Dr. N.G.P. ARTS AND SCIENCE COLLEGE (Autonomous)

REGULATIONS 2024-25 for Post Graduate Programme
(Outcome Based Education model with Choice Based Credit System)

M.Sc. Degree

(For the students admitted during the academic year 2025-26 and onwards)

Programme: M.Sc. Physics

Eligibility:

A pass in the course of B.Sc. Degree Examination with Physics as Major and Mathematics and Chemistry as Ancillary subjects, or an examination accepted as equivalent there to accept by the academic council.

Programme Educational Objectives:

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To produce graduates with advanced knowledge in Physics and requisite skills, in order to use their knowledge in Physics in a wide range of practical applications.
2. To develop creative thinking and the power of imagination to enable graduates work in research in academia and industry for broader applications.
3. To relate the training of Physics graduates to the employment opportunities within the country.
4. To promote societal values through Physics related activities.

PROGRAMME OUTCOMES:

On the successful completion of the program, the following are the expected outcomes.

PO Number	PO Statement
PO1	Apply theoretical knowledge of principles and concepts of Physicsto practical problems.
PO2	Develop skills in planning and carrying out advanced physics experiments.
PO3	Solve scientific problems by applying a combination of theory,numerical simulation, and experiments.
PO4	Relate critically to scientific models.
PO5	Examining specific phenomena theoretically and experimentally, to contribute to the generation of new scientific insights or to the innovation of new applications of physics research.

PG Credit Distribution:

Part	Subjects	No. of Papers	Credit	Semester No.
III	Core	14 06	Theory: 11 x 04 =44 02 x 03 = 06 Practical: 06 x 02= 12	I-IV
	Elective	04	04 x 04 =16	I-IV
	EDC	01	01 x 04 =04	II
	Industrial Training		02	III
	Project Work	01	01 x 08 =08	IV
TOTAL CREDITS			**92**	-

PG CURRICULUM
M.Sc. Physics: AY 25 - 26

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
First Semester												
25PYP1CA	Core- I	Mathematical Physics	4	1	-	5	60	3	25	75	100	4
25PYP1CB	Core- II	Thermodynamics and Statistical Mechanics	4	1	-	5	60	3	25	75	100	4
25PYP1CC	Core- III	Classical Mechanics	4	-	-	4	48	3	25	75	100	4
25PYP1CD	Core- IV	Electronics	4	-	-	4	48	3	25	75	100	4
25PYP1CP	Core Practical - I	Thermodynamics and Optics	-	-	4	4	48	4	40	60	100	2
25PYP1CQ	Core Practical -II	Electronics -I	-	-	4	4	48	4	40	60	100	2
25PYP1DA	DSE -I	Energy Physics	4			4	48	3	25	75	100	4
25PYP1DB		Materials Physics and Processing Techniques										
25PYP1DC		Laser Physics and Nonlinear Optics										
		Total	20	2	8	30	360	-	-	-	700	24

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Second Semester												
25PYP2CA	Core - V	Spectroscopy	4	-	-	4	48	3	25	75	100	4
25PYP2CB	Core - VI	Solid State Physics	4	1	-	5	60	3	25	75	100	4
25PYP2CC	Core - VII	Quantum Mechanics-I	4	1	-	5	60	3	25	75	100	4
25PYP2CP	Core Practical - III	Solid State and Spectroscopy	-	-	4	4	48	4	40	60	100	2
25PYP2CQ	Core Practical - IV	Electronics-II	-	-	4	4	48	4	40	60	100	2
24MTP2EA	EDC	Numerical Methods	4	-	-	4	48	3	25	75	100	4
25PYP2DA	DSE -II	Physics of Nanomaterials	4	-	-	4	48	3	25	75	100	4
25PYP2DB		Experimental Design										
25PYP2DC		Medical Physics										
		Total	**20**	**2**	**8**	**30**	**360**	**-**	**-**	**-**	**700**	**24**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Third Semester												
25PYP3CA	Core -VIII	Quantum Mechanics- II	4	1	-	5	60	3	25	75	100	4
25PYP3CB	Core - IX	Electromagnetic Theory	4	1	-	5	60	3	25	75	100	4
25PYP3CC	Core - X	Condensed Matter Physics	3	1	-	4	48	3	25	75	100	3
25PYP3CD	Core - XI	Microprocessors and Microcontroller	3	1	-	4	48	3	25	75	100	3
25PYP3CP	Core Practical - V	Electronics -III	-	-	4	4	48	4	40	60	100	2
25PYP3CT	IT	Industrial Training	-	-	-	-	-	-	40	60	100	2
25PYP3DA	DSE -III	Crystal growth and thin film techniques	4	-	-	4	48	3	25	75	100	4
25PYP3DB		Instrumental methods of analysis										
25PYP3DC		Radiological safety aspects										
25PYP4CV	Core-XIV	Project	-	-	4	4	48	-	-	-	-	-
		Total	**18**	**4**	**8**	**30**	**360**	-	-	-	**700**	**22**

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Fourth Semester												
25PYP4CA	Core- XII	Molecular Physics	4	1	-	5	60	3	25	75	100	4
25PYP4CB	Core-XIII	Nuclear and Elementary Particle Physics	4	1	-	5	60	3	25	75	100	4
25PYP4CP	Core Practical-VI	General Physics	-	-	4	4	48	4	40	60	100	2
25PYP4CV	Core-XIV	Project	-	-	12	12	144	-	80	120	200	8
25PYP4DA	DSE -IV	Solar Cells	4	-	-	4	48	3	25	75	100	4
25PYP4DB		Band gap Engineering in Semiconductors										
25PYP4DC		Plasma Physics										
		Total	**12**	**2**	**16**	**30**	**360**	**-**	**-**	**-**	**600**	**22**
		***Grand Total**									**3400**	**92**

Theory :CIA 25: ESE 75
Practical/ IT :CIA 40: ESE 60
Project :CIA 80: ESE 120

***Total Credits does not exceed 92 credits**

EXTRA CREDIT COURSES

The following are the courses offered under self study to earn extra credits:

S. No	Course Code	Course Name
1	25PYPSSA	IPR, Innovation and Entrepreneurship
2	22PYPSSB	Nanoscience

Semester – I CORE - I: MATHEMATICAL PHYSICS							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25PYP1CA	MATHEMATICAL PHYSICS	CORE - I	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The concept of matrices, types of linear equations and complex variables • Develop expertise in special functions and partial differential equations • To learn the basics of tensors and develop the character table using group theory
Prerequisite	Basic Knowledge in Mathematics

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Summarize the concept of matrices and vector	K2
CO2	Calculate the definite integrals using complex variables	K3
CO3	Explain the special function in terms of various polynomials	K4
CO4	Examine the differential equations for first and second order equations	K3
CO5	Analyze the concept of tensors and group theory	K4

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	
CO2		✓		✓	✓
CO3	✓		✓		
CO4		✓	✓	✓	✓
CO5	✓	✓		✓	✓

25PYP1CA | MATHEMATICAL PHYSICS

Syllabus

Unit	Content	Hrs	Resources
I	**Matrices and Vectors** Rank of a matrix and some of its theorems (Normal Form, Triangular Form) - Types of linear equations - Solution to linear homogeneous and non-homogeneous equations – Vectors: Linear dependence and independence of vectors - Linear dependence and independence of vectors by rank method - Inner product space - Orthogonal vectors - Orthonormal vectors - Gram-Schmidt orthogonalization process.	12	Text Book
II	**Complex Variable** Analytical functions - Cauchy-Riemann equations - Line integrals - Cauchy's theorem - Cauchy integral formula - Taylor's and Laurent's expansions - Cauchy`s residue theorem – Poles – Evaluation of residues	12	Text Book
III	**Special Functions** Legendre`s differential equations: Legendre polynomials - Generating functions – Recurrence relation - Bessel`s differential equation: Bessel polynomials – Generating functions – Recurrence relation - Hermite differential equation: Hermite polynomials - Generating functions – Recurrence relation	12	Text Book
IV	**Differential Equations and Partial Differential Equations** Differential Equations: Linear ordinary differential equations - First order and second order equations and their various solutions - Partial differential equations: Solution of Laplace equation – Solution of wave and heat equations in two dimensions - Poisson and Helmholtz equations - Diffusion and wave equations.	12	Text Book
V	**Tensor and Group theory** Tensors: Contravariant - Covariant - Mixed tensors – Addition and subtraction of tensors – Symmetry and Antisymmetry tensor - Quotient rule - Pseudo tensors. Group theory: Subgroups - Classes - Cyclic groups - Abelian groups – Cosets - Homomorphism and isomorphism – Reducible and irreducible representations - Character table for simple molecular types (C2v and C3v point group).	12	Text Book / You Tube Videos
	TOTAL	60	

Text book	1.	Dass H K and Rama Verma S, 2010, "Mathematical Physics", S. Chand and Company Ltd , New Delhi.
	2.	Gupta B D, 2009, "Mathematical Physics", 4th Edition, Vikas Publishing House Pvt Ltd, New Delhi.
Reference Books	1.	George B. Arfken, Hans J. Weber, Frank E. Harris, 2012, "Mathematical Methods For Physicists: A Comprehensive Guide", Academic Press, India.
	2.	Sathya Prakash M, 2016, "Mathematical Physics with Classical Mechanics, 6th Edition, Sultan Chand and Sons, New Delhi.
	3.	Rajput, B.S, 2008, "Mathematical Physics", 20th Edition, Pragati Prakashan, Meerut.
	4.	E Book: Greenberg, M D. 2013," Advanced Engineering Mathematics", 2nd Edition, Pearson Education, India.

Journal and Magazines	https://pubs.aip.org/aip/jmp
E-Resources and Website	https://www.tutorialsduniya.com/notes/complex-analysis-notes./ https://www.tutorialsduniya.com/notes/linear-algebra-tensor-analysis-notes https://www.myprivatetutor.ae/prime/documents/ppts/details/199/ppton-state-transition-matrix&title=www.myprivatetutor.ae.
Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion
Focus of the Course	Skill Development/ Employability/ Innovations

Semester –I CORE - II: THERMODYNAMICS AND STATISTICAL MECHANICS							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25PYP1CB	THERMODYNAMICS AND STATISTICAL MECHANICS	CORE - II	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The concepts of microstates, macrostates and ensembles • The various statistical distributions and transport phenomenon • The concepts of phase transitions and thermodynamic functions
Prerequisite	Knowledge in Heat and Thermodynamics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Relate the thermodynamics, microstates through thermodynamics postulates, quantities, and relations	K2
CO2	Identify the micro and macroscopic properties of the matter	K3
CO3	Explain the classical and quantum distribution laws and their relations	K2
CO4	Apply the transport properties and understand equilibrium and non- equilibrium process.	K3
CO5	Classify and evaluate the heat capacities, Ising model through phase transitions.	K4

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1		✓		✓	
CO2	✓		✓		✓
CO3		✓		✓	
CO4	✓		✓		✓
CO5	✓	✓	✓	✓	✓

25PYP1CB	THERMODYNAMICS AND STATISTICAL MECHANICS

Syllabus

Unit	Content	Hrs	Resources
I	**Thermodynamics, Microstates and Microstates** Basic postulates of thermodynamics – Fundamental relations and definition of intensive variables – Intensive variables in the entropic formulation – Equations of state – Euler relation - Densities - Gibbs-Duhem relation for entropy - Microstates and macrostates – Ideal gas – Liouville's Theorem	12	**Text Book**
II	**Microcanonical, Canonical and Grand Canonical Ensembles** Microcanonical distribution function – Two level system in microcanonical ensemble – Gibbs paradox – The canonical distribution function – Partition function and free energy of an ideal gas – Relation between grand canonical and canonical partition functions	12	**Text Book**
III	**Distributions Functions and Fermi Energy** Maxwell Boltzmann – Bose Einstein and Fermi Dirac distributions – Non interacting Bose gas and thermodynamic relations – Chemical potential of bosons – Non interacting Fermi gas and thermodynamic relations – Fermi gas at zero and low temperature – Fermi energy - Fermi momentum.	12	**Text Book**
IV	**Transport Processes** Derivation of Boltzmann transport equation - Representation of states - Free streaming - Collision term - Equilibrium distribution – Transport phenomena - One speed and one dimension – Thermal conductivity - Brownian motion - Langevin's theory - Molecular diameter	12	**Text Book**
V	**Heat Capacities, Ising Model and Phase Transitions** Heat capacities of heteronuclear diatomic gas – Heat capacities of homonuclear diatomic gas – One dimensional Ising model and its solution by variational method - Phase transitions and criterion for phase transitions – Classification of phase transitions by order and by symmetry – Phase diagrams for pure systems – Clausius Clapeyron equation	12	**Text Book**
	Total	60	

Text book	1.	Palash B Pal, 2017, "An Introductory Course of Statistical Mechanics", Narosan Publishing House, New Delhi.
	2.	Reif, 2010, "Fundamentals of Statistical and Thermal Physics", Sarat Book Distributors
Reference Books	1.	Kittel C, 2004, "Elementary Statistical Physics", John Wiley and Sons.
	2.	Agarwal J P, SatyaPrakash, 2008, "Thermodynamics and Statistical Physics", Pragati Prakashan, Meerut
	3.	Gupta and Kumar, 2003, "Statistical Mechanics", Pragati Prakashan, Meerut.
	4.	Mitra J.K, 2017, "Principles of Management", First Edition, Oxford University Press.

Journal and Magazines	AIP journals | Springers
E-Resources and Website	E Book: SatyaPrakash, " Statistical Mechanics", Kedar Nath Ram Nath, Meerut https://youtu.be/SBe7n7WpU8M https://www.slideshare.net/NarendraKumar277/3d-ising-model
Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion
Focus of the Course	Skill Development/ Employability/ Innovations

Semester – I CORE - III: CLASSICAL MECHANICS							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25PYP1CC	CLASSICAL MECHANICS	CORE - III	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The concepts of Lagrangian and Hamiltonian mechanics • Apply the concepts of classical mechanics to the particle systems and rigid bodies • Emphasize the mathematical formulation in relativity problems.
Prerequisite	Knowledge in Newtonian mechanics, Kinematics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Apply the Lagrangian formulation for the motion of the particles	K3
CO2	Construct the Hamilton's dynamics and experiment with variational principle	K3
CO3	Summarize the canonical transformations	K2
CO4	Analyze the dynamics of a rigid body in various aspects	K4
CO5	Conclude the central force problem and theory of relativity	K4

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓			✓	✓
CO2		✓	✓		✓
CO3	✓		✓	✓	
CO4	✓	✓		✓	✓
CO5	✓	✓	✓		✓

25PYP1CC	CLASSICAL MECHANICS

Syllabus

Unit	Content	Hrs	Resources
I	**Lagrangian Dynamics** Mechanics of system of particles - Coordinate systems - Configuration space - Constraints – Principle of virtual work - D'Alembert's principle – Hamilton's principle - Lagrange's equation – Conservation laws and Symmetry properties – Applications of the Lagrangian formulation: Single particle in space - Atwood's machine.	10	Text Book
II	**Hamilton's Dynamics and Variational Principle** Cyclic coordinates - Conservation theorem - Jacobi integral equation for Hamilton's principal function - Hamilton's equations - Hamilton's equations in different coordinate systems - Examples in Hamiltonian dynamics - Calculus of variation - Principle of least action	10	Text Book
III	**Classical Transformation and Poisson Brackets** Canonical transformations - Legendre transformation - Generating functions - Procedure for application of canonical transformations - Condition for canonical transformation - Poisson brackets - Lagrange Brackets - Relation between Lagrange and Poisson brackets	10	Text Book
IV	**Dynamics of a Rigid Body** Generalized coordinates of rigid body - Euler angle - Infinitesimal rotation as vectors - Components of angular velocity - Angular momentum - Inertia tensor - Moments of inertia for different body systems - Euler's equations of motion - Torque free motion of a rigid body	09	Text Book
V	**Central Force Problem and Theory of Relativity** Reduction to the equivalent one body problem - Equation of motion and first integrals - Classification of orbits - Kepler problem: Motion under inverse square law - Artificial satellites - Virial theorem – Lorentz transformation - Consequences of Lorentz transformations	09	Text Book
	Total	48	

Text book	1.	Upadhaya J C, 2018, "Classical Mechanics", 2nd Edition, Himalaya Publishing House Pvt. Ltd, Mumbai.
	2.	Aruldhas G, 2015, "Classical Mechanics", PHI Learning Private Limited, New Delhi.
Reference Books	1.	Gutpa S L, Kumar V, and Sharma HV, 2016, "Classical Mechanics", Pragati Prakashan, Meerut.
	2.	Gupta K C, 2018, "Classical Mechanics of Particles and Rigid Bodies", 3rd Edition, New Age International Publishers, New Delhi
	3.	Rana N C and Joag P J, 2015, "Classical Mechanics", Tata McGraw Hill, New Delhi.
	4.	E-Book: Goldstein H, Poole C, and Safko J, 2002, "Classical Mechanics", 3rd Edition, Pearson Education Asia, New Delhi.

Journal and Magazines	https://www.sciencedirect.com/topics/physics-and-astronomy/classical-mechanics
E-Resources and Website	https://www.youtube.com/watch?reload=9&v=9M1l3zx1vw0 https://archive.nptel.ac.in/courses/115/106/115106123/
Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion
Focus of the Course	Skill Development/ Employability / Innovations

SEMESTER-I CORE - IV: ELECTRONICS							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25PYP1CD	ELECTRONICS	CORE - IV	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The various types of diodes, transistors and their applications. • Acquire knowledge on transistors and thyristors • The types of operational amplifiers and integrated circuits
Prerequisite	Basic Knowledge in Electronics

Course Outcomes (COs)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Outline about various semiconductor diodes.	K2
CO2	Identify and construct various transistors and optoelectronic devices.	K3
CO3	Examine the working of thyristors and its applications	K4
CO4	Categorize the analog electronics.	K4
CO5	Experiment with the operational amplifiers and integrated chips.	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓		✓	✓	
CO2		✓			✓
CO3	✓		✓		✓
CO4		✓		✓	
CO5	✓		✓	✓	✓

25PYP1CD | ELECTRONICS

Syllabus

Unit	Content	Hrs	Resources
I	**Special Diodes** V-I Characteristic of a PN junction diode - The ideal diode - Static and dynamic resistance of a diode - Parallel configuration of a diode circuit with a DC voltage source - Diode circuit with DC and AC voltage sources - Zener diode - Tunnel diode - Varactor diode - Schottky diode.	9	Text Book
II	**Power Electronics and Optoelectronics Device** Bipolar junction transistor construction, Current gain, Input and output of BJT in CB, CE, CC configurations - Phototransistor - Operation, characteristic, drain and transfer characteristics of JFET. Circuit symbol - drain characteristics and transfer characteristics of depletion type MOSFET.	9	Text Book
III	**Thyristors** Types of thyristors - Silicon controlled rectifier (SCR) - SCR biasing and operation - SCR equivalent circuit – V-I Characteristics of SCR – Uni-junction Transistor (UJT) - Constructions and equivalent circuit of UJT - UJT operation – V-I characteristics of UJT - Silicon controlled switch (SCS) - SCS operation - Applications - SUS, SBS, SAS.	10	Text Book
IV	**Analog Electronics** Op-Amp Parameters - Block diagram of an Op-Amp - The Op-Amps as a Voltage amplifier - Ideal operational amplifier - Virtual ground and summing point - Inverting amplifier - Non inverting amplifier - Linear amplifier - Differential amplifier - Active filters - Low pass filters - High pass filters - Band pass filters	10	Text Book
V	**Op Amp Applications and Special ICs** Comparators - The integrator - The differentiator - Log Amplifier - Antilog Amplifier - Linear integrated circuits - Digital integrated circuits - Integrated devices and circuits formation – Applications - 555 timer circuit - Functional block diagram - Characteristics and applications – Astable and monostable multivibrator	10	Text Book
	Total	48	

Text book	1.	Sedha R S, 2013, "Applied Electronics", 3rd Edition, S.Chand and Company, New Delhi.
	2.	Mehta V K, Rohit Mehta, 2014, "Principles of Electronics", 7th Edition S.Chand and Company, New Delhi
Reference Books	1.	Theraja B L, 2014, "Basic Electronics", S. Chand and Company, New Delhi.
	2.	Jacob Millman, Christos C Halkias, Chetan Parikh, 2016, "Integrated Electronics Analog and Digital Circuits and Systems", 2nd Edition, McGraw Hill Education (India) P Ltd, New Delhi.
	3.	David A, 2007," Electronic Devices and Circuits", 4th Edition, Prentice Hall.
	4.	E Book: Walter Banzhaf, 2010, "Understanding Basic Electronics", American Radio Relay League

Journal and Magazines	https://www.mdpi.com/journal/electronics
E-Resources and Website	https://www.vssut.ac.in/lecture_notes/lecture1423726156.pdf
Learning Method	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/ Employability/Innovations

Semester – I CORE PRACTICAL - I: THERMODYNAMICS AND OPTICS							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25PYP1CP	THERMODYNAMICS AND OPTICS	CORE PRACTICAL - I	-	-	48	2

Preamble	This course has been designed for students to learn and understand • The basic knowledge on Thermodynamics • The techniques in Materials Physics • The concepts of Spectroscopy.
Prerequisite	Knowledge in Optics, Heat and Thermodynamics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Develop the skills to solve problems in heat	K3
CO2	Explain the thermal conductivity	K2
CO3	Demonstrate the various materials behavior	K3
CO4	Demonstrate the optical behavior	K3
CO5	Determine refractive index of liquid-Air wedge	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1		✓		✓	✓
CO2	✓		✓	✓	
CO3	✓	✓			✓
CO4		✓	✓	✓	✓
CO5	✓			✓	

25PYP1CP	CORE PRACTICAL -I: THERMODYNAMICS AND OPTICS

S.No	List of Experiments
1	Determination of Stefan's constant
2	Determination of specific heat capacity of metal-Forbes Method.
3	Determination of specific heat capacity of Liquid -Ferguson Method
4	Young's Modulus- Elastic constants of the material -Elliptical fringes.
5	Determination of the wavelength of laser source – transmission grating.
6	Determine unknown resistance using a Kelvin double bridge experiment
7	Determination of refractive index of liquid-Air wedge
8	Characteristics of LDR.
9	Determination of Planck's constant
10	Thermal conductivity of liquid and air by Lee`s disc method.
11	Young's Modulus- Elastic constants of the material-hyperbolic fringes.
12	Determination of the thickness of wire by air wedge

Note: Any 10 Experiments

Text Books	1.	Chattopadhyay. D, 2015, "Advanced Course in Practical Physics", NCBA
	2.	Shrivastava H.P., 2012, "Textbook of Practical Physics", ABD Publishers
Learning Method		Demonstration/ Hands on Experiments
Focus of the Course		Skill Development/ Employability

Semester – I CORE PRACTICAL - II: ELECTRONICS - I							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25PYP1CQ	ELECTRONICS - I	CORE PRACTICAL - II	-	-	48	2

Preamble	This course has been designed for students to learn and understand • The various types of diodes, transistors and their applications • Acquire knowledge on transistors • The types of operational amplifiers.
Prerequisite	Knowledge in transistors and Op-amp

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Outline about various semiconductor diodes	K2
CO2	Identify and construct various transistors devices.	K3
CO3	Examine the working of Op-amp.	K2
CO4	Categorize the analog electronics	K4
CO5	Experiment with the integrated chips	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1		✓		✓	✓
CO2	✓		✓	✓	
CO3		✓	✓		✓
CO4	✓	✓		✓	✓
CO5	✓			✓	

25PYP1CQ | ELECTRONICS - I

S.No	List of Experiments
1	Build the Waveform generation by Digital Cathode ray Oscilloscope using OP-AMP
2	Construction of Hartley oscillator using OP-AMP
3	Construction of an Astable multivibrator using 555/Op-Amp
4	Construction of Differentiator, Integrator circuit to verify the output by Cathode ray Oscilloscope using OP-AMP
5	Construction of adder, subtractor, Sign Changer circuit using OP-AMP
6	Determine the shift of output voltage using Clipping and Clamping Circuits
7	Construct the Modulus counter using IC 7490
8	Construct the Phase Shift Oscillator
9	Construction of an active filter using Op-Amp
10	Study of the frequency response of an Op-Amp
11	Assemble the serial and parallel sequential circuits using Shift Register
12	Determine the Analog to digital converter using Op-Amp

Note: Any 10 Experiments

Text Books	1.	Jones B K, 1986, "Electronics for Experimentation and research", Prentice- Hall.
	2.	Zbar P B., Malvino A P and Miller M A., 1994, "Basic Electronics: A text lab manual", Tata McGraw Hill, New Delhi.
Learning Method		Demonstration/ Hands on Experiments
Focus of the Course		Skill Development/ Employability

Semester – I DSE - I: ENERGY PHYSICS							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25PYP1DA	ENERGY PHYSICS	DSE - I	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The concept of energy resources • The types of renewable energy and production of biomass • The energy storage systems
Prerequisite	Knowledge on renewable energy resources

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Explain the energy sources and their importance	K2
CO2	Make use of the concept of hydro-power and wind power	K3
CO3	Categorize the energy from biomass, biofuels and geothermal	K4
CO4	Analyze various sources of solar energy and photo synthesis	K4
CO5	Identify the energy systems, storage and transmission	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓		✓	✓	
CO2		✓		✓	✓
CO3	✓		✓		✓
CO4		✓	✓		✓
CO5	✓		✓	✓	

25PYP1DA | ENERGY PHYSICS

Syllabus

Unit	Content	Hrs	Resources
I	**Energy Sources** Energy and sustainable development – Scientific principles of renewable energy - Properties of transparent materials - Heat transfer by mass transport – Multimode transfer and circuit analysis - Extraterrestrial solar radiation - Components of radiation - Effect of earth's atmosphere - Measurement of solar radiation.	10	Text Book
II	**Hydro-power and Wind power** Assessing the resource for small installations – Reaction turbines - Hydroelectric systems - Turbine types and terms - Linear momentum and basic theory – Dynamic matching - Blade element theory - Characteristics of the wind - Power extraction by a turbine – Electricity generation - Mechanical power.	09	Text Book, Reference Book
III	**Biomass, Biofuels and Geothermal energy** Biofuel classification - Biomass production for energy farming - Direct combustion for heat – Pyrolysis (destructive distillation) - Alcoholic fermentation - Anaerobic digestion for biogas - Wastes and residues - Vegetable oils and biodiesel - Dry rock and hot aquifer analysis - Harnessing geothermal resources.	10	Text Book
IV	**Solar Energy and Photo synthesis** Air heaters - Water desalination - Solar ponds – Solar concentrators - Solar thermal electric power systems - Photon absorption at the junction - Solar radiation absorption - Maximizing cell efficiency - Solar cell construction - Types and adaptations of photovoltaics - Photovoltaic circuit properties – Thermodynamic considerations - Photosynthesis	10	Text Book, NPTEL
V	**Energy systems, Storage and Transmission** Biological storage - Chemical storage - Heat storage - Electrical storage: batteries and accumulators - Fuel cells - Mechanical storage - Distribution of energy – Electrical power – Socio political factors - Some policy tools.	09	Text Book, You Tube Videos
	Total	48	

Text book	1.	E Book: John Twidell and Tony Weir, 2006, "Renewable Energy Resources", 2nd Edition, Taylor and Francis Group.
	2.	Rai G D, "Solar Energy Utilisation", 2014, Khanna Publishers, New Delhi
Reference Books	1.	Kothari D P, Singal K C, Rakesh Ranjan, 2014, "Renewable Energy Sources and Emerging Technologies", 2nd Edition, PHI Learning (P) Ltd, New Delhi.
	2.	Kreith and Kreider, 1978, "Principles of Solar Engineering", McGraw Hill Pub., New Delhi.
	3.	Sukhatme S P, 1996, "Solar Energy", TMH Publishers, New Delhi.
	4.	Meinel A B and Meinal A P, 1976, "Applied Solar Energy", S. Chand and Co., New Delhi.

Journal and Magazines	Advances in High Energy Physics, Journal of Physics: Energy.
E-Resources and Website	https://www.google.com/urlsa=t&source=web&rct=j&url=https://th.fhi-erlin.mpg.de/th/lectures/materialscience
Learning Method	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/ Employability/Innovations

Semester – I DSE - I: MATERIALS PHYSICS AND PROCESSING TECHNIQUES							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25PYP1DB	MATERIALS PHYSICS AND PROCESSING TECHNIQUES	DSE - I	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The nucleation and growth techniques of crystals, thin films, and nanomaterials • The various plasma and vacuum processing techniques • The structural, morphology, and surface characterization techniques
Prerequisite	Basic knowledge in Materials Science

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Experiment with the growth process of crystals.	K3
CO2	Explain the methods of plasma processing.	K2
CO3	Make use of the important concepts of vacuum Techniques.	K3
CO4	Categorize the physical and chemical growth methods.	K4
CO5	Examine the various spectroscopic and microscopic characterization methods for materials.	K4

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓		✓		✓
CO2		✓		✓	
CO3	✓	✓	✓		✓
CO4	✓		✓		✓
CO5		✓		✓	

25PYP1DB | MATERIALS PHYSICS AND PROCESSING TECHNIQUES

Syllabus

Unit	Content	Hrs	Resources
I	**Crystal Growth and Nucleation** Nucleation phenomena: Critical supersaturation - Homogeneous and heterogeneous nucleation - Nucleation on a substrate - Nucleation of a crystalline material - Surface nucleation - Vapor–Liquid–Solid mechanism of crystal growth - Gibbs's free energy - Chemical potential - Solubility curves - Bridgman–Stockbarger and related techniques - Czochralski and related techniques.	10	Text Book
II	**Thermal Plasma Processing** Advantages of plasma processing - Thermal plasmas - Principles of plasma generation - DC plasma torches – AC plasma torches - RF plasma torches - Plasma-particle interaction - Plasma processing systems - Plasma-spraying - Plasma reactors and furnaces - Plasma decomposition - Treatment of hazardous wastes.	10	Text Book, Reference Book
III	**Vacuum Techniques** Artificial vacuum - Natural vacuum - Applications of vacuum techniques - Calculation of vacuum systems - Vacuum pumps - Principles of pumping - Parameters and classifications - Mechanical pumps - Vapour pumps – Ion pumps - Classification and selection of vacuum gauges - Thermal conductivity gauges - Pirani gauge.	09	Text Book
IV	**Growth Technique of Thin films and Nanomaterials** Thermal Evaporation: RF heating - Electron bombardment heating - Cathodic sputtering: Glow discharge sputtering - Reactive sputtering - Physical Vapor Deposition - Chemical Vapor Deposition - Sol-Gel Technique - Hydrothermal growth - Combustion synthesis.	09	Text Book, NPTEL
V	**Characterization Tools** Working principles and instrumentation: X-Ray Diffraction - Raman spectroscopy - UV-Vis spectroscopy - Photoluminescence spectroscopy - Fourier transform infrared spectroscopy - Scanning electron microscopy - Transmission electron microscopy - Scanning probe microscopy.	10	Text Book, You Tube Videos
	Total	48	

Text book	1.	Bhat H L, 2015, "Introduction to crystal growth principles and practice", CRC Press, Boca Raton, USA.
	2.	Ananthapadmanabhan P V and Venkataramani N, 1999, "Thermal plasma processing", Pergamon Materials series Vol. 2.
Reference Books	1.	Roth A, 1990, "Vacuum Technology", 3rd Edition, North Holland.
	2.	Rajendra Kumar Goyal, 2018, "Nanomaterials and nanocomposites, synthesis, properties, characterization techniques and applications", CRC Press, Boca Raton, USA.
	3.	Hartmut Frey, Hamid R Khan, 2015, "Handbook of thin film technology", Springer-Verlag, Berlin.
	4.	Chopra K L, 1969, "Thin films Phenomena", 1st Edition, McGraw Hill, New York.
	5.	Rajendran V, 2014, "Materials Science", Tata McGraw-Hill, New Delhi.

Journal and Magazines	https://www.sciencedirect.com/journal/journal-of-materials-processing-technology https://doi.org/10.1142/9789812770387_0002
E-Resources and Website	https://nanocomposix.com/pages/nanoparticle-characterizationtechniques
Learning Method	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/ Employability/Innovations

Semester – I DSE - I: LASER PHYSICS AND NONLINEAR OPTICS							
Semester	**Course Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
I	25PYP1DC	LASER PHYSICS AND NONLINEAR OPTICS	DSE - I	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The type of lasers, and their characteristics. • The applications of lasers in industry and medicine. • The theory and applications of nonlinear optics.
Prerequisite	Basic knowledge in Laser Physics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Explain the principle and construction of various lasers.	K2
CO2	Identify the features of lasers.	K3
CO3	Apply the characteristics of LASER in various industrial and medical applications.	K3
CO4	Make use of the concepts of nonlinear optics in higher order harmonic generations.	K3
CO5	Examine the nonlinear optical interactions and make use in various applications.	K4

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓		✓		✓
CO2		✓		✓	
CO3	✓		✓		✓
CO4		✓		✓	
CO5	✓	✓	✓		✓

25PYP1DC | LASER PHYSICS AND NONLINEAR OPTICS

Syllabus

Unit	Content	Hrs	Resources
I	**Lasers Fundamentals and Types** Principle of laser - Absorption process – Emission process - Characteristics of laser - Einstein relation - Laser operation - Population inversion and derivation of threshold gain - Gain medium - Optical feedback - Active medium - Laser types - He-Ne laser - CO_2 laser - Nd:YAG laser- Semiconductor laser - Liquid dye laser.	10	Text Book
II	**Laser Characteristics** Threshold conditions - Line shape function with Doppler broadening - Population inversion and pumping threshold - High intensity laser - Laser modes and mode locking - Mode locking method - Q switching and techniques - Frequency stabilization.	09	Text Book, Reference Book
III	**Laser Applications** Industry - Medical application of laser - Safety aspects in laser usage - Laser Doppler velocity meter – Laser strain gauges - Holography: Operating principle - Construction and reconstruction of hologram - Simplified theory of holography - Holographic memory - Laser machining processes - Laser spectroscopy.	09	Text Book
IV	**Nonlinear Optics** Introduction to nonlinear optics - Descriptions of nonlinear optical processes - Second harmonic generation - Optical parametric oscillation - Third-order nonlinear optical processes - Third-harmonic generation - Nonlinear susceptibility - Properties of the nonlinear susceptibility.	10	Text Book, NPTEL
V	**Nonlinear Optical Interactions** The wave equation for nonlinear optical media – Phase matching - Quasi-phase matching - The Manley Rowe relations - Sum frequency generation – Difference in frequency generation and parametric amplification - Nonlinear optical interactions with focused Gaussian beams.	10	Text Book, You Tube Videos
	Total	48	

Text book	1.	Nagabhushana S, Sathyanarayana N, 2013, "Laser and Optical Instrumentation", IK International Publishing House Pvt. Ltd., New Delhi.
	2.	E Book: Robert W. Boyd, 2008, "Nonliner Optics", 3rd Edition, Academic Press.
Reference Books	1.	Avadhanulu M. N., Hemne P.S., 2013, " An Introduction to Lasers theory and applications", S. Chand and Co., New Delhi.
	2.	Richard L Sutherland, 2003, "Handbook of Nonlinear Optics", 2nd Edition, Marcel Dekker, New York.
	3.	Laud B B, 1991, "Lasers and Nonlinear Optics", 2nd Edition, New Age International Ltd., New Delhi.
	4.	Skoog D A, Holler F J and Crouch S R, 2007, "Principles of Instrumental Analysis", 6th Edition, Thomson, Brooks Cole, Belmont.

Journal and Magazines	Journal of Nonlinear Optical Physics and Materials
E-Resources and Website	https://www.youtube.com/watch?v=Ab1nxxkgjH8&list=PLp6ek2hDcoNC_QQA2CmW1JIHAm5aD7o
Learning Method	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/ Employability/Innovations

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APPROVED

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19th 28.6.25	28.06.25	