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 2024-25 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 24-25

Course Code	Course Category	Course Name	L	T	P	Instruction Hours		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
First Semester												
24PYP1CA	Core- I	Mathematical Physics	4	1	-	5	60	3	25	75	100	4
24PYP1CB	Core- II	Thermodynamics and Statistical Mechanics	4	1	-	5	60	3	25	75	100	4
24PYP1CC	Core- III	Classical Mechanics	4	-	-	4	48	3	25	75	100	4
24PYP1CD	Core- IV	Electronics	4	-	-	4	48	3	25	75	100	4
24PYP1CP	Core Practical - I	Thermodynamics and Optics	-	-	4	4	48	4	40	60	100	2
24PYP1CQ	Core Practical -II	Electronics - I	-	-	4	4	48	4	40	60	100	2
24PYP1DA	DSE -I	Energy Physics	4			4	48	3	25	75	100	4
24PYP1DB		Materials Physics and Processing Techniques										
24PYP1DC		Laser Physics and Non Linear 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												
24PYP2CA	Core - V	Spectroscopy	4	-	-	4	48	3	25	75	100	4
24PYP2CB	Core - VI	Solid State Physics	4	1	-	5	60	3	25	75	100	4
24PYP2CC	Core - VII	Quantum Mechanics - I	4	1	-	5	60	3	25	75	100	4
24PYP2CP	Core Practical - III	Solid State and Spectroscopy	-	-	4	4	48	4	40	60	100	2
24PYP2CQ	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
24PYP2DA	DSE -II	Physics of Nanomaterials	4	-	-	4	48	3	25	75	100	4
24PYP2DB		Experimental Design										
24PYP2DC		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												
24PYP3CA	Core -VIII	Quantum Mechanics - II	4	1	-	5	60	3	25	75	100	4
24PYP3CB	Core - IX	Electromagnetic Theory	4	1	-	5	60	3	25	75	100	4
24PYP3CC	Core - X	Condensed Matter Physics	3	1	-	4	48	3	25	75	100	3
24PYP3CD	Core - XI	Microprocessors and Microcontroller	3	1	-	4	48	3	25	75	100	3
24PYP3CP	Core Practical - V	Electronics - III	-	-	4	4	48	4	40	60	100	2
24PYP3CT	IT	Industrial Training	-	-	-	-	-	-	40	60	100	2
24PYP3DA	DSE -III	Crystal growth and thin film techniques	4	-	-	4	48	3	25	75	100	4
24PYP3DB		Instrumental methods of analysis										
24PYP3DC		Radiological safety aspects										
24PYP4CV	Core-XIV	Project and Viva voce	-	-	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												
24PYP4CA	Core- XII	Molecular Physics	4	1	-	5	60	3	25	75	100	4
24PYP4CB	Core-XIII	Nuclear and Elementary Particle Physics	4	1	-	5	60	3	25	75	100	4
24PYP4CP	Core Practical-VI	Microprocessor	-	-	4	4	48	4	40	60	100	2
24PYP4CV	Core-XIV	Project and Viva voce	-	-	12	12	144	-	80	120	200	8
24PYP4DA	DSE -IV	Solar Cells	4	-	-	4	48	3	25	75	100	4
24PYP4DB		Band gap Engineering in Semiconductors										
24PYP4DC		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**

BoS Chairman/HoD
Department of Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
BoS- 5/4/24 AC - 17/4/24 GB -

Academic Council 17/04/2024 Dr.N.G.P. Arts and Science College

EXTRA CREDIT COURSES

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

S. No	Course Code	Course Name
1	24PYPSSA	IPR, Innovation and Entrepreneurship
2	22PYPSSB	Nanoscience

Semester – I

CORE - I: MATHEMATICAL PHYSICS

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24PYP1CA	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 • Develop expertise in group theory and tensors
Prerequisite	Basic Knowledge on Mathematics

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Understand the concept of free electrons in crystals	K2
CO2	Analyze the Thermal and Optical Properties of Materials	K3
CO3	Interpret the Dielectric Properties of Materials	K3
CO4	Obtain knowledge on Magnetic Properties of Materials.	K3
CO5	Expand Knowledge on Superconductors	K4

Mapping with Program Outcomes:

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

24PYP1CA - MATHEMATICAL PHYSICS

Syllabus

Unit	Content	Hours	E-Contents / 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 - Linearly dependence and independence of vectors by rank method - Inner product space - Orthogonal vectors - Orthonormal vectors - Gram-Schmidt orthogonalization process.	**12 h**	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 h**	Reference 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 h**	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 h**	NPTEL
V	**Tensor and Group theory** Tensors: Contravariant - Covariant - Mixed tensors – Addition and subtraction of tensors – Symmetry and Anti symmetry 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 h**	You Tube Videos
	TOTAL	**60 h**	

Text Book	1.	Dass H K and Rama Verma S, 2010, "Mathematical Physics", S. Chand andCompany 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.
	2.	Sathya Prakash M, 2016, "Mathematical Physics with Classical Mechanics, 6th Edition, Sultan Chand & Sons, New Delhi
	3.	Rajput, B.S, 2008, "Mathematical Physics", 20th Edition, Pragati Prakashan.
	4.	https://www.myprivatetutor.ae/prime/documents/ppts/details/199/ppton-state-transition-matrix&title=www.myprivatetutor.ae.

Journal and Magazines	E Book: Greenberg, M D. 2013," Advanced Engineering Mathematics", 2nd Edition, Person new
E-Resources and Website	https://www.tutorialsduniya.com/notes/complex-analysis-notes./
Learning Method	Chalk and Talk/Assignment/Seminar
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	24PYP1CB	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, microstates, and ensembles • The various statistical distributions and transport phenomenon • The concepts of phase transitions and thermodynamic functions
Prerequisite	Knowledge on Mathematics 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 mater	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	✓	✓	✓	✓	✓

24PYP1CB - THERMODYNAMICS AND STATISTICAL MECHANICS

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Thermodynamics, Microstates and Macrostates** 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	Reference 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	NPTEL
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	You Tube Videos
	TOTAL	**60**	

Text Book	1.	Palash B Pal, 2017, "An Introductory Course of Statistical Mechanics", Narosa 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 & 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.	https://youtu.be/SBe7n7WpU8M

Journal and Magazines	E Book: SatyaPrakash, " Statistical Mechanics", Kedar Nath Ram Nath, Meerut
E-Resources and Website	https://www.slideshare.net/NarendraKumar277/3d-ising-model
Learning Method	Chalk and Talk/Assignment/Seminar
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	24PYP1CC	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 on Mathematics and Mechanics

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	Make use of the central force problem and theory of relativity	K3

Mapping with Program Outcomes:

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

24PYP1CC - CLASSICAL MECHANICS

Syllabus

Unit	Content	Hours	E-Contents / 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 h	Text Book
II	**Hamilton's Dynamics and Variational Principle** Cyclic coordinates - Conservation theorem - Jacobi integral equation for Hamilton's principle function - Hamilton's equations - Hamilton's equations in different coordinate systems - Examples in Hamiltonian dynamics - Calculus of variation - Principle of least action	10 h	Reference 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	09 h	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	10 h	NPTEL
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 h	You Tube Videos
	TOTAL	**48 h**	

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.

Journal and Magazines	E-Book: Goldstein H, Poole C, and Safko J, 2002, "Classical Mechanics" , 3rd Edition, Pearson Education Asia, New Delhi
E-Resources and Website	https://archive.nptel.ac.in/courses/115/106/115106123/
Learning Method	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/ Employability/Innovations

Semester – I
CORE - IV : ELECTRONICS

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24PYP1CD	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 on 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	✓	✓	✓	✓	

24PYP1CD - ELECTRONICS
Syllabus

Unit	Content	Hours	E-Contents / 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 circuits with a DC voltage source - Diode circuit with DC and AC voltage sources - Zener diode - Tunnel diode - Varactor diode - Schottky diode	9 h	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 h	Reference 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 h	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 h	NPTEL
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 h	You Tube Videos
	TOTAL	**48 h**	

Text Book	1.	Sedha R S, 2013, "Applied Electronics", S.Chand and Company, New Delhi.
	2.	Mehta V K, Rohit Mehta, 2014, "Principles of Electronics", 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.

Journal and Magazines	E Book: Walter Banzhaf, 2010, "Understanding Basic Electronics", American Radio Relay League
E-Resources and Website	https://nptel.ac.in/courses/108102095/
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	24PYP1CP	THERMODYNAMICS AND OPTICS	CORE PRACTICAL - I	-	-	48	2

Unit	Content
1	Determination of Stefan's constant.
2	Determination of specific heat capacity of metal-Forbes Method.
2	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 Book	1.	Dunlap R A, 1988, "Experimental Physics: Modern methods", Oxford University Press, New Delhi.
	2.	Smith E V, 1970, "Manual for experiments in Applied Physics", Butter worths.
Reference Books	1.	C Malacara D,1988, "Methods of Experiments Physics", Series of Volume, Academic Press, Inc.
	2.	Raghvan V, 2004, "Experiments in material science", 5th edition, PHI Learning Pvt. Ltd

Semester – I

CORE PRACTICAL-II: ELECTRONICS - I

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24PYP1CQ	PRACTICAL-II: ELECTRONICS - I	CORE PRACTICAL II	-	-	48	2

Unit	Content
1	Build the Waveform generation by Digital Cathode ray Oscilloscope using OP-AMP.
2	Construction of Hartley oscillator using OP-AMP.
3	Study an Astable Multivibrator using Op-Amp/IC 555.
4	Construction of Differentiator, Integrator circuit to verify the Output by Cathode ray Oscilloscope using OP-AMP.
5	Construction of Adder, Subtraction, 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 filters using Op-Amp.
10	Study 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 Book	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.
Reference Books	**1.**	Malvino A.P., 1992, "Basic Electronics - A text lab manual", Tata McGraw Hill.
	2.	Singh S P., 2003, "Advanced Practical Physics – Vol I & II", Pragati Prakasan Meerut

Semester – I
DSE - I : ENERGY PHYSICS

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24PYP1DA	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	Relate the energy source and their importance	K1
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 the 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	✓	✓	✓	✓	

24PYP1DA - ENERGY PHYSICS
Syllabus

Unit	Content	Hours	E-Contents / 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 h	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 h	Reference Book
III	**Biomass, Biofuels and Geothermal energy** Biofuel classification - Biomass production for energy farming - Direct combustionfor heat - Pyrolysis (destructive distillation) - Alcoholic fermentation - Anaerobic digestion for biogas - Wastes and residues - Vegetable oils and biodiesel - Geophysics - Dry rock and hot aquifer analysis - Harnessing Geothermal Resources	10 h	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 h	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 h	You Tube Videos
	TOTAL	**48 h**	

Text Book	1.	E Book: John Twidell and Tony Weir, 2006, "Renewable Energy Resources", 2nd Edition, Taylor & Francis Group
	2.	Rai G D, "Solar Energy Utilisation", 2014, Khanna Publishers, New Delhi.
Reference Books	1.	Kothari D P, Singal K C, RakeshRanjan, 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 MeinalA P, 1976, "Applied Solar Energy", S. Chand & Co. New Delhi.

Journal and Magazines	https://www.slideshare.net/sanjanaangel16/ biomass-energy-ppt
E-Resources and Website	https://www.google.com/urlsa=t&source=web&rct= j&url=https://th.fhi- berlin.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	24PYP1DB	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 on 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					

24PYP1DB - MATERIALS PHYSICS AND PROCESSING TECHNIQUES

Syllabus

Unit	Content	Hours	E-Contents / 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 h	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 h	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 h	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 h	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 h	You Tube Videos
	TOTAL	**48 h**	

Text Book	1.	Bhat H L, 2015, "Introduction to crystal growth principles and practice", CRC Press, Boca Raton, USA. (Unit 1)
	2.	Ananthapadmanabhan P V and Venkataramani N, 1999, "Thermal plasma processing", Pergamon Materials series Vol.2. (Unit 2)
Reference Books	1.	Roth A, 1990, "Vacuum Technology", 3rd Edition, North Holland. (Unit 3).
	2.	Rajendra Kumar Goyal, 2018, "Nanomaterials and nanocomposites, synthesis,Properties, characterization techniques and applications", CRC Press, BocaRaton, USA. (Unit 4)
	3.	Hartmut Frey, Hamid R Khan, 2015, "Handbook of thin film technology", Springer-Verlag, Berlin. (Unit 4, 5).
	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://doi.org/10.1142/9789812770387_0002
E-Resources and Website	https://nanocomposix.com/pages/nanoparticle-characterization-techniques
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	24PYP1DC	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 non- linear optics.
Prerequisite	Knowledge on 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	✓	✓	✓	✓	✓

24PYP1DC - LASER PHYSICS AND NONLINEAR OPTICS

Syllabus

Unit	Content	Hours	E-Contents / 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 h	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 h	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 h	Text Book
IV	**Introduction to 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 h	NPTEL
V	**Non Linear Optical Interactions** The wave equation for nonlinear optical media - Phase matching - Quasi-phase matching - The Manley Rowe relations - Sum frequency generation - Difference frequency generation and parametric amplification - Nonlinear optical interactions with focused Gaussian beams.	10 h	You Tube Videos
	TOTAL	**48 h**	

Text Book	**1.**	Nagabhushana S, Sathyanarayana N, 2013,"Laserand 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.**	AvadhanuluM. 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", Marcel Dekker AG)
	3.	Laud LL, 1991, "Lasers and Nonlinear Optics", 2nd Edition,
	4.	Skoog D A, Holler F J and Crouch S R, 2007, "Principles of Instrumental Analysis", Thomson Brooks/Cole, Belmont, CA.

Journal and Magazines	https://www.youtube.com/watch?v=PK4yFaGHSFc&list=PLU0oJASIjGxdZ MtypwhvGrnmuzNnNdcKt
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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Dr.N.G.P. Arts and Science College

Semester – II
CORE - V: SPECTROSCOPY

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24PYP2CA	SPECTROSCOPY	CORE - V	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The different techniques of spectroscopy and their applications. • The Raman, nuclear magnetic and electron spin spectroscopy • The nuclear quadrupole resonance, surface spectroscopy.
Prerequisite	Knowledge on optics and basic spectroscopy

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Identify the modes of vibration and rotation in molecules using IR and Microwave spectroscopy.	K3
CO2	Apply the theory of Raman spectroscopy for structure determination.	K3
CO3	Examine the spectra of Nuclear magnetic Resonance and Electron Spin Resonance.	K4
CO4	Explain the principle of Nuclear Quadrupole Resonance and Mossbauer spectroscopy.	K2
CO5	Select the type of spectroscopy for interaction of electromagnetic waves with matter.	K2

Mapping with Program Outcomes:

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

24PYP2CA	CORE: SPECTROSCOPY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Infrared Spectroscopy** Vibrational energy of a diatomic molecule- Infrared selection rules - Vibrating diatomic molecule - Normal modes of vibration in crystal - Interpretation of vibrational spectra - Group frequencies - IR spectrophotometer instrumentation - Fourier transform infrared spectroscopy (Principle and Working) - Applications.	10 h	Text Book
II	**Microwave Spectroscopy** Rotation of molecules – Expression for the rotational constant - Theory of microwave spectra of linear and symmetric top molecules – Techniques and instrumentation - Chemical analysis by microwave spectroscopy.	10 h	Text Book
III	**Raman Spectroscopy** Theory of Raman scattering - Rotational Raman spectra - Vibrational Raman spectra - Mutual exclusion principle - Raman spectrometer - Sample handling techniques - Polarization of Raman scattered light - Structure determination using IR and Raman spectroscopy.	10 h	Text book/ Reference Book
IV	**Nuclear Magnetic and Electron Spin Resonance Spectroscopy** Theory of NMR method – Resonance condition – NMR Instrumentation – Relaxation processes - Chemical shift – Spin-spin coupling –Interpretation of certain NMR spectra. Principle of ESR - ESR spectrometer – Total Hamiltonian – Hyperfine structure – ESR spectra of free radicals in solution.	9 h	Text book/ NPTEL
V	**Nuclear Quadrupole Resonance and Mossbauer Spectroscopy** Principle of nuclear quadrupole resonance – Transitions for axially and non-axially symmetric systems – NQR instrumentation – Chemical bonding – Hydrogen	9 h	Text book/ Reference book

	bonding. The Mossbauer effect - Recoilless emission and absorption - Experimental techniques - Isomer shift – Quadrupole Interaction - Magnetic hyperfine interaction – Applications.		
	TOTAL	**48 h**	

Text Book	1.	Aruldhas G, 2017, "Molecular Structure and Spectroscopy", 2nd edition, Prentice Hall of India Pvt. Ltd & New Delhi.
	2.	Colin N Banwell and Elaine M McCash, 2016, "Fundamentals of Molecular Spectroscopy", 4th edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
Reference Books	1.	William Kemp, 2002, "Organic Spectroscopy", 3rd edition, Palgrave Publishers Ltd, New York.
	2.	Jag Mohan, 2004, "Organic Spectroscopy - Principles and Applications", 2nd edition, Narosa Publishing House Pvt. Ltd, New Delhi.
	3.	Banwell C N, 2017, "Fundamentals of Molecular Spectroscopy", 4th edition, McGraw Hill Education, New Delhi.

Journal and Magazines	https://www.sciencedirect.com/journal/journal-of-molecular-spectroscopy
E-Resources and Website	NPTEL: https://www.youtube.com/watch?v=7jOSbtR8mTs&list=PLyqSpQzTE6M8eGML9tjCEgZjci5USazoW
Learning Method	Chalk and Talk/PPT/Assignment/Seminar
Focus of the Course	Skill Development/ Employability

Semester – II
CORE: SOLID STATE PHYSICS

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24PYP2CB	SOLID STATE PHYSICS	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The fundamentals of crystallography • The crystal imperfections and atomic diffusion • The free electron and band theory
Prerequisite	Knowledge on Crystal Physics and Materials Properties

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Explain the concepts and understand the applications of crystal structure.	K2
CO2	Summarize the diffraction nature and properties of lattice.	K2
CO3	Relate the crystal imperfection and atomic diffusion.	K3
CO4	Interpret the lattice vibration and thermal properties.	K3
CO5	Analyze the free electron and band theory.	K4

Mapping with Program Outcomes:

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

24PYP2CB	CORE: SOLID STATE PHYSICS

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Fundamentals of Crystallography and Bonding in Solids** Periodicity in crystals - Bravais lattices in three dimension – Rational features of a crystals and miller indices - Interplanar spacing - Simple and common crystal structures of SC, BCC, FCC, HCP, Diamond, NaCl - Forces between atoms – Ionic bonding – Covalent bonding – Metallic bonding – Hydrogen bonding – Van der Waals bonding	12 h	Text Book
II	**Diffraction of Waves and Particles by Crystals** X-rays and their generation - Moseley's law - X-ray Diffraction - Bragg's law - Laue equation - Interpretation of Braggs equation - Ewald construction - Reciprocal lattice - Properties of reciprocal lattice - X-Ray Diffraction experiment - Powder diffractometer - Neutron Diffraction - Electron Diffraction.	12 h	Reference Book
III	**Crystal Imperfections and Atomic Diffusion** Crystal imperfections: Point imperfections – Concentrations of point imperfection – Line imperfections – Burgers Vector – Presence of dislocation – Surface imperfections - Atomic diffusion: Ficks first and second law – Diffusion mechanism – Random walk treatment of diffusion – Kirkendall effect.	12 h	Text Book
IV	**Lattice Vibration and Thermal Properties** Lattice Vibration: Dynamics of the chain of identical atoms - Symmetry in K space - Number of modes in the first zone - Long wavelength limit - Phase and group velocities - Dynamics of a diatomic linear chain - The acoustic branch - The optical branch - Thermal properties: the classical model - Einstein's theory of specific heat - Density of states.	12 h	Text Book, NPTEL
V	**Energy Band Theory and Fermi Surface** Energy Band Theory: Bloch theorem - Kronig – Penney model - Extended, Reduced, and periodic zone schemes – Nearly free electron model – Fermi surface: Fermi surface and Brillouin zones - Characteristics of Fermi surfaces - Experimental study of Fermi surfaces: Anomalous skin effect - Cyclotron resonance - De Haas Van Alphen effect.	12 h	Text Book, You Tube Videos
	TOTAL	60 h	

Text Book	1.	Wahab M.A, 2019, "Solid State Physics", 3rd edition, Narosa Publication, New Delhi.
	2.	Charles Kittel, 2017, "Introduction to Solid State Physics", 8th edition, Wiley India Pvt. Ltd, New Delhi.
Reference Books	1.	Pillai S O, 2018, "Solid State Physics", 8th edition, New age international Publisher.
	2.	Gupta S L, Kumar V, 2018, "Solid state Physics", 9th edition, K. Nath & Co., Meerut.
	3.	Philip Phillips, 2012, "Advanced Solid-State Physics", 2nd Edition, Cambridge University Press.
	4.	Anthony R. West, Bailey B C, 2007, "Solid state chemistry and its applications", Second edition, John Wiley & Sons Ltd, UK.

Journal and Magazines	https://www.fzu.cz/~knizek/literatura/Ashcroft_Mermin.pdf
E-Resources and Website	http://www.issp.ac.ru/ebooks/books/open/Introduction%20to%20Modern%20Solid%20State%20Phys.pdf
Learning Method	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/ Entrepreneurial Development/ Entrepreneurial Development/Innovations/ Intellectual Property Rights

Semester – II
CORE: QUANTUM MECHANICS - I

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24PYP2CC	QUANTUM MECHANICS - I	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • Enable to learn Schrödinger wave equation • Apply quantum mechanics to dimensional wave equations • Find the solution for identical particles
Prerequisite	Knowledge in undergraduate level quantum mechanics

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Extend the idea and applications of Schrödinger wave equation.	K2
CO2	Utilize the principle of moment of inertia for experimental verification.	K3
CO3	Apply quantum mechanics to three-dimensional wave equations.	K3
CO4	Generalize the Heisenberg and Schrödinger wave equations.	K2
CO5	Analyze the angular momentum and the system of identical particles.	K4

Mapping with Program Outcomes:

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

24PYP2CC	CORE: QUANTUM MECHANICS - I

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Foundations of Quantum Mechanics** Postulates of quantum mechanics - Wave packet, Eigen values and functions – Hermitian operator - Free particle – Operator for momentum and energy –Interpretation of the wave function – Probability of interpretation, expectation value - Schrödinger equation (Time dependent and independent), Ehrenfest's theorem.	12 h	Text Book & You Tube Videos
II	**Eigen Spectrum, Identical Particles** Equation of motion – Schrödinger, Heisenberg and interaction representation - Square well potential with rigid walls - Square well potential with finite walls - Square well potential barrier - Alpha emission - Identical particles – Exchange operator.	12 h	Reference Book
III	**Three-Dimensional Problems and Angular Momentum** Particle in a spherical well - Hydrogen atom – Rigid rotator - Angular momentum operator – Eigen value and eigen function of L_2 and L_z – Eigen value of J_2 and J_z – Addition of angular momenta – Clebsh Gordan coefficients.	12 h	Text Book
IV	**Matrix Formulation, Spin of Quantum Theory** Eigen values and eigen vector of matrices - Hilbert space - Dirac's Bra-Ket notation - 1D harmonic oscillator in matrix mechanics - Pauli's exclusion principle - Inclusion of spin – Spins functions for two electrons.	12 h	Text Book & NPTEL
V	**Scattering Theory** Scattering by a perfectly rigid sphere - Scattering by a Coulomb field - Green's functions – Born approximation and its validity – Scattering by a square well potential – Scattering from an exponential potential.	12 h	Text Book
	TOTAL	60 h	

Text Book	1.	Aruldhas G, 2016 "Quantum Mechanics", 2nd Edition, PHI Learning (P) Ltd.
	2.	Rajasekar Shanmuganathan, Velusamy R, 2014, "Quantum Mechanics I-The Fundamentals", CRC Press.
Reference Books	1.	Leonard I Schiff, 2016, "Quantum Mechanics", 3rd Edition, McGraw-Hill International Publication.
	2.	Thankappan V.K, 2018, "Quantum Mechanics", 2nd Edition, New Age International (P) Ltd.

	3.	Satya Prakash, Kedar Nath, 2018, "Quantum Mechanics", 5th Edition, Ram Nath and Co. Publications.
	4.	Merzbacher E, 2011, "Quantum Mechanics", 3rd Edition, John Wiley Interscience Publications.

Journal and Magazines	https://library.samdu.uz/files/91637c05b4db59f81df4953d6ad54973_Foundations_of_Quantum_Mechanics_An_Exploration_of_the_Physical.pdf
E-Resources and Website	https://www.youtube.com/watch?v=0EWsimmWy5E&t=2s
Learning Method	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/ Innovations/ Employability

Semester – II CORE PRACTICAL: SOLID STATE AND SPECTROSCOPY							
Semester	Corse Code	Course Name	Category	L	T	P	Credits
II	24PYP2CP	SOLID STATE AND SPECTROSCOPY	CORE PRACTICAL	-	-	48	2

Preamble	This course has been designed for students to learn and understand • The basic knowledge on solid state physics • The techniques in materials physics • The concepts of Spectroscopy.
Prerequisite	Knowledge in Solid state and Spectroscopy

Course Outcomes (Cos)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Develop the skills to solve problems in heat experiments	K4
CO2	Examine the solid state physics using various equipment's.	K4
CO3	Demonstrate various Plank's law using experiments	K4
CO4	Make use of the Spectroscopy concepts demonstrate experiments.	K4
CO5	Determine wavelength using Laser Light.	K4

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

24PYP2CP	CORE PRACTICAL: SOLID STATE AND SPECTROSCOPY

Syllabus

S.No	Contents
1	Determination of optical activity of specific rotation using Polarimeter.
2	Determination of refractive index of liquid using He-Ne laser
3	Determination of e /m by Thomson method
4	Determination of Rydberg's constant using Solar spectrum
5	Study of Band gap energy using Thermistor
6	Determination of Hall coefficient using Hall Effect
7	Determination of Refractive index of liquid by Newton's ring
8	Determination of Resistivity using Four probe method
9	Find Young's modulus of the material by Hyperbolic fringes
10	Study of dielectric constant and Curie temperature of magnetic materials.
11	Determination of thermal conductivity of liquid and air by Lee`s disc Method.
12	Determination of Planck 's constant.

Note : Any 10 Experiments

Manuals	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/ Group Trials

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations

Semester – II CORE PRACTICAL : ELECTRONICS - II							
Semester	**Corse Code**	**Course Name**	**Category**	**L**	**T**	**P**	**Credits**
II	24PYP2CQ	ELECTRONICS - II	CORE PRACTICAL		-	48	2

Preamble	This course has been designed for students to learn and understand • The basic principles of oscillators and op-amp • The amplifiers and transistors • The circuits of IC.
Prerequisite	Knowledge on basic electronics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Construct the oscillators using Op-amp.	K4
CO2	Demonstrate the working of amplifier and multivibrator.	K4
CO3	Study the characteristics of BJT, JFET and MOSFET	K4
CO4	Analyze various circuits using IC.	K4
CO5	Measure gain from emitter and transistor amplifier circuits	K4

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

24PYP2CQ	CORE PRACTICAL: ELECTRONICS - II

Syllabus

S.No	Contents
1	Construction of Colpitt's oscillator using Op-Amp.
2	Construct inverting, non-inverting and voltage follower using Op-Amp.
3	Construction of bistable multivibrator using Op-amp 741/NE 555.
4	Construct the Log amplifier using Op-amp 741.
5	Study the characteristics of BJT.
6	Study the static and drain characteristics of a JFET.
7	Study the characteristics of MOSFET.
8	Study the Schmitt trigger using IC 555.
9	Study the half adder, full adder, half subtractor and full subtractor using ICs.
10	Construct second order low and high pass filters using IC 741.
11	Construct the emitter follower and measure its gain.
12	Construction of single state transistor amplifier and to measure the gain at different frequency of the input signal.

Note: Any 10 experiments

Manuals	1.	Ouseph C.C, 2014, "Practical Physics and Electronics", Viswanathan Publishers Ltd.
	2.	Bhattacharya A.B, 2011, "Advanced Electronic Practicals", New Central Book Agency (NCBA).

Learning Method	Demonstration/ Hands on Experiments/ Group Trials

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations

Semester - II
EDC: NUMERICAL METHODS

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24MTP2EA	NUMERICAL METHODS	EDC	36	12	-	4

Preamble	This course has been designed for students to learn and understand • the method of solving algebraic and transcendental equations. • the effectiveness of numerical solution over analytical solution • error analysis of a method to examine its accuracy.
Prerequisite	Knowledge on Basic Mathematics

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	identify numerical solution of algebraic and transcendental equation.	K1
CO2	discuss errors in polynomial interpolation & detection of errors by difference table.	K2
CO3	apply the concept of numerical differentiation and integration.	K4
CO4	compute the solution of system of equations by Gauss elimination and Seidal method.	K3
CO5	estimate the solution of ordinary differential equations.	K5

Mapping with Program Outcomes:

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

24MTP2EA	NUMERICAL METHODS

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Solution of Algebraic and Transcendental Equations:** Introduction - bisection method - iteration method - method of False Position -Newton-Raphson method - Ramanujan's method - Graeffe's Root-Squaring method.	9	Textbook
II	**Solution of Linear Systems:** Direct Methods: Gaussian Elimination method - modification of the Gauss Method to compute the inverse - method of factorization - solution of tridiagonal systems - solution of linear systems: iterative methods - Householder's method.	10	Textbook/ Reference book1
III	**Interpolation:** Introduction - errors in polynomial interpolation - finite differences - detection of errors by difference tables - differences of a polynomial - Newton's formulae - Gauss's central difference formulae - Stirling's formula - interpolation with unevenly spaced points: Lagrange's interpolation formula - error in Lagrange's interpolation formula - Hermite's interpolation formula.	9	Textbook
IV	**Numerical Differentiation and Integration:** Introduction - numerical differentiation - maximum and minimum values of a tabulated function - numerical integration - Trapezoidal rule - Simpson's 1/3 Rule - Simpson's 3/8 Rule - Boole's and Weddle's Rules.	10	Textbook/ Reference books 2-4
V	**Numerical Solution of Ordinary Differential Equations:** Introduction - solution by Taylor's series - Picard's Method - Euler's Method - Runge-Kutta Methods - Predictor Corrector Methods.	10	Textbook/ Reference book 3
	Total	48	

Note: Distribution of marks 80% Problem and 20% Theory

Text Book	**1.**	Sastry S.S., 2012, "Introductory methods of Numerical Analysis", 5th Edition, Prentice-Hall of India, New Delhi
Reference Books	**1.**	Venkataraman M.K, 1999, "Numerical Methods in Science and Engineering", 5th edition, National Publishing Company, Chennai.
	2.	Grewal B.S, 2010, "Numerical Methods in Engineering & Science: with Programs in C and C++", 10th edition, Khanna Publishers, New Delhi.
	3.	Jain M.K., Iyengar S.R.K. and Jain, R.K., 2012, "Numerical methods for Scientific and Engineering Computation", 6th edition, New Age International, New Delhi.
	4.	Curtis F.Gerald, 2007, "Applied Numerical Analysis", 7th edition, Pearson Education India Ltd., New Delhi.

Journal and Magazines	https://www.sciencedirect.com/science/article/pii/S037704270000412X
E-Resources and Website	https://www.youtube.com/watch?v=PIPiv6gn_Ls https://www.youtube.com/watch?v=lBvW0PdOl3o
Learning Method	Chalk and Talk, Assignment
Focus of the Course	Skill development

Semester – II

DSE: PHYSICS OF NANOMATERIALS

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24PYP2DA	PHYSICS OF NANOMATERIALS	DSE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The classification of nanomaterials and their synthesis methods • The properties of special nanomaterials. • The characterization techniques of nanomaterials
Prerequisite	Basic Knowledge on Materials science

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Explain the classification of nanomaterials.	K2
CO2	Explain the properties of special nanomaterials.	K2
CO3	Apply the physical properties of nanomaterials.	K3
CO4	Relate the synthesis of nanoparticles using various methods	K3
CO5	Analyze the material characterization techniques.	K4

Mapping with Program Outcomes:

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

24PYP2DA	DSE: PHYSICS OF NANOMATERIALS

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Classification of Nanomaterials** Definition of zero, one, two and three dimension nanomaterials – Surface energy – Chemical potential as a function of surface curvature – Electrostatic stabilization: Surface charge density - DLVO theory - Steric stabilization: solvent and polymer.	10 h	Text Book
II	**Special Nanomaterials** Carbon fullerenes and nanotubes: Carbon fullerenes, Fullerene derived crystals, Carbon nanotubes - Micro and Mesoporous Materials: Ordered mesoporous structures - Random mesoporous structures - Crystalline microporous materials: Zeolites - Organic-inorganic hybrids: Class 1 hybrids - Class 2 hybrids.	10 h	Text Book
III	**Properties of Nanomaterials** Physical properties of nanomaterials: Melting points and lattice constants – Mechanical properties – Optical properties: Surface plasmon resonance – Quantum size effects – Electrical property: Surface scattering - Change of electronic structure - Quantum transport - Effect of microstructure.	09 h	Reference Book
IV	**Synthesis Methods** Physical vapour deposition: Evaporation - Molecular beam epitaxy - Sputtering - Chemical vapour deposition: Typical chemical reaction - Reaction kinetics – CVD methods - Atomic layer deposition - Superlattices - Sol-Gel Films.	09 h	NPTEL
V	**Characterization Tools** Structural characterization: X-Ray diffraction – Scanning electron microscopy – Transmission electron microscopy - Scanning probe microscopy – Chemical characterization: Optical spectroscopy - Electron spectroscopy - Ion spectroscopy.	10 h	You Tube Videos
	TOTAL	**48 h**	

Text Book	1.	Guozhong Cao, 2017, "Nanostructures & amp; nanomaterials: Synthesis, properties & applications", 2nd edition, World Scientific Publishing Co. Pvt. Ltd.
	2.	Rajendran V, 2010, "Processes and Characterization of Advanced Nanostructured materials" 1st edition, Macmillan, India.
Reference Books	1.	Chattopadhyay K K, Banerjee A A, 2009, "Introduction to Nanoscience and Nanotechnology" 2nd edition, PHI Learning private Limited.
	2.	Pradeep T, 2007, "Nano-The Essentials" Tata McGraw-Hill publishing company limited, New Delhi.
	3.	Chris Binns, 2010, "Introduction to Nanoscience and Nanotechnology" John Wiley & Sons, New Jersey
	4.	Charles P. Poole Jr, Frank, Ownes, 2003 "Introduction to Nanotechnology" Sathyam Enterprise, New Delhi
	5.	Alain nouailhat, 2008,"An Introduction to Nanoscience andNanotechnology"2nd edition, Wiley.

Journal and Magazines	https://pubs.acs.org/journal/aanmf6
E-Resources and Website	https://etp-nanomedicine.eu/wp-content/uploads/2018/10/nano-hands-on-activities_en.pdf
Learning Method	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/ Employability/Innovations

Semester – II
DSE : EXPERIMENTAL DESIGN

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24PYP2DB	EXPERIMENTAL DESIGN	DSE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The applications of various measurements instruments. • The fundamental concepts of monitoring systems and their applications. • The concept of optoelectronic devices.
Prerequisite	Basic Knowledge on Materials science

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Summarize the concepts of measurements and error	K2
CO2	Apply the tools used in electronic and digital instruments.	K3
CO3	Demonstrate the mechanisms of transducer systems.	K2
CO4	Outline the classification and applications of optical fibers.	K4
CO5	Illustrate the concept of optoelectronic devices techniques.	K3

Mapping with Program Outcomes:

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

24PYP2DB	DSE: EXPERIMENTAL DESIGN

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Concepts of Measurements and Error** Measurement - Instrumentation - Classification of instruments - Factors relating to selection of instruments - Functions of instruments - Accuracy, errors and correction - Application of measurement system - Limiting errors - Types of errors - Sources of errors.	10 h	Text Book
II	**Electronic and Digital Instruments** Essentials of an electronic instrument - Advantages - Electronic voltmeter - Types of electronic voltmeters - Vacuum tube voltmeters - Differential voltmeter (D.C) - Analog and digital system - Basic concepts of digital instruments - Digital voltmeter - Advantages - Characteristics - Applications.	10 h	Text Book
III	**Transducers** Classification of transducers - Resistive, inductive and capacitive pressure transducer - Linear variable differential transformer (LVDT) - Piezoelectric transducer - Photoelectric transducers - Carbon microphone - Ribbon microphone - Moving coil microphone - Crystal microphone.	09 h	Reference Book
IV	**Fiber Optics** Structure of optical fiber - Classification of optical fiber - Propagation of light - Total internal reflection - Fiber characteristics - Splicing and connector - Fusion splices - Fiber optic communications - Advantage and disadvantage - Application of fiber optic communication.	10 h	NPTEL
V	**Optoelectronic Devices** Spectral response of human eye - Light emitting diode - Photoemissive devices - Photomultiplier tube - Photovoltaic devices - Type photoconductive	09 h	You Tube Videos

	cells - photodiodes - PN junction - PIN - Avalanche photodiode.		
	TOTAL	**48 h**	

Text Book	1.	Theraja B L, 2014, "Basic Electronics", 3rd edition, S. Chand Publisher, New Delhi.
	2.	Rajput R K, 2008, "Electronic measurements and Instrumentation", 2nd edition, S. Chand Publisher, New Delhi
Reference Books	1.	Sawhney A K, 2013,"A Course in Electronic Measurements and instrumentation", 2nd edition, International publishing house, New Delhi
	2.	Alan S Morris, 2013, "Measurement and instrumentation", 3rd edition, AP publisher, New Delhi.
	3.	Deb A C, 2011, "Fundamentals of Biochemistry", 3rd edition, New central book agency.
	4.	John G. Webster, 2010, "Medical Instrumentation Application and design", 2nd edition, John Wiley & Sons publication, New Delhi
	5.	Fulekar M H, 2013, "Bioinstrumentation", 3rd edition, International publishing house, New Delhi.

Journal and Magazines	https://circuitglobe.com/measurement-error.html
E-Resources and Website	https://www.youtube.com/watch?v=8vKo_TBBX8E
Learning Method	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/ Employability/Innovations

Semester – II
DSE : MEDICAL PHYSICS

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24PYP2DC	MEDICAL PHYSICS	DSE	48	-	-	4

Preamble	This course has been designed for students to learn and understand The basic characteristics and production of X-rays. The fundamental concepts of radiation physics and its applications. The concept of radiation therapy techniques and radiation protection devices.
Prerequisite	Basic Knowledge on Materials science

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Summarize the characteristics and production of X-rays.	K2
CO2	Outline the theory of radiation and various radiation chambers.	K4
CO3	Explain the principle and function of various imaging system.	K3
CO4	Infer the basic radiation therapy techniques.	K2
CO5	Illustrate the various measures and radiation protection devices.	K3

Mapping with Program Outcomes:

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

24PYP2DC	DSE: MEDICAL PHYSICS

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**X-Rays** Electromagnetic spectrum - Production of X-rays - X-ray spectra - Brehmsstrahlung - Characteristics of X-ray - X-ray tubes - Coolidge tube - X-ray tube design - Tube cooling - Stationary Mode - Rotating anode X-ray tubes - Quality and intensity of X-rays - X-ray generator circuits - Half wave and full wave rectification - Filament circuit - Kilo voltage circuit.	10 h	Text Book
II	**Radiation Physics** Radiation units - Exposure - Absorbed dose - Rad gray - Kera relative biological effectiveness - Effective dose - Inverse square law - Interaction of radiation with matter - Radiation detectors - Thimble chamber - Condenser chambers - Geiger counter - Ionization chamber - Dosimeters - Survey methods - TLD and semiconductor detectors.	10 h	Text Book
III	**Medical Imaging Physics** Radiological imaging - Radiography - Filters - Grids - Cassette - X-ray film - Film processing - Fluoroscopy - Computed tomography scanner - Generations - mammography - Ultrasound imaging - Magnetic resonance imaging - Thyroid uptake system - Gamma camera (Only Principle, function, and display).	09 h	Reference Book
IV	**Radiation Therapy Physics** Radiotherapy - Kilo voltage machines - Deep therapy machines - Tele-cobalt machines - Basics of teletherapy units - Medical linear accelerator - Radiation protection - External beam characteristics - Phantom - Dose maximum and build up - Bolus - Percentage depth dose - Tissue - Air ratio - Back scatter factor.	10 h	NPTEL

V	Radiation Protection Principles of radiation protection - Protective materials - Radiation effects - Somatic, genetic stochastic and deterministic effect, Personal monitoring devices - TLD film badge - Pocket dosimeter.	09 h	You Tube Videos
	TOTAL	**48 h**	

Text Book	**1.**	Thayalan K, 2003, "Basic Radiological Physics", 2nd edition, Jayapee Brothers Medical Publishing Pvt. Ltd., New Delhi
	2.	Khan F M, 2003, "Physics of Radiation Therapy", 3rd edition, Williams and Wilkins
Reference Books	**1.**	Bushberg, Seibert, Leidholdt, 2002, "The Essential Physics of Medical Imaging" 2nd edition, Williams and Wilkins
	2.	Scott, K N, Mathur A K, 2007 "Textbook of Biomedical Instrumentation" CBS publisher, New Delhi.
	3.	Fulekar M H, 2013, "Bioinstrumentation", 2nd edition, International publishing house, New Delhi
	4.	Mandeep Singh, 2014, "Introduction to Biomedical Instrumentation, PHI Publisher, New Delhi
	5.	John G, Webster, 2010, "Medical Instrumentation Application and Design" John Wiley & Sons publication

Journal and Magazines	https://indico.cern.ch/event/34840/attachments/687622/944392/Silari_Summer_Students_lecture_01.08.08.pdf
E-Resources and Website	http://ijlalhaider.pbworks.com/w/file/fetch/70354430/IP447_BIB.pdf
Learning Method	Chalk and Talk/Assignment/Seminar
Focus of the Course	Skill Development/ Employability/Innovations

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