credits

Laboratory/ Practical Course-SSP-V
(Solid State Physics Lab –V)

List of Experiments
Group I:

[1] Thin film deposition by SILAR method
[2] Thin film deposition by electro-deposition method
[3] Thin film deposition by hydrothermal method
[4] Thin film deposition by reflux method
[5] Thin film deposition by dip-coating method
[6] Thin film deposition by CBD method
[7] Microwave assisted synthesis of thin film
[8] Thin film deposition by spray pyrolysis method

Group II:

[9] Rietveld method of structure refinement
[10] Calculation of XRD peak positions and intensities
[11] Thickness measurement of thin film by transmittance spectroscopy
[12] Electrical resistivity of thin film by 2 probe method
[13] Thermoelectric power of thin film
[14] Contact angle measurement of thin film
[15] Determination of band gap energy of thin film
[16] Measurement of dielectric constant

M.Sc. (Physics) NEP Semester-III
Course Code: MJ-MPP23-302
Paper title: SOLID STATE PHYSICS LAB –VI
Total Credits: 4-credits

Laboratory/ Practical Course-SSP-VI

(Seminar & certified seminar report 1-credits +Tutorials on practical-1-credits)
Total Credits: 2-credits

M.Sc. (Physics) NEP Semester-III
Course Code: RP-MPT23-304
Paper title: Solid State Physics Project Work - I
Total Credits: 4-credits

Solid State Physics Project Work - I (4 credits)

Elective Paper

Sr. No.	Course Code	Paper Title
1	GE-MPT23-303	Thin solid films: Deposition and properties (4 credits)

M.Sc. (Physics) NEP-Semester-III
Course Code: GE-MPT23-303
Paper title: Thin solid films: Deposition and properties
Total Credits: 4-credits

(Solid State Physics- 3)
Thin solid films: Deposition and properties

Unit 1: Physical methods of thin film deposition (15)

Vacuum deposition apparatus: Vacuum systems, substrate deposition technology, substrate materials, Thermal Evaporation methods: Resistive heating, Flash evaporation, Arc evaporation, laser evaporation, electron bombardment heating, Sputtering: sputtering variants, glow discharge sputtering, Magnetic field assisted (Triode) sputtering, RF Sputtering, Ion beam sputtering, sputtering of multi- component materials.

Unit 2: Chemical methods (15)

Chemical vapor deposition: Common CVD reactions, Methods of film preparation, laser CVD, Photochemical CVD, Plasma enhanced CVD, Chemical bath deposition, Electro deposition, Spray pyrolysis, successive ionic layer adsorption reaction method (SILAR) method, Sol-gel method, Hydrothermal method.

Unit 3: Nucleation growth processes and thickness measurement (15)

Condensation process, Langmuir-Frenkel theory of condensation, Theory of nucleation and growth process, Thickness measurements: Electrical methods, Microbalance monitors, mechanical method, radiation absorption and radiation emission methods, optical interference methods: photometric method, spectrometric method, interference fringes, X-ray interference fringes.

Unit 4: Properties and characterization of thin films (15)

Mechanical properties of thin films: Introduction to elasticity, plasticity, and mechanical behavior, Electrical and magnetic properties of thin films, Optical properties of thin films, Structural characterization: X-ray diffraction, Scanning electron microscopy, Transmission electron spectroscopy, chemical characterization: X-ray Energy Dispersive Analysis (EDX), X-ray photoelectron spectroscopy (XPS).

Reference Books

1. Thin Film Phenomena by K L Chopra McGraw -Hill Book Company, NY 1969
2. The Materials Science of Thin Films by Milton Ohring, Academic Press, (1992)
3. Properties of Thin Films by Joy George, Marcel, and Decker, (1992)
4. Physics of Thin Films by Ludmila Eckertová, Springer (1986)
5. Thin Film Technology by O S Heavens, Methuen young books (1970)
6. Solid State Physics by N.W. Ashcroft, N. D. Mermin, Harcourt College Publishers (1976)
7. Chemical Solution Deposition of Semiconductor Films by G. Hodes, Marcel Dekker Inc. (2002)

M. Sc. - II
Semester - IV

M.Sc. (Physics) NEP Semester-IV
Course Code: MJ-MPT23-401
Paper title: Electrodynamics
Total Credits: 4 - credits

Electrodynamics

Unit - I: Maxwell's Equations and E.M. Waves: (15)

Maxwell's Equations: microscopic and macroscopic forms (revision), Maxwell's equations in free space, dielectrics and conductors, conservation of the bound charge and current densities (Equation of Continuity and Displacement Current), E.M. wave equations in waveguide of the arbitrary cross section: TE and TM modes; Transmission lines and wave guides, rectangular and circular waveguides , dielectric waveguide, resonant cavity. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction.

Unit - II: Time –Dependent Potentials and Fields: (15)

Scalar and vector potentials: coupled differential equations, Gauge transformations: Lorentz and Coulomb Gauges, Retarded Potentials, Lienard – Wiechert Potentials, Fields due to a charge in the arbitrary motion.

Unit - III: Radiation from Accelerated Charges and Radiation Reaction: (15)

Fields of charge in uniform motion, applications to linear and circular motions: cyclotron and Synchrotron radiations, Power radiated by point charge – Larmor's formula, Angular distribution of radiated power, Cerenkov radiation and Bremsstrahlung (qualitative treatments). Radiation Reaction: criteria for validity, Abraham –Lorentz formula, Physical basis of radiation reaction –self force.

Unit - IV: Electrodynamics and Relativity: (15)

Geometry of Relativity, the Lorentz Transformations, The Structure of Space time, Relativistic Mechanics, Proper Time and Proper Velocity, Relativistic Energy and Momentum, Relativistic Kinematics, Relativistic Dynamics, Relativistic Electrodynamics Field Tensor, Relativistic Potential. Four vectors and Tensors: covariance of the equation of Physics, Transformation of Electric field, Lorentz transformation as orthogonal Transformation in Fourier dimensions, Proper time and light cone, Relativistic Particle- Kinematics and dynamics, Covariant Lorentz force.

Reference books:

1) Introduction to Electrodynamics – D. J. Griffiths (Prentices- Hall 2002 (3rd edn)
2) Foundation of E.M. Theory- J. R. Reitz, F.J. Milford & R.W. Christy (Narosa Publication House 3rd edition 1993)
3) Classical Electrodynamics – J. D. Jackson (Wiley Eastern 2nd edition)
4) Classical Electrodynamics –S. P. Puri (Tata McGraw Hill 1990)
5) Electromagnetics - Laud B. B. - New Age International Private Limited; 3rd edition

M.Sc. (Physics) NEP Semester-IV
Course Code: MJ-MPT23-402
Paper title: Nuclear and Particle Physics
Total Credits: 4 - credits

Nuclear and Particle Physics

Unit-I Nucleon-Nucleon Interaction: **(15)**

Nature of the nuclear forces, form of nucleon-nucleon potential, Deuteron problem: The theory of ground state of deuteron, excited states of deuteron, n-p scattering at low energies (cross-section, phase shift analysis, scattering length, n-p scattering for square well potential, effective range theory); p-p scattering at low energies (cross-section, experiment and results) ; exchange forces, tensor forces; high energy N-N scattering (qualitative discussion only of n-p and p-p scatterings), charge-independence and charge-symmetry of nuclear forces.

Unit-II Nuclear Models: **(15)**

Evidences for shell structure, single-particle shell model, its validity and limitations, collective model: collective vibration and collective rotation, single particle motion in a deformed potential

Unit-III Nuclear Reactions: **(15)**

Elementary ideas of alpha, beta and gamma decays and their classifications, characteristics, selection rules and basic theoretical understanding. Nuclear reactions, reaction mechanism, Compound nucleus reaction (origin of the compound nucleus hypothesis, discrete resonances, continuum states), optical model of particle-induced nuclear reaction and direct reactions (experimental characteristics, direct inelastic scattering, and transfer reactions). Fission and fusion, Fission, and heavy ion reactions.

Unit-IV Particle Physics: (15)

Classification of fundamental forces. Classification of Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellman-Nishijima formula. Quark model, CPT invariance. Application of symmetry arguments to particle reactions, Parity non-conservation in weak interaction, Relativistic kinematics.

Reference Books:

1. Nuclear and Particle Physics- W.E. Burcham and M.Jobes, (Addison Wesley, Longman, England, 1995).
2. Introduction to Particle Physics- M.P. Khanna (Prentice Hall, India, 1999).
3. Concept of Nuclear Physics, B.L. Cohen, (Tata McGraw-Hill, 2005)
4. Nuclear Physics Principles and Applications, John Lilley, (John Wiley and Sons (Asia) 2001)
5. Nuclear physics – D. C. Tayal. (Himalaya Publishing House,1997)
6. Nuclear Physics- Iriving Kaplan (Narosa, Madras, 1989).
7. Introduction to High Energy Physics- Donald H.Perkins (Addison Wesley, Massachusetts, 1982).

Course Code: MJ-MPP23-401
Paper title: SOLID STATE PHYSICS LAB –VII
Total Credits: 4-credits

Laboratory/ Practical Course-SSP-VII
(Solid State Physics Lab –VII)

List of Experiments:

Group I:

[1] Particle size analysis by dynamic light scattering

[2] Photo electrochemical Solar Cell

[3] Characteristics of phototransistor and LDR

[4] Spectral response of solar cell

[5] Gas sensing properties of thin film

[6] I-V characteristics of solar panel

[7] Analysis of EIS spectrum

[8] I-V characteristics and solar cell parameters

Group II:

[9] Analysis of FT-IR and FT-IR spectra

[10] Cyclic Voltammetry and electro-chromism

[11] Super capacitive behaviour of MnO_2 sample

[12] Specific area by BET method

[13] Analysis of PL spectrum and calculation of life time of defects

[14] Analysis of TG-DTA pattern

[15] Analysis of XAFs pattern

M.Sc. (Physics) NEP Semester-IV
Course Code: RP-MPT23-404
Paper title: Solid State Physics Project Work - II
Total Credits: 4-credits

Solid State Physics Project Work - II **(6 credits)**

Semester-IV
Elective Paper

Sr. No.	Course Code	Paper Title
1	GE-MPT23-403	Physical Properties of solids (4-credits)

M.Sc. (Physics) NEP Semester-IV
Paper Code: GE-MPT23-403
Paper title: Physical properties of solid
Total Credits: 4-credits

(Solid State Physics - 4)
Physical properties of Solids

Unit 1: Electronic Structure of Crystals (15)

Basic assumptions of Model, Collision or relaxation times, DC electrical conductivity, Failures of the free electron model, The tight-binding method, Linear combinations of atomic orbitals, Application to bands from s-Levels, General features of Tight-binding levels, Wannier functions, Other methods for calculating band structure, Independent electron approximation, general features of valence band wave functions, Cellular method, Muffin Tin potentials, Augmented plane wave (APW) method, Green's function (KKR) method, Orthogonalized Plane Wave (OPW) method Pseudo potentials.

Unit 2: Transport Properties of Metals (15)

Drift velocity and relaxation time, The Boltzmann transport relation, The Sommerfeld theory of metals of electrical conductivity, The mean free path in metals, Thermal scattering, The electrical conductivity at low temperature, The thermal conductivity of metals, Dielectric Properties of insulators, Macroscopic electrostatic Maxwell equations, Theory of Local Field, Theory of polarizability, Clausius- Mossotti relation, Long- wavelength optical modes in Ionic crystals.

Unit 3: Phonons, Plasmons, Polaritons, and Polarons (15)

Vibrations of monatomic lattices: first Brillion zone, group velocity, Long wavelength limit, Lattice with two atoms per primitive cell. Quantization of lattice vibrations, Phonon momentum Dielectric function of the electron gas, Plasma optics, Dispersion relation for Electromagnetic waves, Transverse optical modes in a plasma, Longitudinal Plasma oscillations, Plasmons, Polaritons, LST relations, Electron-electron interaction, Electron phonon interaction: Polarons.

Unit 4: Defects in crystals (15)

Thermodynamics of point defects, Schottky and Frenkel defects, annealing, electrical conductivity of ionic crystals, color centers, Polarons and exciton, dislocations, strength of crystals, crystal growth, stacking faults and grain boundaries.

Reference Books:

1. Solid State Physics by N W Ashcroft and N D Mermin, HRW, International editions (1996) (Units 1, 2 and 3)
2. Introduction to Solid State Physics by C Kittle (4th edition) John Willey Publication (1979) (Units 3)
3. Solid State Physics by A J Dekker ((1986) Macmillan India Ltd