SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS),

Reaccredited with 'A' Grade by NAAC
Affiliated to Periyar University
Fairland's, SALEM- 636 016

DEPARTMENT OF PHYSICS

M.SC. PHYSICS SYLLABUS
(2020 – 2021)

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM – 16
DEPARTMENT OF PHYSICS
M.Sc. PHYSICS COURSE STRUCTURE UNDER CBCS
(Applicable to the candidates for the academic year 2020- 2021)

I SEMESTER				
COURSE	**COURSE TITLE**	**CODE**	**HRS/ WEEK**	**CREDIT**
Core course – I	Classical and Statistical Mechanics	20PPHC1	6	5
Core course – II	Quantum Mechanics – I	20PPHC2	6	5
Core course – III	Advanced Electronics	20PPHC3	5	5
Core course – IV	Electromagnetic Theory	20PPHC4	5	5
Core course – V	Core Practical – I	20PPHQC1	8	4
Extra Skills: • *Productive Preparation for CSIR/SET/JRF- I (Self – study) –1 Credit extra* • *Articulation and Idea Fixation skills – 6 Hours per semester (out of college hours)* • *Life Skills Promotion – 2 Hours per semester (out of college hours) – 1 credit extra* • *Physical Fitness Practice – 35 Hours per semester (out of college hours) – 1 credit extra .*				
		Total	**30**	**24+3***
II SEMESTER				
Core Course – VI	Analytical Methods of Physics	20PPHC5	6	5
Core Course –VII	Microprocessor and Microcontroller	20PPHC6	5	4
Core Course VIII	Condensed Matter Physics	20PPHC7	5	4
Elective – I		20PPHEC1	4	4
Core Course – IX	Core Practical – II	20PPHQC2	8	4
Human Rights	Human Rights	20PHRSC	2	2
Value Education	Value Education	20PVENC		
Extra Skills: • *Productive Preparation for CSIR/SET/JRF- II (Self – study) –1 Credit extra* • *Articulation and Idea Fixation skills – 6 Hours per semester (out of college hours) – 1 credit extra* • *Life Skills Promotion – 2 Hours per semester (out of college hours) – 1 credit extra* • *Physical Fitness Practice – 35 Hours per semester (out of college hours) – 1 credit extra*				
Total			**30**	**23+4***

III SEMESTER				
Core Course – X	Quantum Mechanics – II	19PPHC8	5	4
Core Course – XI	Spectroscopy	19PPHC9	5	4
Elective – II		19PPHEC2	4	3
Elective – III		19PPHEC3	4	3
Core Course –XII	Core Practical – III	19PPHQC3	8	4
EDC		19PPHEDC	4	4
Extra Skills: • *Productive Preparation for CSIR/SET/JRF- II (Self – study) –1 Credit extra* • *Articulation and Idea Fixation skills – 6 Hours per semester (out of college hours)* • *Life Skills Promotion – 2 Hours per semester (out of college hours) – 1 credit extra* • *Physical Fitness Practice – 35 Hours per semester (out of college hours) – 1 credit extra* • *Preparation for the project – 5 hours per week (Out of College hours)*				
		Total	**30**	**22+3***
IV SEMESTER				
Core Course – XIII	Nuclear and Particle Physics	19PPHC10	6	5
Elective –IV		19PPHEC4	5	4
Elective – V		19PPHEC5	5	4
Core Course – XIV	Core Practical –IV	19PPHQC4	8	4
Core Course – XV	Project and Project viva – voce	19PPHPC	6	4
Extra Skills: • *Productive Preparation for CSIR/SET/JRF- IV (Self – study) –1 Credit extra* • *Articulation and Idea Fixation skills – 6 Hours per semester (out of college hours) – 1 credit extra* • *Life Skills Promotion – 2 Hours per semester (out of college hours) – 1 credit extra* • *Physical Fitness Practice – 35 Hours per semester (out of college hours) – 1 credit extra*				
			30	**21+4***
Grand Total				**90+14***

Extra Credits

- ***Free and Open Source Software (FOSS)-2hours per semester (out of college hours)***

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM – 16
DEPARTMENT OF PHYSICS
M. Sc PHYSICS – ELECTIVE PAPERS OFFERED
(Applicable to the candidates admitted from the academic year 2019- 2020 onwards)

Semester	Elective	Title of the Paper	Paper Code
II	I	1. Energy Physics	20PPHEC1
		2. Plasma Physics	20PPHSEC1
III	II	1. Instrumentation	19PPHEC2
		2. Crystal Growth Techniques	19PPHSEC2
	III	1. Materials Science	19PPHEC3
		2. Instrumental Methods of Analysis	19PPHSEC3
IV	IV	1. Communication Electronics	19PPHEC4
		2. Photonics	19PPHSEC4
	V	1. Opto electronics	19PPHEC5
		2. Thin Film Physics	19PPHSEC5

Extra Disciplinary Course offered by the Department

(For students other than Physics)

1. Communication Systems – 19PPHEDC

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM-16
PROGRAMME: M.Sc. PHYSICS

PROGRAM EDUCATIONAL OBJECTIVES

At the end of the program, the students will be able to

PEO1	Pursue higher career paths in industry, teaching, research and development
PEO2	Continue to develop professionally through higher education in their areas of specialization
PEO3	Ability to carry out advanced tasks and projects both independently and in collaboration with others.
PEO4	Function effectively as an individual and as a member/leader in diverse teams.
PEO5	Commit to professional ethics and responsibilities.
PEO6	Gain confidence to engage in life-long learning.

PROGRAMME OUTCOMES

At the end of the program, the students will be able

PO1	To acquire deep knowledge in thrust areas of Physics through exploration and consideration of its complexities.
PO2	To develop knowledge to comprehend, analyse, design and provide solutions for scientific problems suitable to existing requirements.
PO3	To communicate clearly the professional ethics and norms of the scientific and sustainable development using appropriate techniques and tools
PO4	To update knowledge to realize potential for employment in job related requirements.
PO5	To orient students to manage research application projects in multi-disciplinary areas.

PROGRAMME SPECIFIC OUTCOMES

At the end of the program, the students will be able to

PSO1	Acquire knowledge in the fields of physics in the advanced areas.
PSO2	Analyse experimental data and their level of uncertainty and to relate experimental results with theoretical expectations
PSO3	Solve open ended problems and problems with well-defined solutions by identifying key issues and trying different approaches in order to make progress.
PSO4	Plan, execute and report the results by working in groups and interacting constructively with others.

Programme : M.Sc. Physics				
Semester: I	**Code: 20PPHC1**	**Core Course – I CLASSICAL AND STATISTICAL MECHANICS**	**Credit:5**	**Hours: 6/ Week**

Course Objective:

The contents emphasize the advantage of energy representation in dynamics and macroscopic properties. The subject matter has been built up systematically from the fundamental concepts.

SYLLABUS

Unit	Content	Hrs
I	**LAGRANGIAN FORMALISM** Lagrangian Formulation – Generalised coordinates – Principle of virtual work -D' Alembert's principle – Lagrange's equation of motion – Hamilton's Variational Principle and Lagrange's equation. Hamilton's theory – Hamilton's equation – Cyclic variables – Routh's Procedure, Principle of least action	**18**
II	**CANONICAL TRANSFORMATIONS** Canonical Transformations – Equations of canonical transformations - Examples of canonical transformation - Lagrange's and Poisson's brackets – Properties – Applications Constants of motion, Poisson's theorem and symmetry properties.	**18**
III	**RIGID BODY DYNAMICS & SMALL OSCILLATIONS** **Rigid body Dynamics:** Moments and products of inertia – Euler's angles – Euler's equation of motion. **Oscillatory motion:** Theory of small oscillations – Lagrangian Formulation – Normal frequencies – Normal coordinates – Linear triatomic molecules.	**18**
IV	**CONCEPTS OF STATISTICAL MECHANICS** Microstates – Phase – space, Liouville's theorem – Maxwell Boltzmann distribution – The classical perfect gas – Root mean square and most probable velocities – Equipartition of energy – The specific heat of gases. Bose – Einstein distribution, the perfect gas – The specific heat of solids: The phonon gas.	**18**
V	**QUANTUM STATISTICS** Fermi Dirac distribution – The Fermi Dirac gas – The electron gas – Pauli Paramagnetism – Thermionic emission. Third law of thermodynamics – Specific heat and absolute zero – Zero point energy – Liquid Helium.	**18**

Books for Study

1. Classical Mechanics B.D.Gupta& Sathya Prakash 2003 Edition.
2. Classical Mechanics –Gupta Kumar Sharma.
3. Statistical Mechanics –S.L .Guptha, V.Kumar-9th Edition.

Books for Reference

1. Classical Mechanics – Goldstein, Narosa publishing House, Chennai. (1988).
2. Classical Mechanics – Gupta, Kumar & Sharma (1992).
3. Thermodynamics, statistical physics and Kinetics – Satyaprakash& T.P. Agarwal, KedarNethRamnath and Co. Publishers, Meerut.(1989).
4. Statistical Mechanics – Gupta & Kumar, Pragati Prakashan, 9th edition, Meerut (2009).
5. Statistical Mechanics by Satya Prakash, Kedarnath Ramnath and Co. Publishers, Meerut (1989).

Web Resources

1. https://www.physicsforums.com/threads/website–for–classical–mechanics.792083/
2. https://ocw.mit.edu/courses/physics/8–333–statistical–mechanics–i–statistical–mechanics–of–particles

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Gain knowledge and understanding of Lagrangian and Hamiltonian formulations of mechanics and to apply them to simple systems.	K_2
CO2	Analyse the new problem and application techniques of classical mechanics.	K_4
CO3	Get clear understanding of recent intricate theories rigid body dynamics & small oscillations.	K_2
CO4	Understand the concept of statistical mechanics.	K_2
CO5	Apply the concepts of Statistical Mechanics to various physical phenomena.	K_3

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO an PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	M	S	M	S	S	M	M	S
CO 2	S	S	S	M	S	S	S	M	S
CO 3	S	S	S	M	S	S	M	M	S
CO 4	S	M	S	L	S	S	S	M	S
CO 5	S	M	S	M	S	S	M	M	S

Programme : M.Sc. Physics				
Semester I	**Code: 20PPHC2**	**Core Course - II QUANTUM MECHANICS I**	**Credit:5**	**Hours: 6/ Week**

Course Objective:

This paper makes the students to understand the various kinetics involved in advanced physics using approximation methods.

SYLLABUS

Unit	Content	Hrs
I	**FORMALISM OF QUANTUM MECHANICS** Schrodinger equation for a free particle – Statistical interpretation – Condition on the wave function – Operator formalism – Linear operators – Self adjoint operations – Expectation value – Eigen values and eigen functions – Orthonormality. **ONE DIMENSIONAL PROBLEMS** Hydrogen atom – Reduction of equivalent one body problem – Hydrogeniceigen functions and spectra – Normal Zeeman effect of Hydrogenic atoms.	**18**
II	**APPROXIMATE EVALUATION OF EIGEN VALUES AND EIGEN FUNCTIONS FOR DISCRETE LEVEL:** First and second order perturbation theory in Non–degenerate and degenerate cases – Application to ground state of anharmonic oscillator (the perturbed Harmonic oscillator) – Energy term is proportional to x, x^2 and x^4 – Stark effect in hydrogen atom – Variation method – Application to ground state of He atom.	**18**
III	**ANGULAR MOMENTUM** Commutation rules for Angular Momentum operators – Eigen value spectrum J^2,J_z, J_x, J_y, J_+ and J_-– Raising and lowering operators – Matrix representation of Angular momentum – spin matrices and wave functions – Combination of two Angular Momenta – Clebsch – Gordon co–efficients – Its properties and its evaluation.	**18**
IV	**EQUATION OF MOTION** Schroedinger picture – Wave equation – Stationary states – Heisenberg picture – correspondence with classical mechanics – The Interaction picture – Dirac's Braand Ketvector notation – Matrix Representation – An example: Harmonic oscillator – Quantum conditions and their invariance using mechanics.	**18**
V	**TIME EVOLUTION OF STATE** Perturbation theory, first and second order transitions under constant perturbation — Application to potential scattering – Harmonic perturbations, Adiabatic and Sudden approximation.	**18**

Books for Study

1. Quantum Mechanics by SatyaPrakash and Swathi Saluja, Kedarnath Ramnath, Meerut. (2019).
2. Quantum Mechanics by S.L.Gupta, V.Kumar, H.V.Sharma & R.L.Sharma, Jai Prakashnath and Co, Meerut. (1997).

Books for Reference

1. Quantum Mechanics by Srivastava, Prakati Publishers.(1990)
2. Quantum Mechanics by Mathews&Venkatesan, Tata McGraw Hill, second edition. (1989).
3. Quantum Mechanics by Pauling &Wilson, McGraw Hill, Kragakusha ltd.(1935).
4. Quantum Mechanics by Ghatak and Loganathan, Macmillan Ltd.(2004).

Web Resources

1. https://www.springer.com › Home › Physics › Quantum Physics

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Gain good understanding of the formalism of Quantum Mechanics.	K_1, K_2
CO2	Evaluate Eigen values and Eigen functions for descrete level.	K_5
CO3	Develop deep knowledge of angular momentum.	K_1,K_6
CO4	Apply the most appropriate approximation method for solving specific problems.	K_3
CO5	Calculate the rate of transition using time–dependent perturbation theory.	K_4, K_5

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	M	S	S	M	S	S	S
CO 2	S	S	S	M	S	S	L	M	M
CO 3	S	M	L	S	M	S	S	S	S
CO 4	M	S	S	L	S	L	S	M	S
CO 5	L	M	S	S	S	M	S	S	L

Programme : M.Sc. Physics				
Semester I	**Code: 20PPHC3**	**Core course – III ADVANCED ELECTRONICS**	**Credit:5**	**Hours: 5/Week**

Course Objective: To understand the basic functions of digital circuits, which have wide application in electronic appliances.

SYLLABUS

Unit	Content	Hrs
I	**OPAMP AND ITS APPLICATIONS** Op amp – CMRR – Slew rate – Instrumentation amplifier and its applications – Solution of simultaneous and differential equation – Active AC filters: First order, second order and higher order, Low pass, High pass, Band pass filter and Band reject filters – Precision rectifiers: Fast half wave and full wave rectifiers – Logarithmic and Antilog amplifier – Logarithmic multiplier – Analog squaring and square root circuits – Phase locked loop amplifier – Application of PLL 565 – Frequency multiplier.	**18**
II	**WAVE FORM GENERATORS** Astable, Monostable multivibrators and Schmitt trigger circuit using IC 555, OP AMP – Astable, Monostable, Bistable multivibrators – Square and Triangular wave generators, Phase shift oscillator,Wein Bridge oscillator – VCO 566 and its applications.	**18**
III	**COMBINATION AND SEQUENTIAL LOGIC DIGITAL CIRCUITS** Arithmetic circuits; Half, Full and Binary adders – Half, Full and Binary subtractors – BCD adder (complement method) – Encoder – Decoder – Multiplexer – Demultiplexer– Parity checker – Parity generator. Asynchronous and Synchronous counters – Up counter – down counter – Shift register – Ring counter – Johnson counter.	**18**
IV	**DIGITAL TO ANALOG CONVERSION** Variable resistance network – Binary ladder – D/A converter – Weighted resistor Accuracy and resolution. **ANALOG TO DIGITAL CONVERSION** Simultaneous (Flash) converter – Counter type – Dual slope – Voltage to frequency converter – Voltage to time converter – Successive approximation Converter.	**18**
V	**MEMORIES** The read only memory – Implementation of ROMs – Programmable and erasable ROMs – Applications of ROMS – Bipolar – Junction Transistor Random Access – Memory cells – MOS RAMs – Organization of a RAM – The charge coupled device(CCD) – Storage of charge – Transfer of charge – Input and output arrangement – Magnetic Bubble Memory – Programmable Logic Array(PLA).	**18**

Books for Study

1. Modern Digital Electronics – R. P. Jain, TMH, (2006).
2. Hand book of Electronics – Gupta and Kumar, Pragati Prakashan (2008).
3. OP-AMP and Linear integrated circuits – Ramakant A. Gayakwad, IV edition, PHI, (2000)
4. Digital Circuit and Design- S. Salivahanan& S. Arivazhagan – Sectionond Edition (2005).
5. Digital Integrated Electronics – Herbert – Taub/Donald Schilling, TMH (1985).

Books for Reference

1. Integrated Electronics – Millman & Halkias, TATA McGRAW-HILL, (1985).
2. Micro Electronics – Millman and Grabel, TMH, (1987).
3. Digital principles and applications – Malvino and Leach, V edition, TMH,(1996).
4. Digital Fundamentals – Floyd, Pearson Education, (2008).

Web Resources

1. https://www.elsevier.com/...advanced–electronic...materials.../978–0–12–513745–4

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Know the uses of operational amplifiers.	K_1
CO2	Understand the astable, Monostable multivibrators and Schmitt trigger circuit using IC 555.	K_2, K_3
CO3	Acquire knowledge in combination and sequential logic digital circuits and apply the electronic circuit principles.	K_2, K_3
CO4	Learn and understand the Conversion of Digital to Analog, and Analog to Digital Conversion.	K_2,K_3 K_4, K_5, K_6
CO5	Impart the knowledge about different types of Memories devices.	K_2, K_5, K_6

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	S	S	S	S	S	S	S
CO 2	S	S	S	S	M	S	S	S	S
CO 3	S	M	S	S	S	S	M	S	S
CO 4	S	S	S	S	S	S	S	S	S
CO 5	S	S	S	S	S	S	S	S	S

Programme : M.Sc. Physics				
Semester I	**Code: 20PPHC4**	**Core Course – IV ELECTROMAGNETIC THEORY**	**Credit :5**	**Hours: 5/week**

Course Objective: To understand the basic concepts of electrical and magnetic properties of electromagnetic waves. To apply vector Maxwell's equations to solve simple electromagnetic problems to make use of theoretical methods to understand the electrical and magnetic properties of matter and to incorporate the fundamental theory of electromagnetism into the scientific problem.

SYLLABUS

Unit	Content	Hrs
I	**ELECTROSTATICS** Electric field – Gauss law and its application – Electrostatic potential – Dipole and multipole moments – General method of solution to potential problems ; Poisson's equations – Laplace's equation – Solution of Laplace's equation.	18
II	**MAGNETOSTATICS** Biot–Savart's law – Applications – Magnetic field due to current flowing in a wire – Force between parallel wires carrying currents –The force on a current carrying conductor and Lorentz force – Ampere's law in circuital form –Applications –Magnetic field due to a long straight current carrying wire inside a long solenoid – Magnetic Scalar potential – Magnetic vector potential – Characteristics – Lorentz conditions.	18
III	**MAXWELL'S EQUATIONS** Maxwell's equation – Equation of continuity – Maxwell's displacement current – Physical interpretation – Derivation of Maxwell's equations – Physical significance – Electromagnetic energy – Poynting'stheorem – Poynting's vector – The wave equation – Plane electromagnetic waves in free space.	18
IV	**ELECTROMAGNETIC POTENTIALS AND ECTRODYNAMICS** Electromagnetic vector and scalar potentials – Non uniqueness of electromagnetic potentials – Concept of Gauge – Radiation due an oscillating electric dipole – Poynting vector and radiated power – Electric dipole as an accelerated charge – Radiation due to a small current element.	18
V	**APPLICATIONS OF ELECTROMAGNETIC WAVES** Boundary conditions at the surface of discontinuity – Reflection and Refraction of electromagnetic waves at the interface of non–conducting media – Total internal reflection – Dispersion – Normal and Anomalous – Dispersion in gases – Theory of scattering of electromagnetic waves.	18

Books for Study

1. Electromagnetic theory and Electrodynamics – Satyaprakash (2008).

Books for Reference

1. Fundamentals of Electromagnetic Theory by Prentice Hall India Learning Jan 2011.
2. Electromagnetic Theory by U.A. Bakshi, A.V. Bakshi-2009.
3. Fundamentals of Applied Electromagnetics (7^{th} edition)by Fawwaz T. Ulaby, Umberto Ravaioli 2014.
4. Electromagnetic field Theory and Transmission lines by Pearson Education Ltd-Jan 2013.

Web Resources

1. http://ocw.mit.edu>resources>textbo
2. https://www.researchgate.net>journal
3. https://www.calvin.edu>EMFT Book

Course Outcomes: At the end of the course the student will be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Acquire the knowledge on fundamental concepts of electric and magnetic fields.	K_2
CO2	Formulate potential within electrostatics magneto statics and stationery current distributions in linear, isotropic media.	K_4
CO3	Interpret the deeper meaning of the Maxwell equations, formulate and solve electromagnetic problems.	k_5
CO4	Master the technique of deriving and evaluating formulae for the electromagnetic fields from very general charge and current distributions.	k_5,K_3
CO5	Calculate the electromagnetic radiation from radiating systems.	k_5

K_6–Create; K_5–Evaluate; K_4–Analyse; K_3–Apply; K_2–Understand; K_1–Recall

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	M	S	M	S	S	M	M	S
CO 2	S	S	S	M	S	S	M	S	S
CO 3	S	S	S	S	S	S	M	S	S
CO 4	S	S	S	S	S	S	S	M	S
CO 5	S	S	S	S	S	S	M	M	S

Programme : M.Sc. Physics				
Semester I	**Code: 20PPHQC1**	**CORE PRACTICAL – I**	**Credit:4**	**Hours: 8/Week**

Course Objective:
The aim of the course is to develop the practical skills by applying the laws and concepts in physics and electronics experiments.

SYLLABUS

Students are expected to perform at least 10 experiments out of following list.

Unit	Content	Hrs
1.	Cornus Elliptical fringes - Young's modulus and Poisson's ratio.	**90**
2.	F.P. Etalon using Spectrometer.	
3.	Thermistor – Determination of Band gap energy and temperature coefficient.	
4.	Charge of an electron – Spectrometer.	
5.	Mayer's Disc-Determination of Viscosity.	
6.	Construction of Half adder, full adder and Half Subtractor, Full Subtractor using Ex-OR gates.	
7.	Op- amp - Square and Triangular wave generators.	
8.	Mod Counters using IC 7490.	
9.	Schmitt trigger using IC 555 and Op-amp.	
10.	Astable multivibrator using IC 555&IC741.	
11.	Hydrogen arc spectrum.	
12.	Voltage controlled oscillator using IC565.	

Books for Study

1. Practical Physics and Electronics - C. C. Ouseph, U. J. Rao, V.Vijeyendran, SV Printers and Publishers Pvt. Ltd., (2007).
2. Practical Physics, Prof.A.Ponnusamy and B.Amalanathan, Bright Publishers, (1996).

Books for Reference

1. A text book of Practical Physics – M.N.Srinivasan and others, Sultan Chand and Sons, (2014).

Web Resources

1. www.practicalphysics.org/

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Apply theory of electronics to design arithmetic, logical and oscillator circuits and analyze the experimental data and develop skills in using instruments like multimeters, function generator and oscilloscopes.	K_6,K_4
CO2	Acquire knowledge to form Cornus Elliptical fringes in microscope and verify Young's modulus of a glass plate.	K_2,K_4
CO3	Develop logical thinking skills through digital experiments and apply it to solve physical problems.	K_3,K_6
CO4	Acquire profound knowledge in physics concepts by doing laboratory experiments and interpreting the results.	K_6,K_4
CO5	Gain knowledge to make Hydrogen arc spectrum.	K_2

K_6-Create; k_5-Evaluate; K_4-Analyse; K_3-Apply; K_2-Understand; K_1-Recall

Mapping of CO with PO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	M	S	S	S	S	S	M	S
CO 2	S	S	M	S	S	S	S	M	M
CO 3	S	S	M	S	S	S	S	M	S
CO 4	S	M	M	S	S	S	S	S	S
CO 5	S	M	M	M	S	S	S	M	M

Programme : M.Sc. Physics				
Semester II	**Code: 20PPHC5**	**Core Course - VI ANALYTICAL METHODS OF PHYSICS**	**Credit:5**	**Hours: 6/ Week**

Course Objective:

Mathematics has become an integral part of physics. This paper aims at providing extensive mathematical formalism for understanding and interpreting various Physical problems.

SYLLABUS

Unit	Content	Hrs
I	**VECTOR FIELD AND TENSORS** Vector fields – Orthogonal Curvilinear Coordinate systems – expression for gradient, divergent, curl and Laplacian – Spherical polar coordinates and differential operators Transforamtion of coordinates – Summation convention – Contravariant, Covariant and mixed tensor – Rank of a tensor – Kronecker delta symbol – Symmetric and antisymmetric tensor – Invariant tensors.	**18**
II	**COMPLEX INTEGRALS** Cauchy's integral theorem and formula – Derivatives of analytic function – Taylor and Laurent's series - Zeroes and Singularities – Residues – The residue theorem – Evaluation of real integrals.	**18**
III	**SPECIAL FUNCTIONS** Special functions – Legendre, Bessel, Laguerre'sand Hermite differential equations – Generating functions – Orthogonality relations – Rodrigue's formula – Recurrence relations.	**18**
IV	**GROUP THEORY** Definition of groups – Subgroups – Conjugate classes – Symmetry elements – The Group multiplication table – The group of symmetry of an Equilateral triangle and a square - Transformation – Matrix representation – Representation of groups – Reducible and Irreducible representation of groups – Schur's Lemma - Orthogonality theorem – Character representation – Character table for C_{2v} and C_{3v} point groups.	**18**
V	**DIRAC DELTA FUNCTION AND GREEN'S FUNCTION** Dirac – Delta function – Three dimensional delta functions – Green's function – one dimensional case – Symmetry properties of green function – Green's function for poisson equation – Quantum mechanical scattering problem.	**18**

Books for Study

1. Mathematical Physics – SatyaPrakash, S. Chand & Co, New Delhi, 2014.
2. Mathematical Physics – H.K.Dass, S.Chand& Co, New Delhi, 2010.
3. Group theory applications to molecular vibrations- P.G.Puranik, S. Chand & Co, New Delhi, 1979.
4. Mathematical Physics – B.D.Gupta., Vikas Publishing House Pvt Ltd, New Delhi, 1991.

Books for Reference

1. Complex Variable – Schaum Series, McGraw Hill Book Company, Singapore, 1998.
2. Functions of Complex Variable – J.N.Sharma, Krishna Prakashan Media pvt ltd, Meerut, 2001.
3. Elements of Group theory for Physicist – A.W.Joshi, New Age International Publishers, New Delhi, 2005.

Web Resources

1. http://nptel.ac.in/courses/115103036

Course Outcomes: At the end of the course the student should be able to:

CO Number	CO Statement	Knowledge Level
CO1	Know the basic concept of tensors and their applications in physics.	K_1, K_2, K_3, K_4
CO2	Understand the elements of complex variable and evaluate problems related to definite integrals.	K_3, K_4, K_5
CO3	Understand the properties of Special functions that are essential tools to solve the problems in various fields of physics.	K_5, K_4
CO4	Summarize the concepts of group theory and apply it to solve mathematical problems of interest in physics.	K_5, K_4, K_6
CO5	Understand and use the Delta and Green's functions for describing physical systems.	K_4, K_5, K_6

K_6–Create; K_5–Evaluate; K_4–Analyse; K_3–Apply; K_2–Understand; K_1–Recall

Mapping of CO with PO and PSO

CO	PO					PSO			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	M	M	L	S	L	L	M
CO 2	S	M	S	L	L	S	M	L	L
CO 3	S	S	S	L	L	S	S	L	M
CO 4	S	S	S	M	S	S	S	S	S
CO 5	S	S	S	L	M	S	M	M	M

Programme : M.Sc. Physics				
Semester II	**Code: 20PPHC6**	**Core Course – VII MICROPROCESSOR AND MICROCONTROLLER**	**Credit: 4**	**Hours: 5 / Week**

Course Objective:

To make the students to understand the basic functioning of microprocessor, microcontrollers and interfacing devices which have wide applications in electronic appliances.

SYLLABUS

Unit	Content	Hrs
I	**INTRODUCTION AND INSTRUCTION SET OF 8085** Evolution of Microprocessor – Concept of multiplexing in microprocessor – processor cycles – Machine cycles of 8085 – Instruction format of 8085 – Instruction set – Timing diagram of 8085 instructions. Multiprogramming – Time share and multitasking systems – Distributed processing /multiprocessing.	**15**
II	**INTERRUPT STRUCTURE AND INTERFACING WITH 8085** Interrupt and its need – Classification of interrupts – interrupts of 8085 – Software interrupts of 8085 – Hardware interrupts of 8085 – Priorities of Interrupts enabling , Disabling and Masking of 8085 interrupts-Temperature control systems using 8085 – Motor speed control systems using 8085 – Traffic light control using 8085. Interfacing of I/O and peripheral devices – Keyboard and display interfacing – keyboard and display interface using 8279 – DAC interface – ADC interface.	**15**
III	**ASSEMBLY LANGUAGE PROGRAMMING** Levels of programming – Flowchart – Assembler directives – Procedure and Macro – Delay Routine – List and Array – Stack – Examples of 8085 Assembly language programs – Program to subtract two numbers of 16 bit data stored in memory – Program to add two numbers of 8-bit data stored in memory – write an assembly language program to add two numbers of 2-digit(8-bit) BCD data stored in memory, program to multiply two numbers of 8-bit data, program to divide two numbers of 8-bit data, program to add an array of data- program to search the smallest data in an array.	**15**
IV	**PERIPHERAL DEVICES** Parallel data transfer schemes –Programmable I/O part and timer – Intel 8155/8156-Programmable Peripheral interface – Intel 8255 – DMA data transfer scheme – Serial data communication interface USART – INTEL 8251A.	**15**
V	**INTEL 8086 AND INTRODUCTION TO MICROCONTROLLERS** 8086 Microprocessor Internal Architecture – programming the 8086 – Addressing modes of 8086 –History of Microcontrollers and microprocessor-Embedded versus External memory devices-8-bit and 16-bit Microcontrollers (Basic idea).	**15**

Books for Study

1. Microprocessor and its application - A. NagoorKani, RBA publications (2004).
2. Microcontrollers [Theory and applications]- Ajay V. Deshmukh, TMH(2007).

Books for Reference

1. Microprocessor architecture, Programming and application with 8085 – Ramesh S. Gaonkar, Wiley Eastern. (2000).
2. Microprocessor and interfacing, Doughlas V. Hall, TMH. (2006).
3. Microprocessor and interfacing, Doughlas V. Hall, TMH. (2006).

Web Resources

1. https://simple.wikipedia.org/wiki/Microprocessor
2. http://www.futureelectronics.com/en/Microcontrollers/microcontrollers.aspx

Course Outcomes: At the end of the course the student should be able to:		
CO Number	CO Statement	Knowledge Level
CO1	Understand and apply the Concept of multiplexing in microprocessor, processor cycles, Machine cycles of 8085, Instruction format of 8085 and multiprogramming.	K_2,K_3
CO2	Understand and apply the interrupts of 8085, Software interrupts of 8085, Hardware interrupts of 8085, Priorities of Interrupts enabling, Disabling and Masking of 8085. Analyse the keyboard and display interfacing.	K_2,K_3,K_4
CO3	Apply, Impart and create the assembly language programs and program to search the smallest data in an array.	K_3,K_6
CO4	Apply, create and gain knowledge in the field of the Peripheral devices.	K_3,K_5,K_6
CO5	Apply, create and gain knowledge in the field of the 8086 Microprocessor Internal Architecture, programming the 8086, Addressing modes of 8086.	K_2,K_3,K_4

K_6–Create; K_5–Evaluate; K_4–Analyse; K_3–Apply; K_2–Understand; K_1–Recall

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	S	S	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	S	M	S

Programme : M.Sc. Physics				
Semester: II	**Code: 20PPHC7**	**Core Course - VIII CONDENSED MATTER PHYSICS**	**Credit:4**	**Hours: 5/Week**

Course Objective:
The aim of the course is to provide the basic elements of the physics of solids and to educate basics of Crystallography, Bonding, Lattice vibrations, Band theory of solids, Transport phenomena, and Superconductivity.

SYLLABUS

Unit	Content	Hrs
I	**CRYSTALLOGRAPHY AND BONDING** Reciprocal lattices – Vector development of reciprocal lattice – Properties of the reciprocal lattice – Reciprocal lattice to bcc lattice and fcc lattice – Bragg condition in terms of reciprocal lattice – Crystal diffraction – Neutron and electron diffraction – Brillouin zones. Binding energy of ionic crystals – Madelung constant – Cohesive energy – Compressibility and Bulk Modulus – Born Haber cycle. Crystals of inert gases –Vanderwaal's interaction – London interaction – Cohesive energy.	**18**
II	**LATTICE VIBRATION** Elastic vibration of continuous media – Group velocity of Harmonic wave trains – Wave motion of one dimensional atomic lattice – Lattice with two atoms per primitive cell – Some facts about diatomic lattice – Number of possible normal modes of vibration in a band – Optical properties in the infra red – Phonons – Momentum of phonons – Inelastic scattering of photons by phonons and neutrons by phonons.	**18**
III	**FREE ELECTRON THEORY** Free electron gas - Drude– Lorentz theory of metals – Sommerfeld model- Energy levels and density of orbitals in one dimension –Fermic – Dirac distribution for a free electron gas - Effect of temperature on the F.D. distribution –Free electron gas in three dimension – Heat capacity of a electron gas – Electrical conductivity and Ohm's law – Thermal conductivity of metals – Wiedemann – Franz law – Mathiessen's rule.	**18**
IV	**BAND THEORY OF SOLIDS** Early free electron model and origin of energy gap -Bloch wave function – wave equation in a periodic potential - Kronig - penney model – motion of electrons in one dimensional periodic lattice - effective mass of the electron – limitations of K- P model - Free electron approximation – the tight binding approximation – Brillouin zones – reduction of zones – De Hass – Van Alphen effect.	**18**

V	**SUPERCONDUCTIVITY** Super conductivity– Critical temperature– Isotope effect– Effect of magnetic field–Meissner effect– Penetration depth– Heat capacity – Energy gap – Theoretical survey – London equation–BCS theory– Cooper pair– Energy gap– Type I and type II Superconductors – Josephson tunneling – ac Josephson effect and dc Josephson effect – SQUIDS – High TC Superconductors.	**18**

Books for Study

1. Solid State Physics – S. L. Gupta & V. Kumar, K. Nath & Co, Meerut, 9th edition 2016 – 2017.
2. Solid State Physics - S.O.Pillai New Age International Publishers, 8th edition 2018.
3. Solid State Physics – K. Elangovan, S. Viswandhan Pvt. Ltd, 2007.

Books for Reference

1. Fundamentals of SolidState Physics – Saxena Gupta and Saxena, PragatiPrakashan, Meerut, (1989).
2. Solid state Physics – C.Kittel, Wiley Eastern Ltd.(2007).
3. Solid state Physics – Singhal, Kedarnath Ramnath & Co, Meerut.(2007).
4. Solid state Physics – S.O. Pillai, Wiley Eastern, New Age international Ltd.(1994).
5. Elements of Solid state Physics – J. P. Srivastava.

Web Resources

1. https://www.britannica.com/science/condensed–matter–physics

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Provide an in–depth knowledge of structure of solids.	K_1
CO2	Know the basics of bonding, lattice vibrations and free electron theory of solids.	K_2
CO3	Acquire deep understanding in the field of material science.	K_3
CO4	Emphasize the applications of superconductors in industry.	K_5,K_4
CO5	Understanding the concepts of crystallography.	K_6

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	M	S	S	S	S	S	L	S
CO 2	S	S	S	L	M	M	S	S	S
CO 3	S	M	M	S	S	S	S	M	S
CO 4	M	S	S	S	S	L	M	S	S
CO 5	S	S	S	S	S	S	M	S	M

Programme : M.Sc. Physics				
Semester II	**Code: 20PPHEC1**	**Elective –I ENERGY PHYSICS**	**Credit :4**	**Hours: 4/week**

Course Objective:
The aim of the course is to provide the conventional and non–conventional energy sources in a simple, lucid and precise manner.

SYLLABUS

Unit	Content	Hrs
I	**INTRODUCTION TO ENERGY SOURCES** Energy sources and their availability – Prospects of renewable energy sources. **SOLAR RADIATION AND ITS MEASUREMENTS** Solar constant – Solar radiation at the Earth‟s surface – Solar radiation – Geometry – Solar radiation measurements using Pyrheliometers, Pyranometers and Sunshine Recorder – Solar radiation data – Estimation of average solar radiation – solar radiation on tilted surfaces.	**12**
II	**SOLAR CELLS** Solar Electric power generation: Solar Photovoltaics – Solar cell principle – Semiconductor junctions – Conversion efficiency and power output – Single crystal Silicon solar cell. Polycrystalline solar cell – Cadmium sulphide Solar cell.	**12**
III	**APPLICATIONS OF SOLAR ENERGY** Solar water heating –Space heating and space cooling – Agricultural and industrial process heat – Solar distillation – Solar pumping – Solar furnace –Solar cooking – Solar green house.	**12**
IV	**WIND ENERGY** Basic principles of wind energy conversion - Wind data and energy estimation – Basic components of wind energy conversion systems (WECS) –Advantages and Disadvantages of WECS– Types of wind machines – Horizontal axis machine and vertical axis machine– Applications of wind energy – Pumping applications – Direct heat applications – Electric generation applications.	**12**
V	**ENERGY FROM BIO MASS** Biomass conversion Technologies – Wet and dry process – Photosynthesis. **BIO GAS GENERATION** Introduction – Basic process and energetics – Advantage – Anaerobic digestion – Factors affecting bio digestion of Generation of gas **CLASSIFICATION OF BIOGAS PLANTS** Continuous and batch type – The dome and drum types of bio gas plants – Different variations in Drum type. Types of Bio gas plants – Janatha biogas plant –Deenbandhu biogas plant–Fuel properties of bio gas and utilization of bio gas.	**12**

Books for Study

1. G.D.Rai, Non–Conventional energy sources, Khauna publication (2005).

Books for Reference

1. Solar Cells by Charles Cohen Agrotech Press Jaipur New Delhi-2019.
2. Solar Energy Fundamentals and Applications by Brajesh Priyadarshi Ishwar Books –New Delhi-2019.
3. Renewable energy by Robert Ehrlich March 15, 2013.

Web Resources

1. http://extension.psu.edu>renewable
2. http://www.e–education.psu.edu>node
3. http://www.researchgaate.net>publication

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Acquire basic knowledge on renewable energy resources.	K_2
CO2	Study the principle and performance of harnessing solar and other alternative energy sources.	K_2,K_1
CO3	Implement the solar energy in various applications like solar heating, cooling, cooking, etc.,	K_3
CO4	Collect the various energy sources like wind energy.	K_6
CO5	Apply the basic physical concepts to develop the conversion technologies like wet process, dry process and photosynthesis.	K_4

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	S	M	S	S	M	M	S
CO 2	S	M	S	M	S	S	M	M	S
CO 3	S	S	S	M	S	S	S	M	S
CO 4	S	M	S	M	S	S	M	M	S
CO 5	S	M	S	M	S	S	M	M	S

Programme : M.Sc. Physics				
Semester II	**Code: 19PPHESEC1**	**Elective I PLASMA PHYSICS**	**Credit:4**	**Hours 4/Week**

Course Objective:
The aim of the course is to know the basics and applications of plasma physics in nature and technology and to understand the problems of fusion research for energy generation.

SYLLABUS

Unit	Content	Hrs
I	**FUNDAMENTAL CONCEPTS ABOUT PLASMA** Kinetic pressure in a partially ionized gas – Mean free path and collision cross section – Mobility of charged particles – Effect of magnetic field on the mobility of ions and electrons – Thermal conductivity – Effect of magnetic field; Dielectric constant of plasma –Quasi neutrality of plasma – Debye shielding distance – Optical properties of plasma.	12
II	**MOTION OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELD** Particle description of plasma; Motion of charged particle in an electrostatic field – Motion of charged particle in uniform magnetic field – Motion of charged particles in electric and magnetic fields – Motion of charged particles inhomogeneous magnetic field – Motion of charged particles in a magnetic mirror confinement – Motion of an electron in a time varying electric field – Magneto hydrodynamics – Magneto hydrodynamic equations – Interpretation of the equations – Condition for magneto hydrodynamic behavior.	12
III	**PLASMA OSCILLATIONS AND WAVES** Introduction: Theory of simple Oscillations – Electron Oscillation in a Plasma – Derivation of plasma Oscillations by Utilising Maxwell's Equation – Ion Oscillations and Waves – Oscillations and waves in a magnetic field – Thermal effects on Plasma Oscillations – Landau damping – Hydromagnetic waves – Oscillations in electron beam.	12
IV	**PLASMA DIAGNOSTIC TECHNIQUES** Single probe method – Double probe method – Use of probe technique for measurement of plasma parameters in magnetic field – Microwave method – Spectroscopic method –: Laser as a tool for plasma diagnostics – X–ray diagnostics of plasma – Acoustic method – Conclusion.	12
V	**POSSIBLE APPLICATIONS OF PLASMA PHYSICS** Magneto hydrodynamic generator –Basic theory – Magneto hydrodynamic generator – Principle of working – The fuel in M.H.D – Magnet in M.H.D. generator – Generation of Microwaves utilizing high density plasma – Plasma diode.	12

Books for Study

1. Plasma Physics – Plasma State of Matter – S.N. Sen, Pragati Prakashan Meerut –I

2. Introduction to Plasma Physics – FF. Chen.1600 Plenum Press, London.

Books for Reference

1. Plasma Diagnostic Techniques – RH Huddlestone and SL Leonard, 1600
2. Plasma The fourth state of Matter – D.A. Frank – Kamenetskii –Macmillan Press Ltd, London.

Web Resources

1. https://www.nature.com/subjects/plasma–physics

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Know the fundamental Concepts about Plasma.	K_1
CO2	Understand the motion of charged Particles in Electric and Magnetic Field.	K_2
CO3	Acquire the knowledge of Plasma Oscillations and Waves.	K_3
CO4	Analyse Plasma Diagnostic Techniques.	K_4, k_5
CO5	Discusses possible applications of Plasma Physics, MHD and Plasma diode.	,k_3

K_6–*Create;* K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	S	M	S	S	M	M	S
CO 2	S	M	S	M	S	S	M	M	S
CO 3	S	S	S	M	S	S	S	M	S
CO 4	S	M	S	M	S	S	M	M	S
CO 5	S	M	S	M	S	S	M	M	S

Programme : M.Sc. Physics				
Semester II	**Code: 20PPHQC2**	**CORE PRACTICAL – II**	**Credit:4**	**Hours: 8/Week**

Course Objective:
The aim of the course is to develop the practical skills by applying the laws and concepts in physics and electronics experiments.

SYLLABUS

Students are expected to perform at least 10 experiments out of following list.

Unit	Content	Hrs
1.	Cornus Hyperbolic fringes- Young's modulus and Poisson's ratio.	**90**
2.	Solar spectrum-Rydberg's constant.	
3.	Polarizability of liquid – Hollow prism –Spectrometer.	
4.	Microprocessor programs 1. To find the biggest number and smallest number. 2. Arranging numbers in ascending and descending order.	
5.	Microprocessor programs II 1. Factorial of a given number. 2. Square root of a given number. 3. BCD to Binary conversion. 4. Binary to BCD conversion.	
6.	Design of NAND/NOR Network to generate the given Sum of Products.	
7.	Op –Amp – First order low pass, high pass and band pass filters.	
8.	ADC using comparators.	
9.	Analog computer circuit design – Solving the Simultaneous equations.	
10.	Synchronous and Asynchronous Counters (Up and down counter).	
11.	Bistable multivibrator using op-amp and IC555.	
12.	GM Counter.	

Books for Study

1. Practical Physics and Electronics - C.C.Ouseph, U.J.Rao, V.Vijeyendran, SV Printers and Publishers Pvt. Ltd., (2007).
2. Practical Physics, Prof.A.Ponnusamy and B.Amalanathan, Bright Publishers, (1996).

Books for Reference

1. A text book of Practical Physics – M.N.Srinivasan and others, Sultan Chand and Sons, (2014).

Web Resources

1. www.practicalphysics.org/

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Acquire knowledge to design and analyze digital and electronic circuits.	K_2,K_4
CO2	Understand and apply the knowledge of theory like properties of matter, light and dielectrics to experiments.	K_2,K_4
CO3	Apply physics principle to validate the experimental results and develop skills in using instruments like microscope, multimeters, function generator and oscilloscope.	K_3,K_4
CO4	Apply logical thinking skills to write the program in 8085 microprocessor and verify the results.	K_2,K_4
CO5	Apply the theory of Op- amp to design filter circuits design and analyze logical circuits.	K_3,K_6

K_6-*Create*; k_5-*Evaluate*; K_4-*Analyse*; K_3-*Apply*; K_2-*Understand*; K_1-*Recall*

Mapping of CO with PO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	M	S	S	S	S	S	M
CO 2	S	M	M	S	S	S	S	M	S
CO 3	S	S	S	S	S	S	S	S	S
CO 4	S	S	M	S	S	S	S	S	M
CO 5	S	M	M	S	S	M	S	M	M

Programme : M.Sc. Physics				
Semester: II	**Code: 20PHRSC**	**HUMAN RIGHTS**	**Credit:2**	**Hours: 2/Week**

Course Objective: The course aims

- To educate the students regarding the study of Human Rights.
- To know about the efforts, taken by the makers of our constitution to include these rights.
- To understand the role of judiciary in safeguarding the economic and women's rights.

SYLLABUS

Unit	Content	Hrs
I	Human rights-Definition-characteristics of Human rights-Classification of Human rights-the Universal declaration of Human rights -international covenants on economic, social and cultural rights.	**6**
II	Constitutional guarantee on Human rights - fundamental rights part III of the constitution-Directive principles part IV of the constitution.	**5**
III	Civil and political rights – Right to work, right to personal freedom, right to freedom of expression, right to property, right to education, right to equality, right to religion, right to form association and unions, right to family, right to contract, right to constitutional remedies, right to contest in election, right to hold public office, right to petition, right to criticize government.	**7**
IV	Economic rights: right to work, right to adequate wages, right to reasonable hours of work, right to self government in industry.	6
V	Women's right: Right to inheritance, right to divorce, right to remarry, right to education, right to employment and career advancement.	**6**

Books For Study

1. Sivagami Paramasivam - Human Rights, Sri Ram Computer Prints, Salem, 2002.

Books for Reference

1. Desai, A.R. - Violation of Democratic Rights in India, Popular Prakasam Publication, Bombay, 1986.

2. Human Rights - UNESCO, 1982.

3. Human Rights - A selected Bibliography, USIS, New Delhi, 2004.

4. Pandey - Constitutional Law, Chand & Co, New Delhi, 2000.

5. Singh, K.S. - Indian Social Institution, PrakashKandra, New Delhi, 1983.

Web Sources

1. https://en.wikipedia.org/wiki/Civil_and_political_rights

Course Outcomes: On completion of the course, students should be able		
CO Number	**CO Statement**	**Knowledge Level**
CO1	To teach the value of Human Rights.	**K_1**
CO2	To provide knowledge on the fundamental rights and directive principles of the constitution.	**K_2**
CO3	To create an awareness on the civil and political rights.	**K_2**
CO4	To summarise the economic rights.	**K_6**
CO5	To analyse the importance of women's rights.	**K_4**

K_6-*Create*; k_5-*Evaluate*; K_4-*Analyse*; K_3-*Apply*; K_2-*Understand*; K_1-*Recall*

Programme : M.Sc. Physics				
Semester III	**Code: 19PPHC8**	**Core Course - X QUANTUM MECHANICS II**	**Credit:4**	**Hours: 5/Week**

Course Objective:

The aim of the course is to provide an understanding of the advanced concepts and its applications to study the scattering of fundamental particles, relativistic modification in particle behavior, approximations in molecular atomic structure and atom field interaction.

SYLLABUS

Unit	Content	Hrs
I	**SYSTEMS OF IDENTICAL PARTICLES** Indistinguishability of identical particles – Symmetric and anti Symmetric wave function – Exchange operator – Distinguishability of identical particles – Bosons and Fermions – Pauli's Exclusion principles – Collision of identical particles – Ensemble of identical particle systems – Density matrix – Properties – Symmetric and Anti symmetric wave function of hydrogen molecule.	15
II	**EIGEN STATES BELONGING TO THE CONTINUUM** The scattering problem - Formulation – The method of partial waves - Scattering amplitude – Phase shifts – Low energy scattering – Scattering length and effective range – Effect of identity of particles – Green's function – Born approximation and its validity – scattering by Yukawa potential – Coulomb Scattering – Screened coulomb potentials -	15
III	**EMISSION AND ABSORPTION OF RADIATION** The Einstein coefficient – atom field interaction – Spontaneous and induced emission of radiation from semi – Classical theory – Electric dipole transition – Selection rules and polarizability – Transition probabilities for stimulated emission and absorption and spontaneous emission of radiation – Quantization of radiation field – Radiation field as an assembly of oscillators– Interaction with atoms and absorption rates .	15
IV	**ATOMIC AND MOLECULAR STRUCTURE** Approximations in atomic structure – Central field approximation – Thomas Fermi Statistical model – HartreeFock Equation – The method of self consistent field – Residual electrostatic and spin orbit interaction – Alkali atoms – Doublet separation – Coupling schemes – Hydrogen molecule – Covalent bond.	15
V	**RELATIVISTIC WAVE EQUATION** The Klein – Gordon Equation – Charge and current densities in four vector – KG equation in electromagnetic field – The Dirac relativistic equation : The Dirac matrices – Free particle solutions – Meaning of negative energy states – Electromagnetic potential – magnetic dipole moment – Existence of electron spin – Spin orbit energy.	15

Books for Study

1. Quantum Mechanics -Satyaprakash, KedarNath Ram Nath, 2012.
2. Quantum Mechanics - Ajay Ghatak and S.Loganathan, Macmillan India Ltd, 2011.
3. Quantum Mechanics -P.M. Mathews and K.Venkatesan, Tata McGraw Hill Education Pvt.Ltd., 2013.

4. Quantum Mechanics -Leonard I.Schiff, Tata McGraw Hill Education Pvt. Ltd., 2010.
5. Quantum Chemistry -R.K. Prasad, New Age International Pvt. Ltd., 2010.

Books for Reference

1. Quantum Mechanics - Gupta, Kumar, Sharma, Jai Prakash Nath & Co., 2004.
2. Quantum Mechanics - B. N. Srivastava, Pragati Prakashan, 1990.
3. Advanced Quantum Theory and Fields - S. L. Gupta & I. D. Gupta, S. Chand & Company, Pvt Ltd., 1986.
4. Advanced Quantum Mechanics - B. S. Rajput, Pragati Prakashan, 2009.
5. Quantum Mechanics - Chatwal Anand, Himalaya Publication House, 1991.
6. Quantum Mechanics - Powell Crasemann, Addison Wesley Publication Company, 1988.
7. Quantum Chemistry - Henry Eyring, The Late John Walter &n George E.Kimball, John Wiley & Sons INC, 1994.
8. Introductory Quantum Mechanics - Waghmare, S. Chand & Company, Pvt, Ltd., 1990.

Web Resources

1. http://bookboon.com/Introduction to Quantum Mechanics, Intermediate Quantum Mechanics, Chemistry: Quantum Mechanics and Spectroscopy I , Chemistry: Quantum Mechanics and Spectroscopy II
2. https://swayam.gov.in/courses/3485-quantum-chemistry
3. http://freevideolectures.com/Course/2876/Fundamentals-of-Physics-III/19
4. http://www.freebookcentre.netNuclear physics books

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Describe the concept of identical particles and learn to apply the concepts of quantum mechanics quantitatively to predict the behavior of identical particles.	**K_2, K_3**
CO2	Apply integral / residual approach to simple problems using Born's Approximation, Partial Wave Approximation, Green's Function and evaluate total scattering cross- section.	**K_2, K_4**
CO3	Compare and contrast atom field interaction with classical and quantum theory of radiation.	**K_4**
CO4	Understand approximations in atomic and molecular structure.	**K_5, K_3**
CO5	Understand relativistic effects in quantum mechanics and Apply the theory of Matrices / Tensors to the behaviour of elementary particles due to relativistic corrections under different situations.	**K_2, k_5**

K_6-*Create*; K_5-*Evaluate*; K_4-*Analyse*; K_3-*Apply*; K_2-*Understand*; K_1-*Recall*

Mapping of CO with PO and PSO

	PO					**PSO**			
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	M	S	M	S	S	M	L	S
CO 2	S	S	S	S	S	S	S	L	S
CO 3	S	S	S	S	S	S	S	L	S
CO 4	S	M	S	S	S	S	S	L	S
CO 5	S	M	S	S	S	S	M	L	S

Programme : M.Sc. Physics				
Semester: III	**Code: 19PPHC9**	**Core Course - XI SPECTROSCOPY**	**Credit: 4**	**Hours: 5/Week**

Course Objective:

The aim of the course is to study and interpret the most popular technique for structure determination and analysis. This syllabus deals with IR, Raman, NMR, NQR, ESR, Mossbauer and Electronic spectroscopy along with an introduction to the subject and spectroscopic solution of structural properties.

SYLLABUS

Unit	Content	Hrs
I	**MICROWAVE SPECTROSCOPY** Rotation of diatomic molecules – Classification of rotators – rigid and non rigid rotator – Spectra of linear polyatomic and top molecules – stark effect – Inversion spectra of Ammonia – Microwave spectrometer.	**15**
II	**IR AND RAMAN SPECTROSCOPY** Vibrating diatomic molecule as a harmonic oscillator – Molecule as an harmonic oscillator – Diatomic molecule as a vibrating rotator – Vibrational Spectra of Polyatomic molecules – Linear molecule – Symmetric top molecules – Experimental aspects of IR – Fourier transform spectroscopy. **RAMAN SPECTROSCOPY** Classical and Quantum mechanical theories – Pure rotational spectra – vibrational raman spectra – Raman activity – Mutual exclusion principle – Vibrational rotation raman spectra – Structure determination from Raman and IR spectroscopy – Laser raman spectrometer.	**15**
III	**ELECTRONIC SPECTRA OF MOLECULES** Born Oppenheimar approximation – Vibrational structure of electronic transitions – Intensity of vibrational electronic spectra – Frank – Condon principle – Rotational structure of electronic vibration transition – the Fortrat diagram – Pre dissociation – Molecular orbital theory – The shapes of some molecular orbitals – classification of states – Chemical analysis by electronic spectroscopy – charge transfer spectra.	**15**
IV	**NMR SPECTROSCOPY** Theory of NMR – Quantum mechanical theory – Classical theory – Bloch equation – Steady state solution – Relaxation processes – Spin–spin relaxation – spin– lattice relaxation– Experimental method – Continuous wave spectrometer, FT–NMR – Chemical shift – spin–spin coupling. **ESR SPECTROSCOPY** Quantum mechanical theory of ESR – ‘g’ factor – Experimental method – Hyperfine structure – Applications – Free radicals.	**15**
V	**NQR SPECTROSCOPY** Quadrupole Hamiltonian – Energy levels for Half integral spin and integral spins of nuclei – Experimental method – Continuous wave oscillator – Application – Hydrogen bonding. **MOSSBAUER SPECTROSCOPY** Theory of recoilless emission and absorption – Experimental methods – Chemical isomer shift – Magnetic hyperfine interactions – Zeeman Splitting – Electronic Quadrupole interactions.	**15**

Books for Study

1. Fundamentals of Molecular Spectroscopy – C. N. Banwell, Tata McGraw – Hill Publishing company Ltd. (1996).
2. Atomic and molecular Spectroscopy –Gurdeep R. Chatwal and Shem K. Anand– Himalaya Publishing house (2004).
3. Spectroscopy Volume 1 & 2 – B. P. Straughan and S. Walker, John Wiley & Sons Inc., New York (1976).
4. Spectroscopy Volume 1 – S. Walker and H. Straw, Macmillan (1962).
5. Molecular Structure and Spectroscopy – G. Aruldhas, Prentice Hall of India Pvt Ltd.,

Books for Reference

1. Basic principles of spectroscopy – R. Chang, Tata McGraw – Hill Publishing Company Ltd., 1971.

2.Spectra of Diatomic molecules Infrared and Raman Spectra of polyatomic molecules - G. Herzberg, Volume – I – Molecular spectra and Molecular Structure.

3. Vibrational Spectroscopy – D. N. Sathyanarayanan, New age international Pvt. Ltd.
4. Spectroscopy of Organic compounds - P.S.Kalsi-New age International Publishers., 2004.
5. Molecular Spectroscopy – Jack D. Graybeal – Hill International editions, 1988.
6. Vibrational Spectroscopy-D.N.Sathyanarayana - New age International Publishers., 2004.
7. Spectroscopy – Pavia, Lampman, Kriz, vyvyan – India edition, 2007.
8. Organic spectroscopy – William kemp – Indian edition, 2009.

Web Resources

1. www.anadolu.edu.tr
2. www.swinburne.edu.au

Course Outcomes: At the end of the course the student should be able to:

CO Number	CO Statement	Knowledge Level
CO1	Understand the significance of microwave spectroscopy and have knowledge on the techniques and instrumentation of microwave spectroscopy. Analyse the different types of spectroscopic importance.	K_2,K_4
CO2	Apply the basic concepts IR and Raman. Spectroscopy in structure and functional group determination apply the principle of Raman spectroscopy and its applications in the different field of science & technology.	K_2,K_3, K_4,K_5
CO3	Understand the theory and practise electronic spectra of molecules. Apply the knowledge to interpret the spectra of the samples and solving molecular problems.	K_2,K_3,K_4
CO4	Gain knowledge about fundamentals of NMR and ESR spectroscopy and understand the basics of NMR spectroscopic techniques and apply it in to hospital for solving society problem.	K_5,K_3,K_2 ,K_6
CO5	Understand the physic–chemical techniques of Mossbauer and NQR spectroscopy. Apply this technique in analyzing the properties of matter.	K_3,K_2,K_5

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	PO					PSO			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	M	M	S	S	S	S	S
CO 2	S	S	S	S	M	S	S	S	M
CO 3	S	M	M	S	S	S	S	M	S
CO 4	S	S	S	S	M	S	M	S	S
CO 5	S	S	S	S	S	S	S	S	S

Programme : M.Sc. Physics				
Semester: III	**Code: 19PPHEC2**	**Elective – II INSTRUMENTATION**	**Credit: 3**	**Hours: 4 / Week**

Course Objective:

The aim of the course is to present different types of instrumental methods of analysis available and their working.

SYLLABUS

Unit	Content	Hrs
I	**TRANSDUCERS** Transducers – Classification – Strain gauge – gauge factor – resistance – Strain gauge theory – Construction of Electrical resistance strain gauge – Bridge circuit for strain measurements – measurement of Displacement – LVDT – Construction – advantages – disadvantages – uses. Capacitive transducers – Capacitance equation – Measurements of angular displacements – Differential capacitive Displacement transducer – Advantages , disadvantages, uses – Measurement of non–electrical quantities – Thermistor – Construction – Characteristics – Measurement of force using strain gauge – Digital force transducers.	**15**
II	**DIGITAL INSTRUMENTATION** Principle – block diagram and working of digital frequency counter, digital multimeter, digital pH meter, digital conductivity meter, digital storage oscilloscope. **MICROSCOPY INSTRUMENTATION** Introduction– Scanning Voltage Microscope– Types of Scanning Probe Microscope – Block diagram and working of Transmission electron Microscope(TEM) – HR–TEM – Advantages– Disadvantages.	**15**
III	**ANALYTICAL INSTRUMENTATION** Elements of analytical instrument – absorption spectrometry – Absorption instrument – Essential components – prism Monochromator – grating monochromator – Photo voltaic cell – Photo emissive cell – Photo multiplier tube (PMT) –Principle, block diagram, description – working and applications of UV–VIS spectrometer–Flame emission spectrometer– ICP–AES Spectrometer – Basicconcepts of Gas and Liquid chromatography.	**15**
IV	**BIOMEDICAL INSTRUMENTATION** Biomedical instrumentation – Resting and action potentials – Bio potential – Electrodes – Electrode theory – Classification – Physiological transducers to measure blood pressure. Thermistor – Measurement of body temperature – ECG and EEG – Recorders, principle, block diagram and operation.	**15**

V	**COMPUTER PERIPHERALS** Input /output devices – Description of computer inputs– Keyboard– TTY – VDU – Mouse (Basic idea) output device – LED and LCD Display – Printers – Dot matrix, Ink jet and Laser printers – Computer memories– ROM,RAM Physical devices to construct memories – Hard disc – Floppy disks –CDROM –Optical disk – Magnetic tape drives (Qualitative study only).	**15**

Books for Study

1. Electrical and electronics measurement and instrumentation - A. K. Sawhney, Dhanpat& sons, 2000.
2. Instrumentation – V.Ramasamy,Sowmi Publications,2005.
3. Nanotechnology - S. Shanmugam, MJP publishers, 2010.

Books for Reference

1. Electronic measurements and instrumentation - Dr. Rajendra Prasad, Khanna publications, 2003.
2. Electronics measurements and instrumentations - S. M. Dhir, Khanna publications, 2002.
3. Electronics measurements and Instrumentation - S. Ramachandran, Khanna publishers, 2002.
4. Digital instrumentation - A. J. Bowens, TMH, 1977.
5. Nanotechnology - S. Shanmugam, MJP publishers, 2010.
6. Biomedical instrumentation - M. Arumugam, Anuradha agencies, Kumbakonam, 2000.
7. Instrumental method of analysis - Willand and Meriet, PHI, 1999.

Web Resources

1. http://www.kelm.ftn.uns.ac.rs/literatura/si/pdf
2. https://www.britannica.com/technology/microscope
3. https://www.accessengineeringlibrary.com/browse/handbook–of–biomedical–instrumentation–third–edition

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Know and apply the basic concepts of transducers and their applications.	K_1, K_2, K_3, K_4
CO2	Understand, apply and analyse the techniques of digital instrumentation microscopy instrumentation.	K_2, K_4 , K_5
CO3	Impart and master the basic principles of analytical instrumentation.	K_3, K_4 , K_5
CO4	Gain knowledge and analyse the principle, working function of ECG and EEG field of the biomedical instrumentation.	K_2, K_3, K_4 , K_5
CO5	Summarise the concepts of computer peripherals.	K_4 , K_5

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	PO					PSO			
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO1	PSO2	PSO3	PSO4
CO 1	S	S	S	S	S	S	S	S	S
CO 2	S	S	S	M	S	S	S	S	S
CO 3	S	S	S	S	S	S	S	M	S
CO 4	S	S	S	M	S	S	S	S	S
CO 5	S	S	S	S	S	S	S	S	S

Programme : M.Sc. Physics				
Semester III	**Code: 19PPHESC2**	**Elective II CRYSTAL GROWTH TECHNIQUES**	**Credit:4**	**Hours: 3/Week**

Course Objective:
The aim of the course is to describe the fundamentals of Crystal growth, different methods of growing crystals, characterization of crystals and its applications

SYLLABUS

Unit	Content	Hrs
I	**CRYSTAL GROWTH PHENOMENA** Introduction – Nucleation – Theories of Nucleation – Classical theory of nucleation – Gibbs Thomson equation for vapour – modified Thomson's equation for melt – Gibbs Thomson equation for solution – energy of formation of a nucleus – spherical nucleus – Cylindircal nucleus – Heterogeneous nucleation – cap shaped nucleus – Disc shaped nucleus.	15
II	**KINETICS OF CRYSTAL GROWTH** Introduction – Singular and rough faces – models on surface roughness – The Kossel , Stranski, Volemr (KSV) Theory – The Burton, Cabera and Frank (BCF) theory – Periodic Bond Chain theory.	15
III	**SOLUTION GROWTH** **Slow Evaporation Technique** Low temperature solution growth: Solution , Solubility and super solubility – Expression of Super saturation – methods of crystallization – crystallization by slow cooling of solutions – crystallization by solvent evaporation – Temperature gradient method – Crystal Growth system : Constant temperature bath – Crystallizer – filtration assembly – seed, seed mount platform and crystal revolution unit – Seed preparation mounting and reasoning: Solution preparation and reasoning – Initial growth and cooling rate. **Gel Growth** Introduction – principle of gel growth various types of gel – structure of gel – Growth of crystals in gels – Importance of gel technique.	15
IV	**CRYSTAL GROWTH TECHNIQUE AT HIGH TEMPERATURE** **Crystal Growth from the melt** Bridgeman Technique – Czochralski Technique Verneuil Technique – Zone melting technique. **Vapour Growth** Physical Vapour deposition – Chemical Vapour deposition – MOCVD – Advantages of CVD – Disadvantqages of CVD.	15
V	**CHARACTERIZATION OF CRYSTALS** UV–VIS–NIR–FTIR–FT Raman – TGA – DTA – DSC – X–ray Spectrograph – EDAX – NLO studies. **Application** UV, VIS, IR filters –optical and thermal sensors– Modulation in fibre optics	15

Books for Study

1. Crystal growth processes and methods – Dr.P.Santhana Raghavan, Dr.P.Ramasamy – KRV Publications.
2. Elementary crystal Growth – K. Sangwal, Saan Publisher, UK (1994).
3. Crystal Growth Process – J.C. Brice, John Wiley Publications, New York (1996).

Books for Reference

1. Modern Crystallography – III – Crystal Growth in Solid State – A.A. Chernov, Springer series, New York, 1984.
2. Progress in crystal Growth Characterisation – B.R. Pamplin, Pergamon Press Ltd, UK.

Web Resources

1. https://en.wikipedia.org/wiki/Crystal_growth
2. https://link.springer.com/chapter/10.1007/978–3–540–74761–1_1

Course Outcomes: At the end of the course the student should be able to:

CO Number	CO Statement	Knowledge Level
CO1	Apply the concepts of thermodynamics and kinetics to nucleation, crystal growth and epitaxy.	K_3
CO2	Describe the relation between growth parameters and the quality and properties of the grown material.	K_2
CO3	Gain knowledge about recent trends in crystal growth and its application in super lattices and hetero structures.	K_3
CO4	Evaluate and select a crystal growth method, suitable for a specific situation.	K_5, K_2
CO5	Understand various characterization techniques of crystals and applications of crystals in day to day life.	K_2, K_3

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO

CO	PO					PSO			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	S	S	S	S	S	M	S
CO 2	S	S	M	S	S	S	S	S	S
CO 3	S	S	S	S	S	S	M	S	S
CO 4	S	S	S	S	S	S	S	M	S
CO 5	S	S	M	S	S	S	S	S	S

Programme : M.Sc. Physics				
Semester: III	**Code: 19PPHEC3**	**Elective – III MATERIALS SCIENCE**	**Credit:3**	**Hours: 4/ Week**

Course Objective:

To enhance the knowledge about the physics of new materials and describe the properties of condensed systems.

SYLLABUS

Unit	Content	Hrs
I	**IMPERFECTIONS IN CRYSTALS** Classification of imperfections – Point defects – Lattice Vacancies and interstitial atoms (Schottky defect) – Frenkel defect – Equilibrium concentration of point defect – Colourcentres – F – centres, F' centres – Line defects – definition of dislocation – Edge and Screw dislocation – Burger's Circuit – Dislocation motion – Strain due to dislocation motion - Stress fields around dislocation – Plane defects – Grain boundaries dislocation.	15
II	**MAGNETISM** Introduction- Review of Basic Concept And Formulae- Paramagnetism – Quantum Theory –Quenching of Orbital Angular Momentum– Ferromagnetism-Classical Theory of Ferromagnetism - Spontaneous Magnetization – Weiss Theory – Temperature Dependence of Spontaneous Magnetization – Heisenberg Interpretation of Weiss Field – Ferromagnetic Domains – Evidence – Origin of Domains – Bloch Wall - Thickness and Energy – Anti Ferromagnetism – Molecular Field Theory - Neel Temperature- Ferrimagnetic Materials: Structure of Ferrites- The Saturation Magnetism- Curie Temperature and Susceptibility of Ferrimagnets.	15
III	**PHOTOCONDUCTIVITY ,LUMINESCENCE AND FERROELECTRICS** Photoconductivity – Excitation across a gap – Simple model of a Photoconductor – Traps- Luminescence: Excitation and emission – Thallium activated Potassium chloride. **Ferroelectrics materials** Ferro electricity – General properties -Dipole Theory of Ferroelectricity – Classification Ferroelectric materials- Antiferroelectricity - Ferroelectric domains – Piezoelectricity.	15
IV	**THERMAL PROPERTIES OF SOLIDS** Introduction- Specific Heat: Classical Theory(Dulong And Petit Law)- Einstein Theory-Debye's Theory-Density of Vibrational Modes-Debye Approximation- Heat Capacity of an Array of N Identical Atoms-Modification of Debye's Theory – Anharmonic Crystals Interaction – The Gruneisen Relation- Lattice Thermal Conductivity of Solids .	15

V	**NANOMATERIALS** Introduction – Historical perspective on Nanomaterial – Classification of Nanomaterials – Quantum dots – Properties – Preparation methods – Ball milling - Plasma arc - Nano Lithography – Vapor phase deposition –Chemical vapour deposition - Physical vapour deposition – Plasma enhance chemical vapour deposition – Size quantization effects – Charge transfer processes – Particle size estimation by XRD/SPM/STM/AFM techniques-Application of Nanomaterials: medical-chemical-energy conservation-information and communication-industry.	**15**

Books for Study

1. Solid State Physics – S.L.Gupta&Dr.V.Kumar, K.Nath& Co., Meerut (2016-2017).
2. Solid State Physics –S.O.Pillai- New AGE international publications(2018).
3. Essentials in Nanoscience and Nanotechnology- Narendra Kumar, Sunita Kumbghat, John Wiley & Sons, 2016.
4. Solid State Physics Questions and Answers – C. Kavitha, Mangalam Publishers, 2015.
5. Introduction to Solid State Physics- Arun Kumar, PHI learning Private Limited, 2010.
6. Engineering Physics - V.Rajendran, Tata McGraw Hill Publishing Company Limited, 2008.
7. The Nanoscope – An Introduction to Nanoscience and Nanophotonics- A.Santhi, Scientific International Pvt Ltd, 2016.

Books for Reference

1. Fundamentals of Solid State Physics -Saxena Gupta and Saxena, PragatiPrakashan,Meerut,2003.

2. Solid State Physics -R.L.Singhal, KedarNath Ram Nath, 2019.

Web Resources

1. https://swayam.gov.in/nd1_noc19_mm20/preview

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Create the ability to identify, recognize and classify imperfections found in crystals.	K_4, K_5, K_6
CO2	Know various types of magnetic materials and applications.	K_4, K_5
CO3	Understand the optical and electrical properties of materials.	K_2, K_3
CO4	Acquire knowledge on thermal properties of solids.	K_2, K_3
CO5	Impart the knowledge about nanomaterials and to understand the potential applications of nanotechnology.	K_3, K_4, K_5, K_6

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	PO					PSO			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	M	S	M	L	S	M	S	L
CO 2	S	M	S	S	L	S	S	M	S
CO 3	S	S	S	S	M	S	M	M	M
CO 4	S	M	S	M	S	S	M	M	M
CO 5	S	S	S	S	S	S	S	S	S

Programme : M.Sc. Physics				
Semester III	**Code: 19PPHSEC3**	**Elective – III INSTRUMENTAL METHODS OF ANALYSIS**	**Credits: 4**	**Hours: 3 / week**

Course Objective:
Instrumental methods of analyses plays important role in day to day life. This paper presents different types of instrumental methods of analyses available and their working.

SYLLABUS

Unit	Content	Hrs
I	**ERRORS AND ANALYSIS OF EXPERIMENTAL DATA** Types of errors – Mean, Variance and standard deviation, standard deviation of standard deviation – Sampling techniques – Chi square test. **EXPERIMENTAL STRESS ANALYSIS** Stress analysis by strain gauging – High temperature strain gauge techniques – Photo elasticity and holography.	**15**
II	**THERMAL ANALYSIS** Introduction – Thermo gravimetric analysis – Instrumentation of weight loss and decomposition products – Differential scanning calorimetric – Instrumentation – Specific heat capacity measurements – Determination of thermo chemical parameters – Differential thermal analysis – Basic principles – Melting point determination and analysis.	**15**
III	**X–RAY ANALYSIS** Single Crystal and Powder diffraction – Diffractometer – Interpretation of diffraction patterns – Indexing – Unknown and phase identification – Double and four crystal Diffractometer for epitaxial characterization – Lattice mismatch – Tetragonal distortion – Thin film characterization – X–ray fluorescence spectroscopy – Uses.	**15**
IV	**OPTICAL METHODS AND ELECTRON MICROSCOPY** Photoluminescence – Light – Electroluminescence – Instrumentation – Photo reflectance – Electronic transitions – Behaviour of electronic transitions as a function of electric field. Principles of SEM. TEM, EDAX,AFM,EPMA – Instrumentation – Sample preparation – Analysis of materials – Study of dislocations – Ion implantation – Uses – Nanolithography.	**15**
V	**ELECTRICAL METHODS** Hall Effect – Carrier density – Resistivity – Two probe and four probe methods – Scattering mechanism – Vander pauw method – CV characteristics – Schottky barrier capacitance – Impurity concentration – Electrochemical CV profiling – Limitations.	**15**

Books for Study

1. Willard.M, Steve.D, Instrumental Methods of Analysis, CBS Publishers, New Delhi(1986).
2. Strading, R.A, Electron microscopy and microanalysis of crystalline materials, Applied Science Publishers, London (1979).

Books for Reference

1. Belk. J.A, Electron microscopy and microanalysis of crystalline materials, Applied Science publishers, London (1979).
2. Philips V.A, Modern metallographic techniques and their applications, Wiley Intescience (1971 hill (1).

Web Resources

1. http://www.researchgate.net>topic>ins.,
2. http://global.oup.com>product>instru...

Course Outcomes: At the end of the course the student will be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Learn and measure uncertainities, error propagation, standards and reference materials.	K_2
CO2	Solve problems related to changes in materials under thermal treatment.	K_5, K_4
CO3	Learn the theory based on Bragg's law concerning XRD.	K_2
CO4	Perform measurements on analytical instruments like photometers, spectrometers, TEM, EDAX.	K_3
CO5	Measure the resistivity of any semiconductor material.	K_5

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	M	S	M	S	S	M	S	S
CO 2	S	S	S	S	S	S	S	M	S
CO 3	S	S	S	S	S	S	S	M	S
CO 4	S	M	S	S	S	S	M	M	S
CO 5	S	S	S	S	S	S	S	S	S

Programme : M.Sc. Physics				
Semester III	**Code: 19PPHQC3**	**CORE PRACTICAL – III**	**Credit:4**	**Hours:8/ Week**

Course Objective:

The aim of the course is to

- Give exposure to experimental techniques in Electronics, Micro Processor and Interfacing Devices so that they can verify some of the things read in theory here or in earlier classes and develop confidence to handle sophisticated equipment.
- Impart the broad knowledge of experimental methods and measurement techniques.

SYLLABUS

Students are expected to perform at least 10 experiments out of following list.

1.	CDS – Copper and Iron arc spectrum.	**120**
2.	Laser diffraction at a straight edge and circular aperture.	
3.	Velocity and Compressibility of liquids –Ultrasonic Interferometer.	
4.	Multiplexer and Demultiplexer	
5.	Studies of Shift register, Ring and Johnson counters.	
6.	Four bit binary adder, Subtractor and BCD adder.	
7.	C programs 1. To find the length of the string 2. To find the biggest number	
8.	C programs 1. Sorting of names 2. Searching name in an array.	
9.	Microprocessor – Analog to digital & Digital to Analog conversion	
10	Microprocessor -Waveform generation	
11	Microcontroller Programs – Arithmetic operations.	
12	Microcontroller Programs 1. To find the biggest number and smallest number 2. Arranging numbers in Ascending and Descending order	

Books for Study

1. Practical Physics and Electronics- C.C.Ouseph,U.J.Rao, V.Vijeyendran, SV Printers and Publishers Pvt. Ltd., 2007.
2. Programming in AnsiC - E.Balagurusamy, Tata McGraw Hill, 2008.
3. Advanced Practical Physics- Ghosh, New Central Book Agency, 1997.
4. Microprocessor Architecture,Programming and Application with 8085-Ramesh S.Gaonkar,Wiley Eastern,2000.
5. Fundamentals of Microprocessor and Microcontroller-B.Ram, 2011.

Books for Reference

1. Microprocessor and its Application-A.NagoorKani, RBA Publications, 2004.
2. Microprocessor-Gillmore,TMH Editions,1997.
3. Microprocessor and interfacing-DoughlasV.Hall,TMH, 2006.
4. Microcontrollers (Theory and Applications)-Ajay V.Deshmuk, TMH, 2007.

Web Resources

1. http://iitg.ac.in/subhasht/ph511%20July-Dec-2015/Manual%20PH511.pdf
2. http://dusty.physics.uiowa.edu/~goree/teaching/29_128_manual_01_07_v2.pdf

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Make measurements, analyze and interpret the experimental data with techniques of advanced general experiments.	**K_3 , K_4**
CO2	Use the 8085 microprocessor for interfacing devices.	**K_3**
CO3	Acquire hands on experience of handling and building electronics circuits.	**K_2,K_3**
CO4	To apply the C language to solve problems in Physics.	**K_3, K_5**

K_6-*Create*; K_5-*Evaluate*; K_4-*Analyse*; K_3-*Apply*; K_2-*Understand*; K_1-*Recall*

Mapping of CO with PO and PSO

CO	PO					PSO			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	S	M	M	S	S	L	S
CO 2	S	S	S	M	M	S	S	L	S
CO 3	S	S	S	M	M	S	S	M	S
CO 4	S	S	S	M	M	S	S	L	S

Programme : M.A / M.Sc				
Semester III	**Code: 19PPHEDC**	**Extra Disciplinary Course COMMUNICATION SYSTEMS**	**Credit:4**	**Hours: 4/Week**

Course Objective:

The aim of the course is to describe communication system that enable transfer of information from one source to another and also to understand the prevailing nature of communication media.

SYLLABUS

Unit	Content	Hrs
I	**COMMUNICATION FUNDAMENTALS (BLOCK DIAGRAMS ONLY)** Communication – Communication systems – Electromagnetic spectrum – Radio broadcasting – Radio transmitter – Modulation – Need for modulation – Types of modulation - Amplitude modulation (AM) – Frequency modulation (FM) and Phase modulation (PM) – Explanation with waveforms only – Advantages of FM over AM – Demodulation – Radio receiver – Super heterodyne receiver.	12
II	**RADAR (BLOCK DIAGRAMS ONLY)** Basic principles of Radar – Transmission and reception - Automatic tracking Radars **TELEVISION (BLOCK DIAGRAMS ONLY)** Elementary concepts of TV transmitter and receiver – Camera tube (Iconoscope) – Scanning Synchronization TV channels - Colour mixing principle (additive and subtractive) – transmission and reception of colour signals – Picture tube – Delta gun colour picture tube.	12
III	**MOBILE COMMUNICATION** Need for Mobile communication – Requirements of mobile communication – History of mobile communication – Properties of wireless medium – Radio propagation – Reflection, scattering and diffraction in propagation – Propagation coverage calculations – Cellular structure – Frequency reuse – System architecture – Authentication centre - Home location register – Visiting location register – Equipment identify register – Base station system - Advantages And disadvantages of using cellular mobile system.	12
IV	**SATELLITE COMMUNICATION** Evolution and Growth of communication satellites – The satellite orbit – Geostationary orbit – Linkages – Assignable satellite frequencies – Satellite construction or equipment on satellite – Special purpose satellites – Indian space centres and the Indian satellite systems.	12
V	**FIBRE OPTIC COMMUNICATION** Introduction – Structure of optical fibres – Light propagation through fibres – Classification of optical fibres – Fabrication of optical fibres – Optical couplers, splicers and fibre sensors – Advantages of optical fibres – Application of fibre optic communications – Fibre optic communication systems.	12

Books for Study

1. Electronic communication Systems 3rd edition - George Kennedy, Tata McGRAW HILL Publishing company,1991
2. Hand book of Electronics - Gupta & Kumar, Pragati Prakashan, 2008.

3. Electronics fundamentals and applications - D. Chattopadhyay and P. C. Rakshit, New Age International, 2008.
4. Basic Electronics Solid state - B. L. Theraja, S. Chand & Co., 2006.
5. Wireless and mobile communication – T. G. Palanivelu, PHI Learning Pvt. Ltd, 2011.
6. Principles of Electronics – V.K. Mehta, S.Chand & Co, 11th edition, 2008.
7. Applied Electronics – A. Subramaniyam, National Publishing House, 2nd edition, 2003.
8. Monochrome and Colour Television- R.R. Gulati, New Age International Pvt Ltd, 2002.

Books for Reference

1. Electronic Communication 4th edition - Dennis Roddy and John Coolen, Prentice Hall of India, 2009.
2. Communication Electronics - N. D. Deshpande, D. A. Deshpande and P. K. Rangole,TMH, 2001.

Web Resources

1. NPTEL Electronics And Communication Engineering Video Lecture ... https://www.btechguru.com/courses--nptel--electronics-and-communication-engineering

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Understand the various modulation techniques and distinguish between FM, AM and PM. Analyse and determine the performance of transmitter and receiver circuits.	K_2, K_4
CO2	Understand the principles of Radar communication system and colour television operation.	K_2
CO3	Recall knowledge of mobile communication standard, its architecture, logical channels, advantages and limitations.	K_1
CO4	Apply the basic physical concepts on satellite communication. Understand the orbital and functional principles of satellite communication systems.	K_2, K_3
CO5	Identify and characterize different components of an Optical Fiber Communication link.	K_4, K_5

K_6-*Create*; K_5-*Evaluate*; K_4-*Analyse*; K_3-*Apply*; K_2-*Understand*; K_1-*Recall*

Programme : M.Sc. Physics				
Semester IV	**Code: 19PPHC10**	**Core Course - XIII NUCLEAR AND PARTICLE PHYSICS**	**Credit: 5**	**Hours: 6/Week**

Course Objective:

The aim of the course is to provide better understanding of the structure and properties of the nucleus, nuclear interaction, radioactive decay, nuclear models and the interaction of nuclear radiation with matter; and develop an insight into the building block of matter along with the fundamental interactions of nature.

SYLLABUS

Unit	Content	Hrs
I	**NUCLEAR PROPERTIES** Nuclear properties -Determination of Nuclear radius – Electrical and Nuclear matter methods –Weizacker Semi empirical mass formula – Nuclear stability – Mass parabola for odd and even isobaric nuclei and β – decay stability- Determination of Nuclear magnetic dipole moment – Experimental determination – Rabi's magnetic resonance method – Block's method.	**18**
II	**NUCLEAR INTERACTION** Ground state of deuteron –Wave Mechanical theory- square well potential-range-depth- non-central forces – magnetic and quadrupole moment - excited states of deuteron – p-p & n-p scattering at low energy (partial wave analysis)– Spin dependence – scattering from molecular hydrogen and determination of singlet and triplet scattering lengths –Nuclear force –Meson theory of nuclear force -– Isotopic spin formalism.	**18**
III	**NUCLEAR DECAY** α-decay–Gamow's theory – β-decay–Fermi's theory– Fermi–kurie plot - Fermi and GT Selection rules – Allowed and forbidden decays– Non conservation of parity in β decay– Gamma decay– internal conversion – Nuclear isomerism– Angular correlation in gamma emission.	**18**
IV	**NUCLEAR REACTION AND MODELS** Compound Nucleus – energy level – level width and de excitation – Breit and wigner single level formula – Nuclear models – Liquid drop model – Shell model: Evidence for magic number –extreme Single Particle Model with square well potential infinite depth –Hormonic osicillator potential–spin orbit potential– predictions of shell model.	**18**
V	**ELEMENTARY PARTICLES** Elementary particles – conservation laws –Isospin– strangeness – Hyper charge– charge conjugations – parity invariance – combined inversion CP – Time reversal – combined inversion of CPT – Violation of parity conservation in weak interaction – symmetry multiples of Hadrons – SU(2) – SU(3) multiplets – Gell–mann Okubo mass formula for SU(3) multiplets – Quarks – Quark Gluon model – classification of isotopic multiplets on Quark model .	**18**

Books for Study

1. Nuclear physics by D.C.Tayal, Himalaya Publishing House, 2009.
2. Elements of Nuclear Physics by M.L.Pandya and R.P.S.Yadav, KedarnathRamnath Publishing, 2009.
3. Nuclear Physics by R.R.Roy and B.P.Nigam, Wiley Eastern Ltd.,1993.
4. Basic Nuclear Physics by Dr. B.N.Srivastawa, Pragati prakashan, 1990.

Books for Reference

1. V.Devanathan, Narosa publishing House,2006.
2. Nuclear Physics byR.C.Sharma, KedarnathRamnath& Co., 1992.

Web Resources

1. http://www.freebookcentre.net/Physics/Nuclear-Physics-Books.html
2. https://www.pdfdrive.net/introduction-to-nuclear-and-particle-physics-d34369147.html

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Demonstrate the knowledge of fundamental aspects of the nuclear structure and outline their theoretical descriptions to explore the nuclear stability and to solve problems.	K_2, K_3
CO2	Understand the deuteron behavior at ground and excited states and apply deuteron physics and the Nucleon-Nucleon scattering for explaining the nuclear forces .	K_2, K_4
CO3	Analyses the differences between various nuclear decay modes, state selection rules, and determine whether a given decay can take place.	K_4
CO4	Compare and contrast different nuclear models, explain the need of standard model and its limitations.	K_5, K_3
CO5	Gain knowledge on elementary particles, symmetry in baryon decuplets and octets for J^Pstates and acquire familiarity with the fundamental constituents of matter (quarks, leptons and gluons); know their quantum characteristics and apply conservation laws to nuclear	K_2, k_5

K_6-*Create*; K_5-*Evaluate*; K_4-*Analyse*; K_3-*Apply*; K_2-*Understand*; K_1-*Recall*

Mapping of CO with PO and PSO

CO	PO					PSO			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	M	S	S	M	L	S	M	M	S
CO 2	S	M	S	M	M	S	L	M	S
CO 3	S	S	S	S	S	S	M	S	S
CO 4	S	S	S	S	S	S	L	S	S
CO 5	S	S	S	M	M	S	L	M	S

Programme : M.Sc. Physics				
Semester IV	**Code: 19PPHEC4**	**Elective - IV COMMUNICATION ELECTRONICS**	**Credit:4**	**Hours: 5/Week**

Course Objective:
The aim of the course is to understand about different types of communication systems available and their working in day to day life.

SYLLABUS

Unit	Content	Hrs
I	**ANTENNAS AND WAVE PROPAGATION** Short dipole antenna – Radiation resistance-power radiated by the antenna-Effect of ground on antennas- grounded λ/4 antenna-Ungrounded λ/2 antenna - Antenna arrays: Broad side and end fire arrays – Types of wave propagation - ionosphere and its layers – Eccles Larmor theory – Critical frequency - Maximum usable frequency – Skip distance - Expression for skip distance and maximum usable frequency.	15
II	**MICROWAVE GENERATION (PRINCIPLE AND OPERATION ONLY)** Multi cavity Klystron-Reflex Klystron- Magnetron- Travelling wave tube - MASER-Gunn Diode. **MICROWAVE MEASUREMENTS** Power, frequency, wavelength, impedance, attenuation and standing wave ratio.	15
III	**DIGITAL COMMUNICATION** **DIGITAL MODULATION** Advantages and disadvantages of digital communication – Simple delta modulation- companded delta modulation - Continuous, variable slope delta modulation-Pulse code modulation technique - Binary coding – Regeneration process - PCM receptors and noise- advantages of PCM-CODECS**.** **DIGITAL DATA TRANSMISSION** Representation of data signal- Parallel and serial data transmission – MODEMS- Repeaters - Digital modulation systems- Amplitude shift keying – Frequency shift keying- Phase shift keying.	15
IV	**RADAR** RADAR Fundamentals – Range equation- Doppler effect-CW Doppler radar- FMCW radar- Antennas and scanning –Display methods: PPI and MTI radar Beacons- Phased array radars-planar array radars**.** **TELEVISION** TV fundamentals – Monochrome - TV transmitter and receiver- Colour transmission and reception – Colour picture tubes - delta gun picture tube – PIL colour picture tube – Cable TV, CCTV and theatre TV.	15

V	**BROAD BAND COMMUNICATION SYSTEMS** Multiplexing - frequency division - time division - Short and medium Haul systems: coaxial cables- fibre optic link- Microwave link – Tropospheric Scatter links - Submarine cables. Types of network, design features of Computer communication networks. **SATELLITE COMMUNICATION** Satellite orbits and inclination - Geostationary orbit – Attitude control – Satellite station keeping - Uplink power budget calculations – Down link budget calculations - Multiple access methods – Different domestic satellites.	15

Books for Study

1. Hand book of Electronics- Gupta & Kumar, Pragati Prakashan, 2008.
2. Antenna and Wave Propagation -K.D. Prasad, Satya Prakashan, 2007.
3. Electronic Communication Systems - George Kennedy, Bernard Davis, TMH, 1991.
4. Microwave Engineering – Sanjeeva Gupta & others, Khanna Publishers,
5. Modern Electronic Communication Theory and systems- Ashok Raj, Umesh publications, 1995.
6. Electronics communication – Dennis Roddy, John Coolen, Prentice Hall of India, 2009.
7. Applied Electronics – A. Subramaniyam, National Publishing House, 2nd edition, 2003.
8. Monochrome and Colour Television – R.R.Gulati, New Age International Publishing Company, 2002.
9. Communication Eletronics – N.D.Despande, D.A.Despande and P.K.Rangole, TMH, 2001.

Books for Reference

1. Electronics fundamentals and applications - D. Chattopadhyay and P.C. Rakshit, New Age International, 2008.
2. Basic Electronics Solid state -B.L. Theraja, S. Chand & Co., 2006.
3. Electronic Communications system – Fundamentals through advanced-Wayne Tomasi, Pearson Education, 2004.

Web Resources

1. NPTEL Electronics and Communication Engineering Video Lecture...
https://www.btechguru.com/courses--nptel--electronics-and-communication-engineering

Course Outcomes: At the end of the course the student should be able to:

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of radiation through mathematical formulation and measure the antenna parameters.	K_2, K_5
CO2	Understand the principle and generation of microwaves. Analyse various microwave parameters.	K_2, K_4
CO3	Identify source coding and channel coding schemes for a given communication link and also to evaluate the performance of PCM and MODEM in a digital communication system.	K_4, K_5
CO4	Understand the principles of Radar communication system and colour television operation. Analyze and determine the performance of television transmitter and receiver circuits.	K_2, K_4
CO5	Analyse and apply an appropriate modulation, multiplexing, coding and multiple access schemes for a given satellite communication link.	K_3, K_4

K_6-*Create*; K_5-*Evaluate*; K_4-*Analyse*; K_3-*Apply*; K_2-*Understand*; K_1-*Recall*

Mapping of CO with PO and PSO

CO	PO					PSO			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	M	M	L	S	M	M	M
CO 2	S	S	S	S	L	S	M	S	M
CO 3	S	S	S	S	S	S	S	S	S
CO 4	S	S	S	S	S	S	S	S	S
CO 5	S	S	M	S	S	S	S	S	S

Programme : M.Sc. Physics				
Semester IV	**Code: 19PPHSEC4**	**Elective – IV PHOTONICS**	**Credit:4**	**Hours: 5 /Week**

Course Objective:
The aim of the course is to make the students learn the impact of photonics in fields ranging from nanotechnology to communications in a fundamental level.

SYLLABUS

Unit	Content	Hrs
I	**INTRODUCTION TO PHOTONICS** Description: Photonics and light technology – Scientific topics of Photonics – technical topics – properties of photonics – speed – Energy – Frequency – Wavelength– Moments – Mass – timing – Uncertainty principle for photons – Position and momentum – Energy and time – Frequency and time – Uncertainty of field strength – Gaussian beams – Ray matrices – Deriving Ray matrices – Ray matrices of some optical elements.	**18**
II	**LINEAR INTERACTION BETWEEN LIGHT AND MATTER** Refraction – Dispersion – Absorption – Emission – Measurement of absorption – Polarization in refraction and reflection – Relation between reflection absorption and refraction – Birefringence – Optical activity – Diffraction – Diffraction at a one dimensional slit – Diffraction at a two dimensional slit – Diffraction at a circular aperture – Diffraction at one dimensional gratings – Diffraction at a two dimensional gratings – Diffracting at optically thin and thick gratins.	**18**
III	**NON–LINEAR INTERACTION OF LIGHT AND MATTER** Non–linear polarization of the medium – second order effects – General second harmonic – Phase matching – Type I and Type II phase match Quasi phase matching – frequency mixing – Parametric amplifiers oscillator – Pockel's effect – electro optical beam deflection – Third order effects – Generation of third harmonics – Kerr effect – Spatial solitons – Stimulated Raman scattering (SRS) – Inverse Raman scattering(IRS) – Stimulated gain spectroscopy(SRGS) – coherent antistokes Raman scattering (CARS) – Higher order non–linear effects.	**18**
IV	**LASERS** Principle – Pump mechanism – Quantum defect and efficiency – pumping in diode lasers – Lamp pumping – chemical pumping – resonators – Stable resonators – unstable resonators – Threshold gain and power of laser beams – Laser intensity and power – Q switching – nano second pulses – Active Q switching – passive Q switching – Theoretical description of Q switching.	**18**
V	**NON–LINEAR OPTICAL SPECTROSCOPY** Non–Linear transmission measurements – Experimental method – Evaluation of the nonlinear absorption measurement – Variation of excitations wave – variation of excitation pulse width – Variation of spectral width of exciton pulse – Non–Linear emission measurements – Time resolved measurements – White Light generation with fs duration – white light generation with ps duration – Fluorescence in the ns range.	**18**

Books for Study

1. Photonics – Linear and Nonlinear interactions of Laser light and matter – Ralf Men Zel – Springer – New Delhi, 2004.

Books for References

1. Nonlinear optics – R.W.Boyd – Academic press, 1992.
2. The elements of non–linear optics – P.N.Butcher, Cambridge University press, 1990.
3. Hand book of photonics – M.C. Gupta – CRC press, New York, 1997.
4. Non–linear photonics – H.M. Gibbs – Springer – New York, 1990.

Web Resources

1. www.newport.com/n/gaussian–beam–optics

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Recall the scientific topics on Photonics	K_1
CO2	Understand Linear Interaction between light and matter	K_2
CO3	Tackle the new problem and application techniques of Photonics to far–flung reaches of science.	K_3
CO4	Study the basic concepts and applications of lasers	K_2 K_3
CO5	Provide smooth transition from traditional techniques to rapidly growing area of non–linear optics	K_1

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	M	S	S	S	S	M	M	S
CO 2	S	M	S	S	S	S	M	S	S
CO 3	S	S	S	S	S	S	S	S	S
CO 4	S	S	S	S	S	S	S	S	S
CO 5	S	S	S	S	S	S	S	S	S

Programme : M.Sc. Physics				
Semester: IV	**Code: 19PPHEC5**	**Elective –V OPTOELETRONICS**	**Credit:4**	**Hours: 5 /Week**

Course Objective:

The aim of the course is to make the students learn the nuances of the Optoelectronics and how it can be used for expansion and introduction of new telecommunication services.

SYLLABUS

Unit	Content	Hrs
I	**OPTICAL FIBRES** Structure and Properties of Optical fibres– Types. Acceptance angle and acceptance core of a fibre – Numerical aperture (General) – Numerical aperture of a graded index fibre – modes of propagation – Meridional and skew rays – Numbering modes and cut–off parameters eg. Fibres – Single mode propagation – Comparison of step and graded index fibres– Application of fibres – Fibres classification – stepped index fibre – Stepped – index monomodefibre – Disadvantage of monomodefibre – Graded index multimode fibre – Plastic fibres.	**18**
II	**FIBRE FABRICATION, FIBRE LOSSES** Fibre fabrication – External CVD – Axial Vapour Deposition (AVD) – Internal Chemical Vapour Deposition (ICVD) – Characteristics of all these methods – Fibre drawing and coating – Double – Crucible method – Attenuation in optical fibres – Material loss – Rayleigh Scattering loss– Absorption loss – Leaky modes – Bending losses radiation induced losses – Inherent defect losses – Inverse square law losses – Transmission Losses – Temperature dependence of fibre losses – Core and cladding losses.	**18**
III	**OPTICAL COUPLERS –SPLICING AND MEASUREMENT ON OPTICAL FIBRES** Types of optical couplers – Biconically tapered direction coupler – Beam splitting directional couplers – T – couplers – Calculation on couplers – splicing – Mechanical Splicing – splicing procedures – Loss comparison – Losses in splices and connectors – Measurement of numerical aperture and its related terms – OTDR – Working of OTDR – Applications of OTDR – Fibre loss measurement by OTDR – Limitations – Advantages.	**18**
IV	**OPTICAL FIBRE COMMUNICATION** Introduction–Important applications of Intergrated Optic fibre technology – Long Haul communication – Coherent optical fibre communication – Principle of coherentdectection–comparsion of coherent and direct – detection performance – practical system constrain – LAN–Fibre in computer networking – Advantages and disadvantages –Fibre optical system.	**18**

V	**LIGHT SOURCES AND DETECTORS** Introduction – LED – The processes involved in LEDs – Structures of LED – LED materials – Output characteristics of LED – Fibre– LED coupling – Modulation Bandwidth of LED – Spectral emission of LEDs – Semiconductor Laser diode – Spatial Emission pattern of Laser –Current Vs output power – Photo detectors – characteristics of photo–detectors – Photo emissive photo detectors – Photo conductive devices – Photo –Voltaic devices – PN junction photo detector – PIN photo diode Avalanche photo diode (APD) – Photo transistor – Bit – Error rate.	**18**

Books for Study

1. Optical fibres and fibre optic communication systems –Subir Kumar Sarkar, Fourth revised edition, S. Chand & Co, (2010).

Books for Reference

1. Optoelectronics and Optical Communication–ArijitSaha and Nilotpal Manna, Publisher by University science (2011).
2. Optical Communication – V.S. Bagad, Technical publication (2009).
3. Fibre optic communication – D.C Agrawal, S. Chand & company Ltd. (1933) Optoelectronics.

Web Resources

1. http://research.psut.edu.jo/Project/Puplications/Optical%20losses.pdf
2. https://en.wikipedia.org/wiki/Optical_time–domain_reflectometer

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Acquire the basic knowledge in Fibre Optic communications and able to solve basic problems.	K_2
CO2	Understand the various losses in Fibre optic cables.	K_2
CO3	Analyze the working and applications of OTDR.	K_4
CO4	Develop deep knowledge on the role of optical fibre communication systems.	K_6
CO5	Apply knowledge of optoelectronic devices in light sources.	K_3

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	PO					PSO			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	M	S	M	S	S	S	M	S
CO 2	S	S	S	M	S	S	S	M	S
CO 3	S	S	S	M	S	S	M	S	S
CO 4	S	M	S	S	S	S	M	M	S
CO 5	S	M	S	L	S	S	M	M	S

Programme: M.Sc. Physics				
Semester IV	**Code: 19PPHSEC5**	**Elective – V THIN FILM PHYSICS**	**Credit: 4**	**Hours: 5/Week**

Course Objective:
The aim of the course is to enhance the knowledge about the physics of new materials and describe the properties of thin films.

SYLLABUS

Unit	Content	Hrs
I	**PREPARATION OF THE THIN FILM** Nature of thin film– Deposition Technology – Distribution of Deposit – Thermal Deposition in Vacuo – Kinetic theory of Gas and Emission condition – Resistance heating –Thermal Evaporation – Election beam Method.	**18**
II	**SPUTTERING AND DEPOSITION SPUTTERING** Cathodic sputtering – Glow discharge sputtering – Low pressure sputtering–Reactive sputtering – R.F.Sputtering – Chemical Vapour Deposition (CVD) – Thermal Decomposition or Pyrolysis – Vapour phase Reaction – Vapour Transportation method – Disproportionation method – Chemical deposition – Electro deposition– Anodic oxidation – Electrodless plating – Deposition by chemical Reaction – Chemical Displacement – Spray pyrolytic process–characterization features of the spray pyrolytic process.	**18**
III	**FILM THICKNESS AND ITS CONTROL** Mass methods –Microbalance Technique – Crystal oscillator – Optical method –Photometric – Ellipsometry – Interferometry – Other methods–Substrate cleaning. Microscopic defect and dislocation –Edge dislocation–Screw dislocation – boundary defect– Intergranualar boundary– Twinning –stacking fault– Super lattice and anti–phase boundary – defect crystal and non–stoichiometric compound– surface states and interfacial effect–Removal of defect–Defect and energy state – Donor and Acceptor levels – Trap and Recombination centres – Exciton– Phonon.	**18**
IV	**THIN FILM ANALYSIS** Electron diffraction technique–High energy electron diffraction – low energy electron diffraction– Electron microscopy – Spinning electron microscopy – X–ray photoelectron spectroscopy – Mass spectroscopy – Thermodynamics of nucleation – Nucleation theories capillarity model – Atomistic model – Film growth – Incorporation of defects. Impurities etc. in film – Deposition parameters and grain size.	**18**
V	**EPITAXY** Epitaxy – Thin film structure – Substrate effect – Expitaxial deposit– Twinning and multiwinning – Phase transition – Dissociation – Film thickness effect – Crystal growth process – Nucleation stage – Epitaxial Stage – Intermediate stage – Final stage.	**18**

Books for Study

1. Thin film fundamentals – A. Goswami– New age international Pvt., Ltd, New Delhi (1996).
2. Thin film phenomena – K.L. Chopra, 1600.

Books for Reference

1. Hand Book of thin film technology – L.T. Maissel and R. Glang – McGraw Hill Instrumentational Publishers, 1600 (1978).

Web Resources

1. physics.bu.edu/py106/notes/Thinfilm.html

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	To impart fundamentals of thin film physics.	K_2
CO2	Understand the fundamentals of different types of sputtering and deposition sputtering.	K_1, K_2
CO3	Understand the film thickness and its control, effect of the process conditions on film growth micro structural evolution using various methods and techniques**.**	K_2, K_4
CO4	Know the principle techniques, methods and models involving to analyze the deposition and size of the thin film, and also the advantages and the disadvantages of different thin film deposition methods.	K_2,K_3 K_4,
CO5	Evaluate and use models for nucleating and growth of thin films and asses the relation between deposition technique, film structure, and film properties.	K4, K_5, K_6

K_6–*Create*; K_5–*Evaluate*; K_4–*Analyse*; K_3–*Apply*; K_2–*Understand*; K_1–*Recall*

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	S	M	S	S	S	M	S
CO 2	S	M	S	M	S	S	S	M	S
CO 3	S	M	S	M	S	S	M	S	S
CO 4	S	S	S	S	S	S	M	M	S
CO 5	S	S	S	L	S	S	M	M	S

Programme : M.Sc. Physics				
Semester IV	**Code: 19PPHQC4**	**CORE PRACTICAL – IV**	**Credit:4**	**Hours: 8/Week**

Course Objective:

The aim of the course is to

- give exposure to experimental techniques in Electronics, Micro Processor and Interfacing Devices so that they can verify some of the things read in theory here or in earlier classes and develop confidence to handle sophisticated equipment.
- Impart the broad knowledge of experimental methods and measurement techniques.

SYLLABUS

Students are expected to perform at least 10 experiments out of following list.

S. No.	Content	Hrs
1.	Laser beam parameters - Wavelength and beam divergence	**120**
2.	C program 1. Matrix multiplication 2. Rank list 3. Student Record.	
3.	Design of binary Weighted and R/2R Ladder DAC using the IC 741.	
4.	Parity checker, generator, Encoder, decoder.	
5.	Quincke's method-Magnetic Susceptibility	
6.	Microprocessor Programs– Keyboard display interface	
7.	Microprocessor Programs – Counters	
8.	MicroprocessorPrograms –Stepper motor interface	
9.	Microprocessor Programs – Counters	
10.	Microcontroller Programs – Analog to digital & Digital to Analog Conversion	
11.	Microcontroller Programs - Keyboard display interface	
12.	Microcontroller Programs - Stepper motor interface	

Books for Study

1. Practical Physics and Electronics - C.C.Ouseph, U.J.Rao, V.Vijeyendran, SV Prniters and Publishers Pvt. Ltd., 2007.
2. Programming in Ansi C - E.Balagurusamy,Tata McGraw Hill, 2008.
3. Advanced Practical Physics- Ghosh, New Central Book Agrency, 1997.
4. A Text Book of Practical Physics- S. N. Ganguly, K. P. Basu Publishing, 1960.
5. Microprocessor and its Application-A.NagoorKani,RBA Publications,2004.

Books for Reference

1. Microprocessor-Gillmore,TMH Editions,1997.
2. Microprocessor Architecture,Programming and Application with 8085-Ramesh S.Gaonkar, Wiley Eastern,2000.
3. Microprocessor and interfacing-Doughlas V.Hall,TMH, 2006.
4. Microcontrollers (Theory and Applications)-Ajay V.Deshmuk, TMH, 2007.
5. Fundamentals of Microprocessor and Microcontroller - B.Ram, 2011.

Web Resources

1. http://iitg.ac.in/subhasht/ph511%20July-Dec-2015/Manual%20PH511.pdf

Course Outcomes: At the end of the course the student should be able to:		
CO Number	**CO Statement**	**Knowledge Level**
CO1	Make measurements, analyze and interpret the experimental data with techniques of advanced general experiments.	**K_3 ,K_4**
CO2	Evaluate and compare magnetic properties and magnetic behavior of magnetic materials.	**K_5, K_4**
CO3	Able to interface different programmable devices with 8085 microprocessor and 8531 microcontrollers.	**K_3**
CO4	Design and analyze electronic circuits.	**K_4, K_3**
CO5	Apply the C language to solve problems.	**K_2, k_5**

K_6-*Create*; K_5-*Evaluate*; K_4-*Analyse*; K_3-*Apply*; K_2-*Understand*; K_1-*Recall*

Mapping of CO with PO and PSO

CO	**PO**					**PSO**			
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO 1	S	S	S	M	L	S	S	L	S
CO 2	S	S	S	L	L	S	S	L	S
CO 3	S	S	S	M	S	S	S	M	S
CO 4	S	S	S	M	M	S	S	M	S
CO 5	S	S	S	L	M	S	S	L	S

Programme : M.Sc. Physics				
Semester IV	**Code: 19PPHPC**	**Core Course - XV PROJECT AND PROJECT VIVA-VOCE**	**Credit:4**	**Hours: 6/Week**

Course Objectives:
The aim is to expose the students to preliminaries and methodology of research in Theoretical and Experimental Physics. Students get the opportunity to participate in some ongoing research activity and development of a laboratory experiment.

Course Outcomes: At the end of the course the student should be able to:

CO Number	CO Statement	Knowledge Level
CO1	Explain the significance and value of problem in physics to both scientific and societal communities.	K_3
CO2	Design and carry out scientific experiments as well as accurately record the results.	K_3
CO3	Critically analyse and evaluate experimental strategies, and decide which is most appropriate for answering specific questions.	K_4
CO4	Research and communicate scientific knowledge in the context of a topic related to condensed matter physics/Nuclear/High Energy Physics, in oral, written and electronic formats.	K_5, K_3
CO5	Explore new areas of research in physics and allied fields of science and technology.	K_2, k_5

K_6-*Create*; K_5-*Evaluate*; K_4-*Analyse*; K_3-*Apply*; K_2-*Understand*; K_1-*Recall*

Guidelines for the Project:

- The aim of project work in M.Sc. 4th semesters is to expose the students to preliminaries and methodology of research and as such it may consist of review of some research papers, development of a laboratory experiment, identification of methodology, fabrication of a device, working out some problem, participation in some ongoing research activity, analysis of data, etc..
- Project work can be in Experimental or Theoretical Physics in the thrust as well as non-thrust research areas of the department.
- A student opting for this course will be attached to one teacher of the department before the end of the 3rd semester.
- A report about the work done in the project (typed on both the sides of the paper and properly bound) will be submitted on the announced date
- Assessment of the work done under the project will be carried out by both the guide and external examiner on the basis of effort put in the execution of the project, interest shown in learning the methodology, report prepared, grasp of the problem assigned and viva-voce etc. as per course guidelines.

Mapping of CO with PO and PSO

CO	PO					PSO			
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO1	PSO2	PSO3	PSO4
CO 1	S	S	S	M	S	S	S	S	S
CO 2	S	S	S	S	S	S	S	S	S
CO 3	S	S	S	M	S	S	S	M	S
CO 4	S	S	S	M	M	S	S	M	S
CO 5	S	S	S	S	M	S	S	S	S