CH. RANBIR SINGH UNIVERSITY, JIND

Scheme of Examination and Syllabus for

Under-Graduate Programme

Subject: Physics (Semester 5th & 6th)

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24

Ch. Ranbir Singh University, Jind

Scheme and Syllabus of Examination for Undergraduate programme
Subject: PHYSICS
Under Multiple Entry-Exit, Internships and
CBCS-LOCF in accordance to NEP 2020
w.e.f. 2023-24 (in phased manner)

Semester	Course Type	Course Code	Nomenclature of paper	Credits	Contact hours	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs) T / P
5	CC-5 MCC-9	B23-PHY-501	Modern Physics	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
	MCC-10	B23-PHY-502	Nuclear Physics	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
	DSE-2	B23-PHY-503	Environmental Physics	4	4	30	70	100	3
		OR							
		B23-PHY-504	Non-Linear Dynamics	4	4	30	70	100	3
	DSE-3	B23-PHY-505	Instrumentation and Analytical Methods	4	4	30	70	100	3
		OR							
		B23-PHY-506	Renewable Energy and Energy Harvesting	4	4	30	70	100	3
6	CC-6/ MCC-11	B23-PHY-601	Electronics	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
	MCC-12	B23-PHY-602	Solid State Physics-1	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
	DSE-4	B23-PHY-603	Radiation Physics	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
		OR							
		B23-PHY-604	Thin Films and Characterization	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3

DSE-5	B23-PHY-605	Numerical Methods in Physics	3	3	20	50	70	3
		Practicum	1	2	10	20	30	3
	OR							
	B23-PHY-606	Applied Nuclear Techniques	3	3	20	50	70	3
		Practicum	1	2	10	20	30	3
CC-M6	B23-PHY-607	Basic Electronics	3	3	20	50	70	3
		Practicum	1	2	10	20	30	3

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: CC-5/MCC-9

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	5th		
Name of the Course	Modern Physics		
Course Code	B23-PHY-501		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 4th sem (B.Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the need for Quantum Mechanics, Heisenberg's uncertainty principle, time dependent and time independent Schrodinger equation, expectation values of position and momentum, particle confined in one dimensional box. 2. Familiar about the crystalline state, basis, crystal lattices, Reciprocal lattice to sc, bcc and fcc lattices. 3. Analyze the Hydrogen atom problem based on Sommerfeld theory, Vector Atom Model, LS&JJ coupling. 4. Familiar about various Nuclear Models, Magic Numbers, Classification of fundamental particles and Strange particles. 5. Learn to present observations, results, analysis and different concepts related to experiments of Quantum Mechanics and Solid State physics.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70	Time:3hrs

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Introductory Quantum Mechanics:** Need of Quantum Mechanics, Planck's quantum hypothesis and Black body Radiation (Qualitative only), photoelectric effect, Compton effect, de-Broglie hypothesis, de-Broglie wave, wave packet, phase and group velocities, Time-dependent and time-independent Schrodinger equations, Properties of wave function, particle confined in a one-dimensional infinite box: energy eigen functions and eigenvalues. Heisenberg's Uncertainty Principle (Qualitative Idea)	11
II	**Solid State Physics:** Crystalline state, crystal lattice, basis, lattice translation vectors, primitive and non-primitive unit cells, Bravais lattices in two and three dimensions, Miller Indices, crystallographic planes, interplanar spacing, simple crystal structures: NaCl, diffraction of waves by crystals, Bragg's law, Idea of Reciprocal Lattice.	11
III	**Atomic and Molecular Physics:** Bohr model, Sommerfeld theory (qualitative), Larmor's theorem (qualitative), Vector Atom Model, electron spin, space quantization, spin-orbit Interaction energy, LS and JJ coupling, Zeeman effect, Lande's g-factor.	11
IV	**Nuclear and Particle Physics:** Composition of nucleus, stability of nucleus, nuclear properties, nuclear size, spin, parity, magnetic moment, quadrupole moment, binding energy of nucleus, Semi- empirical Mass formula, classification of fundamental particles, Quark and Lepton, Hadrons, Baryons, Mesons, different types of nuclear interactions.	12

	Practicum 1. To determine the Planck's constant using photocell. 2. To determine the Hall Coefficient Using Hall Effect 3. To determine e/m by Thomson method. 4. To determine the ionization potential of mercury. 5. To study quantization of energy using Frank Hertz experiment. 6. To determine the wavelength of laser source using diffraction of double slits. 7. To determine diameter of wire using laser source. 8. To study the variation of resistivity with temperature of given semiconductor crystal using four probe method. 9. To find the unknown capacitance of a capacitor using De-Sauty's Bridge. 10. To find out the wavelengths of Hydrogen Spectrum. **Simulation based experiments (using any programming language)** 11. To verify the Bragg's law of diffraction. 12. To verify the Photoelectric effect. 13. To study the particle in one dimensional infinite box. 14. To study the binding energy and semi-empirical mass formula of atomic nucleus. 15. To verify the Larmor's theorem. **Note: Student will perform at least five experiments. The examiner will allot one practical at the time of end term examination.**	30
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.:**05 Marks** • Mid-Term Exam: **10 Marks** ➢ **Practicum (10 Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.:**10 Marks** • Mid-Term Exam: **Nil**		**End Term Examination : 50 Marks** **: 20 Marks**
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Pearson publishing
3. Quantum Mechanics: Theory and Applications by Ajoy Ghatak and S. Lokanathan (2019), (Extensively revised6th Edition), Laxmi Publications, New Delhi
4. Quantum Mechanics by Ishwar Singh Tyagi, Pearson publication
5. Introduction to solid state physics by C. Kittle, Wiley India
6. Solid state physics by H C Gupta, Vikas publishing house Ltd, New Delhi
7. Solid state physics by Puri & Babber, S. Chand & company, New Delhi
8. Concepts of Nuclear Physics by B L Cohen, Tata McGraw Hill Publication, 1974.
9. Nuclear Physics by D.C. Tayal, Himalaya publishing house
10. Atomic and Nuclear Physics by N. Subrahmanyam, S. Chand & company
11. Atomic & Molecular spectra by Raj Kumar, KedarNath Ram Nath, Meerut
12. Introduction to elementary particles by D. Griffiths
13. Elements ofSpectroscopyS.L.Gupta, V. Kumar and R.C.Sharma, PragatiPrakashan, Meerut.
14. Atomic and NuclearPhysics by S.N. Ghoshal, VolI (1996), S. Chand & Com., New Delhi
15. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
16. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: MCC-10

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	5th		
Name of the Course	Nuclear Physics		
Course Code	B23-PHY-502		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	MCC		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 4th sem (B.Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the Nuclear structure and general properties of nuclei. Determination of Nuclear size, mass and charge. Nuclear binding energy and nuclear stability. 2. Familiar about the different types of nuclear radiation decay and their energetic. What are the processes involved during the interaction of radiations with matter. 3. Understand the principle, construction, working and applications of different nuclear accelerators. Nuclear radiation detector; Types, Principle, construction and working involved to detect the nuclear radiations. 4. Acquire knowledge of different types of nuclear reaction, conservation laws and energetic of nuclear reaction. Nuclear reactor; design, classification and uses. 5. Learn to present observations, results, analysis and different concepts related to experiments of Nuclear Physics.		
Credits	Theory	Practical	Total
	3	1	4

Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks:70**		**Time:3hrs**	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Nuclear structure and general Properties of Nuclei:** Constituents of Nucleus; Nuclear composition (p-e and p-n hypotheses), Nuclear properties; Nuclear size, spin, parity, statistics, magnetic dipole moment, Electric quadruple moment (shape concept). Nuclear mass and its determination by Bain-Bridge, Bain-Bridge and Jordan mass spectrograph. Nuclear charge and its determination by Moseley Law. Determination of size of nucleus by Rutherford Back Scattering. Binding energy, Average binding energy and its variation with mass number, main features of binding energy versus mass number curve, systematic of nuclear binding energy, nuclear stability, stability region.	10
II	**Nuclear Radiation decay Processes:** (a) α-decay: Basics of α-decay process and quantum mechanical explanation of α-decay. Energetics of α-decay, (b) β-decay: β^- -decay, β^+ -decay, electron capture decay, β-energy spectrum, end point energy; Origin of continuous beta spectrum (neutrino hypothesis) and energetics of beta-decay. (c) γ-decay; γ-rays emission and energetics of γ- rays. **Nuclear Radiation Interaction**: Interaction of heavy charged particles (α- particles); Energy loss of heavy charged particle (idea of Bethe formula, no derivation), Range and straggling of α-particles. Geiger-Nuttal law. Interaction of light charged particle (β-particle), Energy loss of β-particles (ionization), Range of electrons, absorption of β-particles. Interaction of γ-Ray; Passage of γ-radiations through matter (Photoelectric, Compton and pair production effect) electron-positron annihilation. Absorption of γ-rays (Mass attenuation coefficient) and its application.	12
III	**Nuclear Accelerators**: Linear accelerators: Principle, construction, theory, working and types. Tandum accelerator; Principle, construction, working, advantages and limitations. Cyclotron: Principle, construction, theory, working and its limitations. Betatron: condition, Principle, construction,	11

	theory, working and comparison with a transformer. **Nuclear Radiation Detectors**: Gas filled detectors; Ionization chamber, proportional counter, G.M. Counter (detailed study), Basic principle of organic and inorganic Scintillation detectors for γ and electron radiation, photomultiplier tube and Semiconductor Detector (Basic idea).	
IV	**Nuclear Reactions:** Nuclear reactions, Elastic and Inelastic scattering, Nuclear disintegration, photonuclear reaction, radiative capture, direct reaction, heavy ion reactions and spallation reactions, conservation laws, Q-value and reaction threshold. **Nuclear Reactors**: Nuclear Reactors, General aspects of reactor design. Nuclear fission and fusion reactors, (Principle, construction, working and applications).	11
	Practicum 1. Determination of Characteristics of GM tube and its operating voltage, plateau length and slop. 2. Verification of inverse square law of radiation for a gamma source. 3. Investigation of statistical nature of nuclear radiation using G. M. Counter. 4. To study the beta counting efficiency of G. M. Counter. 5. Investigation of variation of Linear Absorption Coefficient of beta rays using a GM counter. 6. To study the half-life of radioactive element using G. M. Counter. 7. Resolving time of G. M. Counter set-up. 8. To study the characteristics of Ionization Chamber. **Note: Student will perform at least four experiments. The examiner will allot one practical at the time of end term examination.**	30
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **05 Marks** • Mid-Term Exam: **10 Marks** ➢ **Practicum (10 Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10 Marks** • Mid-Term Exam: **Nil**		**End Term Examination : 50 Marks** **: 20 Marks**
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

1. Kaplan I, Nuclear Physics, 2nd Ed (1962), Oxford and IBH, New Delhi
2. Sriram K, Nuclear Measurement Techniques, (1986), AEWP, New Delhi
3. Tayal D C, Nuclear Physics (1994), HPH, Bombay
4. Ghoshal S N, Atomic and Nuclear Physics Vol II (1994), S Chand & Co New Delhi
5. Srivastava B N, Basic Nuclear Physics, (1993), Pragati Prakashan Meerut
6. Halliday, Introductory Nuclear Physics, Asia Publishing House, New Delhi
7. Sood D D, Ready A V R and Ramamoorthy, Fundamentals of Radiochemistry, IANCAS (2007), BARC, Bombay
8. Cohen B L, Comcepts of Nuclear Physics (1998), Tata Mc Graw Hill, New Delhi
9. Krane K S, Introductory Nuclear Physics (1988), John Wiley & Sons New Delhi
10. Patel S B, Nuclear Physics (1992), Wiley Eastern Ltd, New Delhi
11. Roy R R and Nigam B P, Nuclear Physics (1993), Wiley Eastern Ltd New Delhi.
12. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
13. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: DSE-2

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	5th		
Name of the Course	Environmental Physics		
Course Code	B23-PHY-503		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 4th sem (B.Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Exhibit the knowledge of Basic atmospheric physics and Atmospheric thermodynamics. 2. Learn about the Environmental physics, Human environment, Air regulation in buildings, Thermal conduction effects. 3. Understand the Scope of Environmental Physics. 4. Learn about the Transport of Heat, Mass and Momentum and Radiant Energy.		
Credits	Theory	Tutorial	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks:70**		**Time:3hrs**	
Part B-Contents of the Course			
Instructions for Paper- Setter 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus.			

This question may have 4 parts and the answer should be in brief but not in Yes/No.

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Basic atmospheric physics:** Introduction to the Atmosphere, Composition and Structure: Description of Air, Stratification of Mass, Thermal and Dynamical Structure, Trace Constituent. Concept of Albedo, solar constant, Heat budget of the earth atmospheric system. **Atmospheric thermodynamics**: Air (excluding and including water), Water paths, Ideal gas law, Atmospheric composition, Hydrostatic balance, Constant vertical gradient of temperature, Conservation of energy (dry case, moist case), Entropy and potential temperature, Parcel concepts, lapse rate (dry and moist adiabatic), tephigram, Cloud formation.	14
II	**Environmental physics**: Definition, Physics in the environment: Human environment, Built environment, Urban environment, Global environment, Biological environment. **Human environment**: Introduction, Laws of Thermodynamics, Energy and metabolism, Thermodynamics laws and the human body, Second Law of Thermodynamics and the Gibbs free energy, Conduction, Convection, Radiation, Evaporation, Energy budget equation, Survival in the cold, Thermal comfort and insulation, Boundary layer, Wind chill, Hypothermia, Survival in hot climates, Effect of heat on the human body. **Built Environment:** Introduction, Thermal regulation in buildings, Thermal insulation, Thermal conduction effects, Convection effects, Radiation effects, U-values, Energy use in buildings, Air regulation in buildings, Ventilation requirements, Ventilation installations, Heat pumps, Water vapour, Humidity, Condensation in buildings.	17
III	**Scope of Environmental Physics:** Properties of Gases and Liquids-Gases and Water Vapor, Hydrostatic Equation, First Law of Thermodynamics, and Specific Heats, Latent Heat, Potential Temperature, Water Vapor and its Specification, Vapor Pressure, Dew-Point Temperature, Saturation Vapor Pressure Deficit, Mixing Ratio, Specific and Absolute Humidity, Virtual Temperature, Relative Humidity, Wet-Bulb Temperature. Liquid- Water Content and Potential, Liquid-Air Interfaces, Stable Isotopes.	14
IV	**Transport of Heat, Mass, and Momentum**: Transfer Equation, Molecular Transfer Processes, Momentum and Viscosity, Heat and Thermal Conductivity, Mass Transfer and Diffusivity, Diffusion Coefficients, Diffusion of Particles. **Transport of Radiant Energy:** Origin and Nature of Radiation-Absorption and Emission of Radiation, Full or Black Body Radiation, Wien's Law, Stefan's Law, Planck's Law, Quantum Unit, Radiative	15

	Exchange. Spatial Relations- Cosine Law for Emission and Absorption, Reflection, Radiance and Irradiance, Attenuation of a Parallel Beam.	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (30 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **10 Marks** • Mid-Term Exam: **15 Marks**	**End Term Examination : 70 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Fundamentals of Atmospheric Physics, Murry L. Salby, Publisher Elsevier
2. An Introduction to Atmospheric Physics 2nd Edition, David G. Andrews, Cambridge University Press
3. Introduction to environmental physics: Planet Earth, Life and climate, Nigel Mason and Peter Hughes, Taylor and Francis.
4. Principles of Environmental Physics Plants, Animals, and the Atmosphere (4th Edition), John Monteith and Mike Unsworth, Elsevier
5. Exercises in Environmental Physics, Valerio Faraoni, Springer

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: DSE-2

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	5th		
Name of the Course	**Non-Linear Dynamics**		
Course Code	B23-PHY-504		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 4thsem (B.Sc. Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the concept of dynamical systems. 2. Learn the concept of integrability and non-integrability of dynamical systems. 3. Understand the nonlinear Schrodinger equations, solitons and their solutions. 4. Learn the basic concepts of fluids, flow phenomenon and their dynamics.		
Credits	Theory	Practical	Total
	4	-	4
Contact Hours **Max. Marks:100** **Internal Assessment Marks:30** **End Term Exam Marks:70**	4	- **Time:3hrs**	4

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set

from each unit. Each question may contain two or more parts. All questions will carry equal marks.

4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Introduction to Nonlinearity**: Dynamical systems: Linear and nonlinear forces, Mathematical implications of nonlinearity, linear and nonlinear systems, linear superposition principle, definition of nonlinearity and its effects, Definition of a continuous first order dynamical system. The idea of phase space, flows and trajectories. Concept of stability and un-stability. Simple mechanical systems as first order dynamical systems: simple and damped harmonic oscillators	15
II	**Integrability**: Integrable and non-integrable dynamical systems, notion of integrability, complex integrability, symmetries and integrability: invariance condition, first integral of motion and its types, applications, A direct method to find first integral of motion	15
III	**Partial different equations & Solitons:** Linear and nonlinear differential equations, diffusive and dispersive; boundary value problems; methods of separation of variables, characteristics; inverse scattering; symbolic computation; similarity and Backlund transformations. Soliton theory: periodic, conoidal and solitary wave solutions of Korteweg-de Vries, Nonlinear Schrodinger and sine-Gordon equations; conserved densities.	15
IV	**Elementary Fluid Dynamics:** Importance of fluids: Fluids in the pure sciences, fluids in technology. Study of fluids: Theoretical approach, experimental fluid dynamics, computational fluid dynamics. Basic physics of fluids: The continuum hypothesis-concept of fluid element or fluid parcel; Definition of a fluid- shear stress; Fluid properties:-viscosity, thermal conductivity, mass diffusivity, other fluid properties and equation of state; Flow phenomena- flow dimensionality, steady and unsteady flows, uniform and non-uniform flows, viscous and inviscous flows, incompressible and compressible flows, laminar and turbulent flows, rotational and irrotational flows, separated and unseparated flows.	15

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination**
➢ **Theory (30 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **10 Marks** Mid-Term Exam: **15 Marks**	**70 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Nonlinear Dynamics: Integrability, Chaos and Pattern, M. Lakshmanan & S. Rajasekar, Springer
2. Nonlinear Dynamics and Chaos, Steven H. Strogatz, Levant Books, Kolkata, 2007
3. Understanding Nonlinear Dynamics, Daniel Kaplan and Leon Glass, Springer.
4. An Introduction to Fluid Dynamics, G.K. Batchelor, Cambridge Univ. Press, 2002
5. Classical and Quantum Mechanics of Noncentral Potentials: A survey of two-dimensional systems, R. S. Kaushal, Narosa Publishing House, New Delhi, 1998
6. Elementary Fluid Mechanics, Tsutomu Kambe (World Scientific, 2007)

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: DSE-3

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	5th		
Name of the Course	Instrumentation and Analytical Methods		
Course Code	B23-PHY-505		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 4th sem (B.Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Have knowledge about the errors in measurements. 2. Understand the basic instrumentation of electrical and electronic measurements. 3. Understand the principles and working of basic analytical instruments – CRO, frequency signal generator and pulse generators, 4. Have awareness about the spectroscopic instruments.		
Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks:70**		**Time: 3hrs**	
Part B-Contents of the Course			
Instructions for Paper- Setter 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus.			

This question may have 4 parts and the answer should be in brief but not in Yes/No.

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Basics of Measurement:** Least count of an instrument, instrument's accuracy, precision, sensitivity, resolution, significant figures, Errors in measurement-Gross errors and systematic errors, absolute errors and relative errors; Measurement error combinations-Sum of errors, difference of errors, product of errors, quotient of quantities and quantity raised to a power. **Statistical analysis of errors**: Arithmetic Mean value, deviation, standard deviation of mean, least square fitting, normal distribution, covariance and correlation, Binomial distribution, Poisson distribution and Chi square test.	15
II	**Electrical instrumentation:** AC bridges-Measurements of inductance by Maxwell's bridge, Measurement of capacitance and high resistance by De Sauty's bridge, measurement of mutual inductance by Carry Foster bridge **Signal generators:** Block diagram, explanation of low frequency signal generator, pulse generator and function generator	14
III	**Display devices:** Cathode Ray Oscilloscope: Block diagram of general purpose oscilloscope and its basic operation, Construction of CRT, electron gun, Electrostatic focusing and deflection, screen for CRT, Dual trace oscilloscopes, Front panel controls, Measurement of voltage, frequency and phase; Pulse measurements-Pulse amplitude, pulse width and space width; Display of device characteristics; Time based measurements LED: Construction and use of LED in display. Liquid crystal, types of liquid crystals. Basic principle of LCD and its construction, Comparison between LED and LCD.	16
IV	**Spectroscopic Instrumentation:** UV-visible spectrophotometer: Beer-Lambert law, absorptivity, UV and Visible absorption, Instrumentation, essential parts of spectrophotometer (double beam spectrophotometer), grating and prisms, radiant energy sources, filters, photosensitive detectors, photomultiplier tubes, relation between absorption in visible and UV region and molecular structure, applications of UV-visible spectroscopy. IR spectrophotometry: Fourier Transform Infrared (FTIR) spectrometer, Principle, working and applications.	15
Suggested Evaluation Methods		

Internal Assessment:	End Term Examination
➢ **Theory (30 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **10 Marks** • Mid-Term Exam: **15 Marks**	**70 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Theory of errors in Physical measurements by J C Pal, New Central Book Agency-2010.
2. Measurement, Instrumentation and Experimental Design in Physics and Engineering by Michael Sayer and Abhai Mansingh, PHI Learning Private Limited, Delhi, 2015.
3. Electronic Instrumentation and Measurements by David A. Bell, PHI Learning Private Limited, Delhi, 2nd edition 2010.
4. Handbook of Analytical Instruments by R.S. Khandpur, Tata McGraw-Hill, 3rd edition 2006.
5. Measurement and instrumentation Principles by Alan S Morris, Elsevier-2006.
6. Polymer characterization. Physical techniques- D. Campbell and J.R. White, Chapman and Hall.

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: DSE-3

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	5th		
Name of the Course	**Renewable Energy and Energy Harvesting**		
Course Code	B23-PHY-506		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 4thsem (B.Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the significance of renewable energy in addressing global energy challenges 2. Differentiate between various renewable energy sources and their applications 3. Analyze the environmental, social and economic implications of renewable energy adoption 4. Explain the mechanisms of renewable energy conversions.		
Credits	Theory	Practical	Total
	4	-	4
Contact Hours	4	-	4
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks:70**		**Time:3hrs**	
Part B- Contents of the Course			
Instructions for Paper- Setter 1. Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus.			

This question may have 4 parts and the answer should be in brief but not in Yes/No.

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Introduction to Renewable Energy:** Overview of renewable energy sources, Importance of renewable energy in sustainable development, Comparison between renewable and non-renewable energy sources, Basic principles of energy conversion in renewable energy systems, Environmental and economic benefits of renewable energy	15
II	**Solar Energy Harvesting:** Principles of solar energy conversion, Photovoltaic effect and solar cell technology, Types of solar panels and their efficiency, Solar thermal energy systems: principles and applications, Challenges and advancements in solar energy technology	15
III	**Wind Energy Conversion and Geothermal Energy:** Wind energy resources and distribution, Aerodynamics of wind turbine blades, Types of wind turbines and their applications, Power generation from wind energy, Wind energy integration into the electrical grid, Geothermal Energy and its sources, Geothermal power plants, its types and operation, Applications of geothermal heat pumps.	15
IV	**Biomass and Hydroelectric Energy:** Biomass as a renewable energy source, Biomass conversion technologies: combustion, gasification, and anaerobic digestion, Hydroelectric power generation: principles and types of hydroelectric plants, Environmental and social impacts of biomass and hydroelectric energy, Future trends and innovations in biomass and hydroelectric energy.	15

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination**
➢ **Theory (30 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **10 Marks** • Mid-Term Exam: **15 Marks**	**:70 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Renewable Energy: Power for a Sustainable Future by Godfrey Boyle, Oxford University Press, 3rd edition, 2012.
2. Introduction to Renewable Energy by Vaughn C. Nelson, CRC Press, 2016.
3. Renewable Energy: Sources for Fuels and Electricity by Thomas B. Johansson et al.,

Island Press, 1992.
4. Solar Engineering of Thermal Processes by John A. Duffie and William A. Beckman, John Wiley & Sons., 3rd edition, 2006.
5. Solar Electricity Handbook: A Simple, Practical Guide to Solar Energy by Michael Boxwell, Greenstream Publishing, 2023.
6. Wind Power: Renewable Energy for Home, Farm, and Business by Paul Gipe, Chelsea Green Publishing, 2004.
7. Introduction to Wind Energy: Renewable Energy and the Environment by John Twidell and Tony D. Weir, Taylor and Francis, 1986.
8. Wind Energy Handbook by Tony Burton et al., Wiley, 2011.
9. Biomass to Renewable Energy Processes by Jay Cheng, CRC Press, 2017.
10. Fundamentals of Geophysics by William Lowrie, Cambridge University Press, 2nd edition, 2012.

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: CC-6/MCC-11

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	6th		
Name of the Course	Electronics		
Course Code	B23-PHY-601		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 5thsem (B.Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the operation of pn junction, use of diode as Rectifier, voltage multiplier circuits, Zener Diode, Photo diode, solar cell, clipping and clamping circuits. 2. Familiar about Bipolar Junction Transistor, use of transistor as Amplifier in CB, CE and CC configurations. 3. Understand the concept of feedback in amplifiers, its types and effect of negative feedback on characteristics of amplifiers. 4. Analyze the operation of oscillators, classification of oscillators as LC oscillators, RC oscillators and crystal oscillators. 5. Learn to present observations, results, analysis and different concepts related to experiments of Electronics.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks:70**		**Time:3hrs**	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Semi-Conductor Diodes:** Semiconductors: Intrinsic and Extrinsic, p-n Junction diode and its V-I characteristics, Ideal Diode, Zener and Avalanche Breakdown, Zener Diode and its application as Voltage regulator, Photo-Diode, Light Emitting Diode, Solar Cell (Idea only). p-n Junction as Half Wave and Full Wave Rectifiers: Efficiency and Ripple Factor.	11
II	**The Bipolar Transistor:** The Bipolar Junction Transistor, Transistor Action and Working (PNP and NPN transistor), Transistor Circuit configurations: Common Base (CB), Common Emitter (CE) and Common Collector (CC) configurations, Current Amplification Factors (α, β and γ) and Relationship between them.	12
III	**Amplifiers:** CB, CC and CE amplifiers, Transistor Biasing: selection of operating point, Load line analysis and operating point. Methods of Transistor biasing and stabilization (Fixed Base Bias, Bias with emitter resistor and voltage divider circuit) **Multistage Transistor amplifiers:** RC Coupled amplifier (two-stage, concept of bandwidth, no derivation), Classification of amplifiers: Class A, B, AB and C amplifiers.	11
IV	**Oscillators:** Types of feedback, Oscillators, Damped and Undamped Oscillations, Oscillatory circuit, Principle of Oscillation, Condition for self-sustained oscillation: Barkhausen Criteria for sustained oscillations, LC oscillators: Tuned collector, Tuned Base, Hartley Oscillator, Colpitt's Oscillator.	11

	Practicum 1. To draw V-I characteristics of a semiconductor diode. 2. To study voltage regulation characteristics of Zener diode. 3. To verify inverse square law using photo cell. 4. To study characteristics of a solar cell. 5. To draw CB characteristics of a transistor and calculate transistor characteristics parameter. 6. To draw CE characteristics of a transistor and calculate transistor characteristics parameter. 7. Study of voltage doubler and tripler circuits. 8. Transistor as voltage amplifier in CB configuration. 9. Transistor as voltage amplifier in CE configuration. 10. Study of RC phase Shift Oscillator. **Note: Student will perform at least five experiments. The examiner will allot one practical at the time of end term examination.**	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.:**05 Marks** • Mid-Term Exam: **10 Marks** ➢ **Practicum (10 Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.:**10 Marks** • Mid-Term Exam: **Nil**	**End Term Examination : 50 Marks** **: 20 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS

1. Electronic Devices and circuit theory by Boylested
2. Integrated Electronics by Jacob Millman, C. Halkias
3. Basic Electronics by B.L.Threja
4. Basic Electronics and linear circuits by N.N. Bhargav
5. Electronic Fundamentals and Applications by J.D.Ryder
6. Electronics made simple by V.K.Mehta
7. Fundamentals of Analog Electronics by J.B.Gupta
8. Analog Electronics by A.K.Maini
9. A textbook on Analog Circuits by A. Rajkumar
10. Basics of Analog Electronics by D.Prasad, Mohd. Ashrof, Z. Haseeb
11. Electronics: Analog and Digital by B. Raychaudhuri
12. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
13. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course:MCC-12

Session: 2025-26	
Part A - Introduction	
Subject	Physics
Semester	6th
Name of the Course	Solid State Physics-I
Course Code	B23-PHY-602
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC
Level of the course (As per Annexure-I	300-399
Pre-requisite for the course (if any)	Appeared or passed the 5thsem (B.Sc Physical Science or equivalent)
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Have a brief idea about crystalline and amorphous materials, unit cell, primitive cell, miller indices, Bravais lattices and crystal structures of Zinc Sulphide, Sodium Chloride and Diamond. 2. Acquire knowledge about X-ray diffraction, Bragg's Law, experimental X-ray diffraction methods and about the reciprocal lattice to a simple cubic lattice, B.C.C. and F.C.C. lattice. 3. Understand about different types of bonding such as Vander wall's, Ionic, Covalent, hydrogen and Metallic bonding in crystals. 4. Analyze the concept of free electron gas model, density of states in one, two and three dimensions, Fermi energy, heat capacity of electron gas, Concept of thermal effective mass, Electrical conductivity and Ohm's law, Hall effect, and thermal conductivity of metals. 5. Learn about dielectric and ferroelectric properties of materials such as Polarization, Electric susceptibility, Polarizatibility, Complex Dielectric Constant, piezoelectric effect, pyroelectric effect, Ferroelectric effect, Curie-Weiss Law, PE Hysteresis

	loop.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks:70**		**Time:3hrs**	

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Crystal Structure-I:** Crystalline and glassy forms, liquid crystals, crystal structure, periodicity, lattice and basis, crystal translational vectors and axes. Unit cell and Primitive Cell, Winger Seitz primitive Cell, symmetry operations for a two-dimensional crystal, Bravais lattices in two and three dimensions. Crystal planes and Miller indices, Interplanar spacing, Crystal structures of Zinc Sulphide, Sodium Chloride and Diamond.	11
II	**Crystal Structure-II:** X-ray diffraction, Bragg's Law and experimental X-ray diffraction methods. K-space and reciprocal lattice and its physical significance, reciprocal lattice vectors, reciprocal lattice to a simple cubic lattice, bcc and fcc lattices. **Bonding in Crystals:** Vander Waal's bonding, Ionic bonding, Covalent bonding, example of hydrogen molecule, hydrogen bonding, Metallic bonding.	11
III	**Electronic Properties of Metallic Solids:** Free electron gas model, Energy levels and density of states in one, two and three dimensions, Fermi momentum, Fermi energy, Fermi temperature, Effect of temperature, heat capacity of electron gas (explicit calculation), Experimental heat capacity of metals, Concept of thermal effective mass, Electrical conductivity and Ohm's law, Experimental resistivity of metals, Matthiessen's rule, Motion in magnetic fields and Hall effect, Thermal conductivity of metals and Wiedmann-Franz law.	12

IV	**Dielectric Properties of Materials:** Polarization, Local electric field at an atom, Depolarization field, Electric susceptibility, Polarizatibility, Clasusius Mosotti equation, Classical theory of polarizability, Normal and Anomalous dispersion, Cauchy and Sellmeir relations, Langevin-Debye equation, Complex Dielectric Constant. **Ferroelectric properties of Materials:** Classification of crystals, piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electro strictive effect, Curie-Weiss Law, Ferroelectric domains, PE Hysteresis loop.	12
	Practicum 1. To determine Hall coefficient and mobility of a given semiconductor. 2. To measure the resistivity of a semiconductor (Ge) with temperature (up to 150^0 C) by four probe method. 3. To determine conductivity of given semiconductor crystal using four probe method. 4. To measure the magnetic susceptibility of Solids. 5. To measure the Coupling Coefficient of a piezoelectric crystal. 6. To measure the dielectric constant of a dielectric material with frequency. 7. To study the PE Hysteresis loop of a Ferroelectric crystal. 8. To determine the dielectric constant of paper. 9. To find the polarizability of a dielectric substance. 10. To determine the dielectric constant by charging and discharging of parallel plate capacitor. **Note: Student will perform at least five experiments. The examiner will allot one practical at the time of end term examination.**	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.:**05 Marks** • Mid-Term Exam: **10 Marks** ➢ **Practicum (10 Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.:**10 Marks** • Mid-Term Exam: **Nil**	**End Term Examination : 50 Marks** **: 20 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Solid State Physics by S. O. Pillai, New Age International Publisher, New Delhi.
2. Introduction to Solid State Physics by C. Kittel, Wiley India Pvt. Ltd.
3. Solid State Physics by R. K. Puri, V.K. Babbar, S. Chand & Co. New Delhi.
4. The Physics of Solids by Richard Turton, Oxford University Press.
5. Solid State Physics by Ashcroft and Mermin, Saunders college publshing.
6. Elements of Solid State Physics by M.N. Rudden, J. Wilson, Willey Blackwell Publishing.

7. Solid State Physics by A.J. Dekker, Luxmi Publicaions Solid State Physics: Essential Concepts by D.W. Snoke
8. Essentials of Solid State physics by S.P.Kuila, New Central Book Agency.
9. Introductory Solid State Physics By H.P.Myres, CRC Press.
10. Solid State Physics by Vimal Kumar Jain, Springer Nature Switzerland Ag.
11. Fundamentals of Solid State physics by Saxena, Gupta, Pragati Prakashan Meerut.
12. Advanced practical Book for students, B. L. Flint and H. T. Wornsop, 1971, Asia Publishing House.
13. A text book of practical physics, I. Prakash & Ramakrishna, 11th edition., 2011 Kitab Mahal.
14. Elements of Solid-State Physics, J. P. Srivastava, 2nd Ed., 2006, Prentice Hall of India.
15. B.Sc Practical Physics, C. L. Arora, R Chand & Co. New Delhi

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: DSE-4

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	6th		
Name of the Course	Radiation Physics		
Course Code	B23-PHY-603		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 5th sem (B.Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand and explain radiation quantities and units 2. Analyze and have better understanding of biological effects of radiation 3. Have knowledge about the principles of Radiological Protection. 4. Have awareness about the radiation hazards' types, their control and radiation emergency and preparedness. 5. Familiar with different techniques of detection of nuclear radiations.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks:70**		**Time: 3hrs**	
Part B-Contents of the Course			

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Sources of Radiations:** Sources of radiations: natural and artificial, Alpha, Beta and Gamma radiations, their origin and energetics, X-rays: Characteristic X-rays, Bremsstrahlung (continuous) X-rays, X ray targets, and Clinical X ray beams; Cosmic rays: Discovery, Nature of a cosmic rays, soft and hard component, and Geometric effects on cosmic rays; Terrestrial radiations: Radon gas and Radioactive isotopes of lighter elements, Radiation quantities and units: Activity, KERMA, Exposure, Dose, Equivalent Dose, Effective Dose, Annual Limit on Intake (ALI), and Derived Air Concentration (DAC)	10
II	**Biological Effects of Ionizing Radiations:** Introduction, Cell Biology: Structure and function of living cell, cell division-mitosis, meiosis and differentiation, central dogma of molecular biology, genetic codes-DNA, RNA and Proteins; Effect of Radiations on Cell: inhibition of cell division, chromosome aberrations, genes mutation, and cell death; Biological effects of Radiations on Human: Somatic Effects (Early effect) and Stochastic effect (Late effect).	12
III	**Principles of Radiological Protection:** Justification of Practice, Optimization of Practice, and Dose Limitations; Internal Exposure, Dose Limit for (i) Radiation Workers (ii) Public, Occupational Exposure of Women, Apprentices and Students. Production of Radioisotopes and Labeled Compounds: Introduction, Separation of Isotopes, Production of labeled compounds, Specific Activity of labeled compounds, Storage, Quality, and Purity of Radio-labeled compounds.	12
IV	**Radiation Hazards**: Internal and External Hazards; Evaluation and Control of Radiation Hazards, Radiation Shield, Monitoring of External Radiation, Control of Internal Hazard: (i) Containment of Source (ii) Control of Environment (iii) Contamination (iv) Air Contamination Monitoring (v) Personal Contamination Monitoring (vi) Decontamination Procedures; Radiation Emergency and Preparedness.	11

	Practicum 1. To study the measurement of Background Radiation using G. M. Counter. 2. To study the detection of alpha, beta and gamma radiations using G. M. Counter. 3. Capturing and Detection of Radon in the Environment using G. M. Counter. 4. Detecting low level radioactivity in food using G. M. Counter. 5. To test the soil for harmful amounts of radiation inside and outside your institute using G. M. Counter. 6. To assess radiation levels in the environment. 7. Radiation detection in the scrap metal industry. 8. To identify radioactive rocks and minerals. 9. Radiation Dose mapping in the given area using Radiation Servey meter. **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **05 Marks** • Mid-Term Exam: **10 Marks** ➢ **Practicum (10 Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10 Marks** • Mid-Term Exam: **Nil**	**End Term Examination : 50 Marks** **: 20 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Radiation Oncology Physics: A handbook for teachers and students; International Atomic Energy Agency, Vienna, 2005.
2. Practical knowledge for Handling Radioactive Sources by Claus Grupen.
3. Introduction to Radiological Physics and Radiation Dosimetry by Frank Herbert Attlx.
4. Radiation Biology: A handbook for teachers and students; International Atomic Energy Agency, Vienna, 2010.
5. Measurement, Instrumentation and Experimental Design in Physics and Engineering, M. Sayer and A. Mansingh (Prentice Hall India, 2010).
6. Radiation Detection and Measurement, G. F. Knoll (John Wiley & Sons, Inc. 3rd Ed.,2000)
7. Physics & Engineering of Radiation Detection, S. N. Ahmed (Academic Press 2007)
8. Techniques for Nuclear and Particle Physics Experiments, W.R. Leo (Springer- Verlag 1987)
9. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
10. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: DSE-4

<table>
<tr><td colspan="4">Session: 2025-26</td></tr>
<tr><td colspan="4">Part A - Introduction</td></tr>
<tr><td>Subject</td><td colspan="3">Physics</td></tr>
<tr><td>Semester</td><td colspan="3">6th</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Thin Films and Characterization</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-PHY-604</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)</td><td colspan="3">DSE</td></tr>
<tr><td>Level of the course (As per Annexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3">Appeared or passed the 5th sem (B.Sc Physical Science or equivalent)</td></tr>
<tr><td>Course Learning Outcomes (CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Familiar about the Thin Film deposition technology and various deposition techniques used for fabrication of thin films.
2. Understand the basic process of growth of thin films on a substrate and how to monitor and calculate the thickness of the film.
3. Familiar about the various characterization tools used for the study of optical, structural and morphological properties of thin films.
4. Acquire knowledge of working principle of basic elements used in thin film deposition technology.
5. Learn to present observations, results, analysis and different concepts related to experiments of fabrication and characterization of thin films.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td colspan="2">Max. Marks:100
Internal Assessment Marks:30
End Term Exam Marks:70</td><td colspan="2">Time:3hrs</td></tr>
</table>

Part B-Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Thin Film Deposition Technology:** Physical Deposition Processes: Introduction, Schematic diagram and working process of (a) Vacuum Evaporation (b) Thermal Evaporation by Resistive heating; Flash evaporation; Arc Evaporation; Exploding wire technique; Laser Evaporation; Electron Beam Evaporation. Chemical Deposition Processes: Introduction, Schematic diagram and working process of (a) Electro Deposition; Electrolytic Deposition; Electroless Deposition; Chemical Vapour Deposition (CVD); Anodic oxidation.	12
II	**Thin Film Deposition Cathodic Sputtering Technology:** Introduction, The Sputtering Yield; Glow-discharge sputtering, Pressure, Deposit Distribution Current and Voltage Dependence, Cathode, Contamination Problem, Deposition Control, Sputtering Variants, Low-pressure Sputtering: RF Sputtering, Ion Beam Sputtering, Reactive Sputtering, Ion Beam Sputtering, Reactive Sputtering.	10
III	**Film Thickness: Thin Film, Foil and Sheet:** Basic introduction, range of their thickness and difference between these three. **Monitoring Processes:** Introduction, schematic diagram and working process of Optical Monitoring, Quartz Crystal monitoring system. **Thin Film Characterization Techniques:** Introduction and measurement of Film thickness by Interference method. Optical Constants: Measurement of Intensity of light as a function of wavelength by Spectrophotometer; Determination of refractive index, absorption coefficient and thickness of thin film by Ellipsometry; Absorption measurement by Calorimetry. Crystalline structure and morphological properties of thin films. Electrical conduction, Defects, Hardness, Humidity and Temperature testing,	11
IV	**Basic Elements of Vacuum Technology:** Vacuum: Basic Concept, different levels of vacuum and terms used in vacuum technology. Atmosphere and how atmospheric pressure is created. Basic concept and measure of Gas Pressure. Brief history of vacuum its requirement and applications in science and technology. **Vacuum Pumps:** Basic principles and processes for production of vacuum. Construction, working, advantages and disadvantages of Rotary, Roots, Diffusion and Turbo molecular Pumps.	12

	Vacuum Measuring Gauges: Introduction construction and working of different types of vacuum measuring Gauges: (a) Direct Measuring Gauges; Bourdon Vacuum Gauge, Mercury Manometer, Macleod Gauge (b) Indirect Measuring Gauges; Thermal Conductivity Gauge, Thermocouple Gauge, Pirani Gaug, Leak detection.	
	Practicum 1. Determination of thickness of a thin film optically. 2. Determination of electrical conductivity of a thin film. 3. Study of surface roughness of a thin film by optical microscope. 4. To measure the I-V characteristics of a thin film. 5. To calculate the sheet resistance of thin films of different thickness and compare the results. 6. Determination of thickness of a given sheet or foil using G M Counter. 7. Study of grain size in the surface of a polycrystalline thin film by optical microscope. 8. To study the thin film interference and to find out its thickness. **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **05 Marks** • Mid-Term Exam: **10 Marks** ➢ **Practicum (10 Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10 Marks** • Mid-Term Exam: **Nil**	**End Term Examination: 50 Marks** **: 20 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Thin Film Phenomena - Kasturi L. Chopra, McGraw Hill Book Company.
2. Nuclear Measurement Techniques, K. Sriram, (1986), AEWP, New Delhi
3. Hand Book of Thin Film Technology - Leon
4. Handbook of Analytical Instrumentation - R.S. Khandpur
5. Vacuum Science and Technology - A. Roth.
6. Thin Film technology –A Layman's Perception, V.V. Shah, A. Basu, Vigyan Prasar(An Autonomous Organisation Under the DST, Govt. of India
7. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
8. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: DSE-5

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	6th		
Name of the Course	**Numerical Methods in Physics**		
Course Code	B23-PHY-605		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 5th sem (B.Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand different type of errors, their propagation, and to minimize errors while writing a program. 2. Solve a set of simultaneous linear algebraic equations numerically and able to find numerically the eigenvalues and eigenvectors of matrices using polynomial and power methods. 3. Solve numerical problems involving interpolation and/or extrapolation using different methods. 4. Solve ordinary and partial differential equations using numerical methods. 5. Understand how to develop a programme for a particular problem and it will improve logical thinking that helps to solve scientific problems using Python language.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours **Max. Marks:100** **Internal Assessment Marks:30** **End Term Exam Marks:70**	3	2 **Time:3hrs**	5
Part B-Contents of the Course			

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Errors and Solutions of Algebraic Equations:** Round off error, Truncation error, Machine error, Random error, Propagation of errors. Loss of Significance: Significant Digits, Computer caused loss of significance, Avoiding loss of significance in subtraction. Solutions of algebraic equations: Bisection method, Iteration method, Method of false position, Newton-Raphson method, Convergence conditions, Muller's method, Secant Method.	12
II	**Systems of Linear Equations and Eigenvalue Problem:** Solutions of simultaneous linear algebraic equations: Gauss elimination method, Gauss Jordan elimination method, Doolittle method, Matrix inversion method, Ill-conditioned matrix and error correction, Jacobi Method, Gauss Seidel iterative method, Matrix eigenvalues and eigenvectors: Polynomial method, Power method.	11
III	**Interpolation and Curve fitting:** Interpolation and Extrapolation: Finite differences, Forward differences, Backward differences, Central differences, Newton's formula for interpolation, Gauss central difference formula, Stirling's formula, Bessel's formula, Lagrange's interpolation formula, error of interpolation, Least square curve fitting: The principle of least square fitting, Linear regression, Polynomial regression, Fitting exponential and trigonometric functions, Data fitting with cubic splines, Data fitting using Gnuplot.	11
IV	**Solutions of ordinary differential equations:** Numerical solution of ordinary differential equations: Single step method, multi-step method, Taylor's series method, Euler's method, Modified Euler's method, Fourth-order Runge Kutta method, Cubic splines method; Second order differential equations: Initial and boundary value problems.	11
	Practicum 1. Least Square fitting (Linear). 2. Least square fitting (polynomial) 3. Least square fitting (exponential function) 4. Solution of Simultaneous Linear Algebraic equations by Gauss-Jordan elimination method.	

	5. To find roots of an equation of degree 1, 2 and 3 by using Bisection method. 6. Numerical Integration using Gauss quadrature methods for one and two-dimensional integrals. 7. Solution of second-order differential equation using Runge-Kutta method. 8. Finding eigenvalues and eigenvectors of square matrices. 9. To solve differential equations by Euler's method. 10. Interpolation and extrapolation using Bessel's formula. **Note: Student will perform at least five experiments. The examiner will allot one practical at the time of end term examination.**	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **05 Marks** • Mid-Term Exam: **10 Marks** ➢ **Practicum (10 Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10 Marks** Mid-Term Exam: **Nil**	**End Term Examination : 50 Marks** **: 20 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. R C Desai, Fortran Programming and Numerical methods, Tata McGraw Hill, New Delhi.
2. P B Patil and U. P. Verma, Numercal Computational Methods, Narosa Publishing House
3. S S Sastry Introductory methods of numerical Analysis, Prentice Hall of India Pvt. Ltd.
4. R C Verma, P K Ahluwalia and K C Sharma, Computational Physics an Introduction, New Age International Publisher.
5. C Balachandra Rao and C K Santha, Numerical Methods, University Press
6. K E Atkinson, An introduction to numerical analysis, John Wiley and Son

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: DSE-5

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	6th		
Name of the Course	Applied Nuclear Techniques		
Course Code	B23-PHY-606		
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 5th sem (B.Sc Physical Science or equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the basic principles of working and applications of various Particle Accelerators, Synchrotron and Synchrocyclotrons. 2. Familiar about the Proton induced X-ray Emission spectroscopy for elemental analysis and its variety of applications in various field of science and technology. 3. Acquire knowledge of working principle of X-ray Fluorescence spectroscopy and its application in material research and industry. 4. Familiar about the basic principle of Neutron Activation analysis and possible applications in Material Science, Chemistry, Biology, radiation assessment, mineral exploration, Medical and Forensic Science 5. Learn to present observations, results, analysis of spectra recorded using different nuclear techniques.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100 Internal Assessment Marks:30 End Term Exam Marks:70	Time:3hrs

Part B –Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Particle Accelerators**: Basic principle, construction, working, advantages and limitations of Van-de-Graff, Basic principle, construction, Theory, working, advantages and Relativistic limitation of Cyclotron. Magnetic Resonance Accelerator. Synchrotrons: Electron synchrotron, Proton synchrotron. Basic principle, construction, theory, advantages and limitations of Synchrocyclotrons. Medical applications of accelerators, Mega volt therapy.	12
II	**Nuclear Spectroscopy Technique:** Charged Particle Induced X-ray Emission (PIXE) spectrometry: Basic Principle, X-ray production process, Radiative and Non-radiative transitions, Coster Krönig transitions, continuous background, Brenmsstrahlung, PIXE set-up, Instrumentation, Qualitative analysis: Energy calibration, comparison with standard. Quantitative analysis: Absolute method, Relative method, Relationship between X-ray intensities and concentrations, Limits of detection, Application of PIXE in air and water pollution industries.	12
III	**X-rays Fluorescence Spectrometry (XRF)**: Nature and origin of X-rays, characteristic X-rays, notation for spectrum, Continuous spectra, Duane - Hunt Law, Relationship between X-rays emission and atomic number, Sources of X-rays: X-ray tube, Function and requirements, Radioisotope source, XRF spectrometer, wave length dispersive devices, Energy dispersive devices, pulse height selection. Application of XRF in various fields, Advantages and disadvantages of XRF.	10
IV	**Neutron Activation Analysis (NAA)**: Introduction, Theory of activation method, Neutron energy distribution, Classification of neutron activation methods: Prompt γ -ray neutron activation, Delay γ-ray neutron activation. Instrumental NAA. Analysis of the gamma spectra, Applications: NAA for semiconductor materials, Soil science, Geological science, Accuracy and sensitivity of NAA.	11

	Practicum 1. Radiation dose measurement. 2. To verify Inverse square law for gamma rays using given radioactive source 3. Qualitative Analysis of recorded PIXE spectra for chemical composition of air. 4. Qualitative Analysis of recorded PIXE spectra for chemical composition of water. 5. Estimation of weight percentage of elements present in a synthesized sample using XRF spectra. 6. Determination of trace elements concentration in the bulk of sample using Neutron Activation Analysis. 7. Measurement of different X-rays energies emitted from a sample using recorded XRF spectra. 8. Determination of elemental composition in the bulk of sample using Neutron Activation Analysis. **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **05 Marks** • Mid-Term Exam: **10 Marks** ➢ **Practicum (10 Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10 Marks** • Mid-Term Exam: **Nil**	**End Term Examination :50 Marks** **: 20 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Introduction to Nuclear and Particle Physics, V.K. Mittal, R.C. Verma, S.C. Gupta, PHI Learning Private Limited, New Delhi.
2. Instrumental methods of Analysis - Hobart H. Willard, et al. 7thedition, CBS Publishers.
3. Handbook of Analytical Instrumentation – R.S. Khandpur.
4. Principles of Instrumental Analysis, Douglas A Skoog et al. Saunders Golden Sunbrust Series.
5. Particle Induced X-ray Emission spectroscopy, Sten A.E. Johnson et al. John Willey & Sons, New York.
6. Principles and Practice of X-ray spectroscopy - Eugene, Bertin Plenum Press.
7. An Introduction to X-ray Spectrometer, R. JenKins, Heydon London Publication.
8. Neutron Activation Analysis - D. De Soete et al. Johan Wiley and Sons.

9. Activation Analysis: Vol. I and II - Z.B. Alfarsi, CRC Press.
10. X-rays in Atomic and Nuclear Physics, N.A. Dyson, Cambridge University Press, New York.
11. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
12. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House

Ch. Ranbir Singh University, Jind
Undergraduate Programs
Course: CC-M6

Session: 2025-26			
Part A - Introduction			
Subject	Physics		
Semester	6th		
Name of the Course	Basic Electronics		
Course Code	B23-PHY-607		
Course Type: (CC/MCC/MDC/CC-M/ DSEC/VOC/DSE/PC/AEC/VAC)	CC-M		
Level of the course (As per Annexure-I	300-399		
Pre-requisite for the course (if any)	Appeared or passed the 3rd sem with physics as minor subject		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the operation of p-n junction, use of diode as Rectifier, voltage multiplier circuits, Zener Diode, Photo diode, solar cell, clipping and clamping circuits. 2. Familiar about Bipolar Junction Transistor, use of transistor as Amplifier in CB, CE and CC configurations. 3. Understand the concept of feedback in amplifiers, its types and effect of negative feedback on characteristics of amplifiers. 4. Analyze the operation of LC oscillators and CRO. 5. Learn to present observations, results, analysis and different concepts related to experiments of Electronics.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks:70**		**Time:3hrs**	
Part B-Contents of the Course			

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus.

This question may have 4 parts and the answer should be in brief but not in Yes/No.

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Semiconductors:** Energy bands in solids, Intrinsic and extrinsic semiconductors, carrier mobility and electrical resistivity of semiconductors, Hall effect, p-n junction diode and their characteristics, Zener and Avalanche breakdown, Zener diode, Zener diode as a voltage regulator. Light emitting diodes (LED), Photoconduction in semiconductors, Photodiode, Solar Cell, p-n junction as a rectifier, half wave and full wave rectifiers (with derivation), filters (series inductor, shunt capacitance, L-section or choke, π and R.C. filter circuits).	12
II	**Transistors:** Junction transistors, Working of NPN and PNP transistors, Three configurations of transistor (C-B, C-E, C-C modes) and their V-I characteristics, transistor parameters and their relation, Advantages and disadvantages of C-E configuration, D.C. load line. Transistor biasing; various methods of transistor biasing and stabilization.	11
III	**Transistor Amplifiers:** Amplifiers, Classification of amplifiers, common base and common emitter amplifiers, coupling of amplifiers, various methods of coupling, Resistance- Capacitance (RC) coupled amplifier (two stage, concept of band width, no derivation), Feedback in amplifiers, advantages of negative feedback, emitter follower, amplifier, Noise in amplifiers.	11
IV	**Oscillators:** Damped and Undamped Oscillations, Oscillatory circuit, Principle of Oscillation, Barkhausen Criteria for sustained oscillations, Classification of oscillators: LC oscillator, Tuned collector oscillator, Tuned base oscillator, Hartley Oscillator, Colpitts's oscillator, CRO: Principle, construction and working.	11
	Practicum 1. To draw forward and reverse bias characteristics of a semiconductor diode. 2. To study the Zener diode voltage regulation characteristics. 3. To verify inverse square law using photo cell. 4. To study characteristics of a solar cell. 5. To draw common base characteristics of a transistor and calculate transistor characteristics parameters. 6. To draw common emitter characteristics of a transistor and calculate transistor characteristics parameters. 7. Transistor as voltage amplifier in CB configuration. 8. Transistor as voltage amplifier in CE configuration. **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	30
	Suggested Evaluation Methods	

Internal Assessment:	End Term Examination: 50 Marks
➢ **Theory (20 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.:**05 Marks** • Mid-Term Exam: **10 Marks** ➢ **Practicum (10 Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.:**10 Marks** • Mid-Term Exam: **Nil**	**: 20 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS

1. Electronic Devices and circuit theory by Boylested
2. Integrated Electronics by Jacob Millman, C. Halkias
3. Basic Electronics by B.L.Threja
4. Basic Electronics and linear circuits by N.N. Bhargav
5. Electronic Fundamentals and Applications by J.D.Ryder
6. Electronics made simple by V.K.Mehta
7. Fundamentals of Analog Electronics by J.B.Gupta
8. Analog Electronics by A.K.Maini
9. A textbook on Analog Circuits by A. Rajkumar
10. Basics of Analog Electronics by D.Prasad, Mohd. Ashrof, Z. Haseeb
11. Electronics: Analog and Digital by B. Raychaudhuri