

M. Sc. Physics

Syllabus

AFFILIATED COLLEGES

Program Code: 32C

2021 – 2022 onwards



BHARATHIAR UNIVERSITY

(A State University, Accredited with “A” Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking: Times -801-1000, Shanghai -901-1000, URAP - 982)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)

The M. Sc. Physics program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Graduates will become experts in various professional zones like industry, research, academic, business, etc. at par with national and international standards.
PEO2	Acquired knowledge in physical concepts facilitate the graduates to recognize, formulate, examine, explore and implement the ideas for societal developments.
PEO3	Graduates capable enough to meet any challenge as an individual or in a part of team towards achieving prospective scope in innovative projects.
PEO4	Graduates will have cognitive base to achieve academic excellence by learning diverse phenomena of physical concepts help them to lead and execute inter- and multidisciplinary academic and research works.
PEO5	Graduates will be skilled enough to perceive novel and innovative concepts to develop cutting edge technologies as entrepreneurial pursuit.
PEO6	Graduates will have a proficiency to enhance the application prospects of physics by interfacing the philosophical concepts with suitable perceptions beyond the subject boundary.



Program Specific Outcomes (PSOs)

After the successful completion of M.Sc. Physics program, the students are expected to	
PSO1	Be a potential graduate with the stuff of vibrant subject knowledge in every subdivision of Physics especially in Classical Mechanics, Quantum Mechanics, Mathematical Physics, Nuclear Physics, Electronics and Materials Science with application tendency.
PSO2	Be a science person to extend the application of Physics discipline to different sectors of common or needy people.
PSO3	Have the competence to get clear any comprehensive examination offers superior opportunity in official, academic and research sectors.
PSO4	Have the skill to manage computational tools to explore scientific activity even at subatomic particle level using theoretical concepts without empirical approach.
PSO5	Be a skillful to perceive rare or exceptional scientific phenomena using the concepts of physical science and to find solution to any challengeable task.
PSO6	Be an efficient to employ research work by applying the subject knowledge acquired from diverse objectives of Physics.
PSO7	Have the ability to meet any employment challenge demands intense subject proficiency.



Program Outcomes (POs)

On successful completion of the M. Sc. Physics program	
PO1	Understand the concepts of advanced physics and capable to apply them in real time problems to find appropriate solutions.
PO2	Develop model and analyse to derive solution using the background of theoretical physics.
PO3	Augment the application feasibility of Physics theoretical formulations in combination with relative concepts belongs to other discipline.
PO4	Apply learned experimental skill to develop newer materials with unique characteristics employing variety of synthesis techniques.
PO5	Develop software tools by applying the learned concepts in combination belongs to Mathematical physics, Quantum mechanics and computational physics.
PO6	Perceive novel and contemporary research philosophies globally facilitate to work at par with international standards.
PO7	Meet any challenge globally for employment in academic, research and industry by exposing the learned skill in diverse zone under Physics discipline.



BHARATHIAR UNIVERSITY: COIMBATORE 641 046**M. Sc. Physics Curriculum (AFFILIATED COLLEGES – OBE PATTERN)***(For the students admitted during the academic year 2021 – 22 onwards)*

Course Code	Title of the Course	Credits	Hours/week		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
13A	Paper - I Classical Mechanics	4	5	-	50	50	100
13B	Paper - II Mathematical Physics-I	4	5	-	50	50	100
13C	Paper - III Integrated Electronics	4	5	-	50	50	100
13D	Paper - IV Advanced Computational Physics	4	5	-	50	50	100
	Practical - I General Physics	-		3	-	-	-
	Practical - II Electronics	-		3	-	-	-
	Elective I	4	4	-	50	50	100
Total			24	6			500
SECOND SEMESTER							
23A	Paper - V Quantum Mechanics-I	4	5	-	50	50	100
23B	Paper -VI Mathematical Physics- II	4	5	-	50	50	100
23C	Paper -VII Atomic and Molecular Spectroscopy	4	5	-	50	50	100
23P	Practical- I General Physics	4	-	5	50	50	100
23Q	Practical- II Electronics	4	-	5	50	50	100
	Elective II	4	5	-	50	50	100
Total			20	10			600
THIRD SEMESTER							
33A	Paper - VIII Quantum Mechanics – II	4	5	-	50	50	100
33B	Paper - IX Classical Electrodynamics	4	5	-	50	50	100
33C	Paper - X Statistical Mechanics	4	5	-	50	50	100
33D	Paper - XI Condensed Matter Physics	4	5	-	50	50	100
	Practical- III Advanced Practicals	-	-	3	-	-	-
	Practical- IV Special Electronics	-	-	3	-	-	-
	Elective III	4	4	-	50	50	100
Total			24	6			500
FOURTH SEMESTER							
43A	Paper -XII Nuclear and Particle Physics	4	5	-	50	50	100
43B	Paper -XIII Communication Electronics	4	5	-	50	50	100
43C	Paper -XIV Laser and Nonlinear Optics	4	5	-	50	50	100
43P	Practical- III Advanced Practicals	4	-	5	50	50	100
43Q	Practical- IV Special Electronics	4	-	5	50	50	100
47V	Project	6	-	5	75	75	150
Total			15	15			650
Grand Total		90	83	37			2250
ONLINE COURSES							
	MOOC, SWAYAM, NPTEL, Websites etc.						

LIST OF ELECTIVE PAPERS		
(College can choose any one elective paper from the choices under each section)		
Course	Course code	Course Title
Elective – I	1EA	Robotics, Artificial Intelligence and Information Theory (Industry 4.0)
	1EB	Elements of Nano science and Nanotechnology
	1EC	Introductory Astronomy, Astrophysics & Cosmology
Elective – II	2EA	Plasma Physics
	2EB	Crystal growth methods and characterization
	2EC	Atmospheric Physics
Elective - III	3EA	Experimental Techniques & Data Analysis
	3EB	Thin film Physics
	3EC	Microprocessor and Microcontroller
	3ED	Non- Conventional energy resources



MARKS DISTRIBUTION (INTERNAL (CIA) AND EXTERNAL)**I - THEORY**

TOTAL MARKS	EXTERNAL		INTERNAL		Overall Passing Minimum (Internal + External)
	Max. Marks	Passing Minimum	Max. Marks	Passing Minimum	
100	50	25	50	25	50

S. No	Theory – CIA Breakups	
	Maximum Marks	50
1	CIA Tests I and II (2 hours test)	15
2	Model Exam - End semester (3 hours)	15
3	Assignment	10
4	Seminar	10

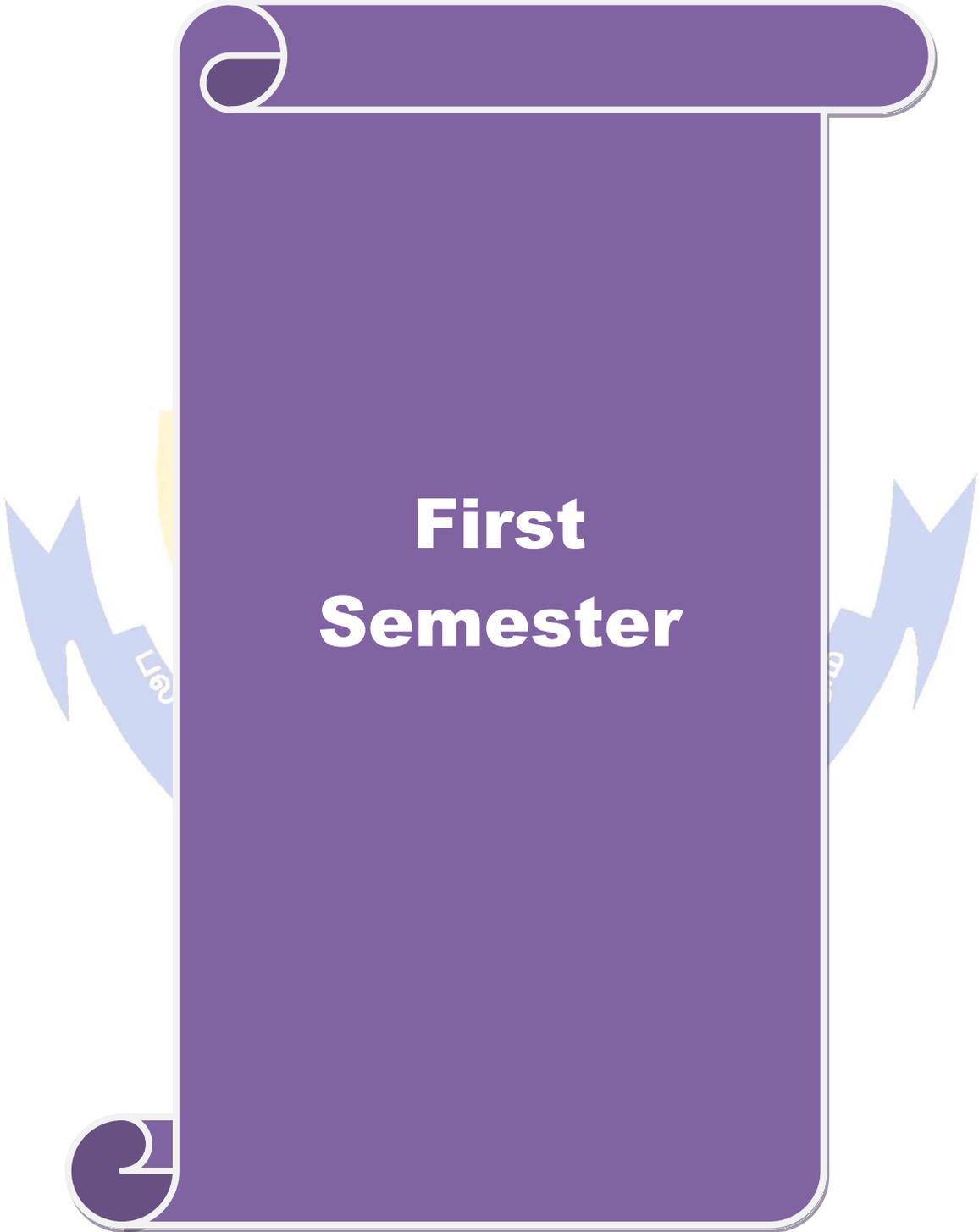
II - PRACTICALS

TOTAL MARKS	EXTERNAL		INTERNAL		Overall Passing Minimum (Internal + External)
	Max. Marks	Passing Minimum	Max. Marks	Passing Minimum	
100	50	25	50	25	50

S. No	Practical – CIA Breakups	
	Maximum CIA Marks	50
1.	Tests: I and II	30
2.	Record	15
3.	Attendance	05

III - Project

S. No	Project – Breakups	
	Total: 150 Marks (Internal : 75 ; External : 75)	
1.	Internal (Project work)	75
2.	External (Dissertation: 45 marks +Viva voice: 30 marks)	75



First Semester

FIRST SEMESTER

Course code	13A	CLASSICAL MECHANICS			
Core Paper I		L	T	P	C
		5	0	0	4
Pre-requisite	Students should have basic understanding in mathematical physics and Newtonian mechanics	Syllabus Version			2020 - 2021
Course Objectives:					
The main objectives of this course are to:					
1. Understand basics of variational principle, Lagrangian and Hamiltonian formalism					
2. know about central force problem, phase space, canonical transformation and Hamilton Jacobi technique					
3. apply normal mode analysis to physical systems					
4. learn concepts of special relativity and familiarise basics of non-linear dynamics					
Expected Course Outcomes:					
On successful completion of the course, the students will be able to :					
1	familiarise basic mathematical tools like variational calculus to mechanical systems and able to compute Lagrangian and Hamiltonian equation of motion				K2
2	understand central force problem and also system in non-inertial reference frame				K3
3	analyse mechanics problems through canonical transformation technique and Hamilton Jacobi technique				K4
4	learn rigid body dynamics and normal mode analysis				K5
5	study basic concept of special theory of relativity and non-linear dynamics				K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create					
Unit I	Variational Principle: Lagrange's and Hamilton's Equations				10 hours
Newton's Three Laws of Motion (Review) – Constraints, Degrees of freedom, Generalized Coordinates and Configuration Space. Variational Principle – Hamilton's Principle – Derivation of Euler Lagrangian Equation of Motion – Symmetries and Conservation Laws – Cyclic Coordinates. Phase Space – Hamilton's Canonical Equation of Motion using Variational Principle – Physical Significance of Hamiltonian. Applications – Lagrangian and Hamilton's Equation of Motion for Simple Pendulum, Linear Harmonic Oscillator and A Charged Particle in Electromagnetic Fields					
Unit II	Central Force and Non-inertial Frame				12 hours
Motion in a Central Force Field in Lagrangian Formalism – Reduction of Two Body Problem to the Equivalent One Body Problem – Classification of Orbits for Inverse Square Forces - Virial Theorem – Differential Equation for the Orbits - Two Body Collisions. Classical Scattering in Laboratory and Centre of Mass Frames - Non-inertial Frames – Rotating frame of Reference - Pseudo Forces - Coriolis Force and Effects of Coriolis Force on the Moving Bodies					
Unit III	Canonical Transformation and Hamilton Jacobi method				12 hours
Principle of Least Action – Statement and Proof – Canonical Transformation – Generating Functions and its different form – Poisson's Bracket – Properties – Angular momentum Algebra – Liouville's Theorem (without Proof) - Hamilton Jacobi method – Harmonic Oscillator Problem - Hamilton's Characteristic Functions – Conservative Systems – Kepler Problem - Action and Angle Variables – Linear Harmonic Oscillator using Action and Angle Variables					

Unit IV	Rigid Body and Small Oscillations	12 hours
Motion of a Rigid Body – Euler Angles – Angular Momentum and Inertia Tensor – Moment of Inertia and Products of Inertia – Principal Axis – Rotational Kinetic Energy - Euler's Equation of Motion – Torque Free Motion – Free motion of a Symmetric Top - Theory of Small Oscillations – Potential Energy – Stable and Unstable Equilibrium – Eigenvalue Problem – Frequencies of Free Vibrations - Normal Modes – Normal Coordinates – Linear Triatomic Molecule – Double Pendulum		
Unit V	Theory of Relativity and Introduction to Non-Linear Dynamics	12 hours
Lorentz Transformations – Mass and Energy Equivalence – Relativistic Kinematics - Force in Relativistic Kinematics and Lorentz Transformation of Force – Lagrangian and Hamiltonian in Relativistic Kinematics – Minkowski space – world point and world line – space time intervals - Dynamical Systems – Autonomous and Non-Autonomous Systems - Phase Portraits – Simple Harmonic Oscillator in One Dimension – Simple Pendulum – Linear Stability Analysis – Classification of Fixed Points		
Unit VI	Contemporary Issues	2 hours
Expert Lectures, Online Seminars – Webinars		
Total Lecture Hours		60 hours
Text Book(s)		
1	Classical Mechanics – J. C. Upadhyaya, Himalaya Publishing House, 2012.	
2	Introduction to Classical Mechanics – R. G. Takwala and P.S. Puranik, Tata – McGraw Hill, New Delhi, 1980.	
Reference Books		
1	Classical Mechanics – H. Goldstein, C.P. Poole and J. Safko, 3 rd Edition, Pearson, 2012	
2	Classical Mechanics - N. C. Rana and P.S. Joag, Tata McGraw Hill, 2001	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]		
1	https://nptel.ac.in/courses/122/106/122106027/	
2	https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/	
Course Designed By: Dr. A Nishara Begum and Dr. S.S. Naina Mohammed (ss.nainamohammed@gmail.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	L	L	M	M
CO3	S	M	M	L	M	S	M
CO3	S	S	S	L	M	S	M
CO4	S	S	M	L	M	S	M
CO5	S	S	M	L	M	M	M

*S-Strong; M-Medium; L-Low

Course code	13 B	MATHEMATICAL PHYSICS I	L	T	P	C
Core Paper II			5	0	0	4
Pre-requisite	Students should have basic understanding in vectors, trigonometry, algebra and calculus			Syllabus Version	2020 - 2021	
Course Objectives:						
The main objectives of this course are to:						
1. understand basics of vector analysis, curvilinear coordinate system, linear vector space and tensors						
2. familiarize infinite series and error analysis						
3. learn complex variables and residue theorem technique to solve real integrals appearing in physics problems						
4. understand differential equations and self adjoint operators						
Expected Course Outcomes:						
On successful completion of the course, the students will be able to :						
1	understand vector calculus and also able to write operators in different coordinate system					K2
2	apply linear vector space concepts in quantum mechanics					K3
3	understand convergence of infinite series, error analysis and curve fitting					K4
4	evaluate real integrals appearing in science and engineering problems					K5
5	solve differential equations and understand self adjoint operators used in quantum mechanics					K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create						
Unit I	Vector Analysis					10 hours
Vector Integration – Line Integral – Path Independence – Exact Differential – Surface Integral – Flux – Volume Integral – Divergence Theorem – Stokes Theorem – Green Theorem– Gauss’s law – Laplace’s Equation and Poission’s Equation in Electrostatics - Orthogonal Curvilinear Coordinates – Unit Vectors in Curvilinear Coordinate System – Arc Length and Volume Element – The Gradient, Divergence, Curl and Laplacian Operator in Cartesian, Cylindrical and Spherical Polar Coordinate System						
Unit II	Linear Vector Space and Tensors					10 hours
Definition of Linear Vector Space – Linear Independence – Basis and Dimensions of a Vector Space – Scalar Product – Schwartz Inequality – Orthonormal Basis (ONB) - Gram Schmid Orthogonalization Procedure – Linear Transformations – Linear Operators – Matrix Representation of a Linear operators - Tensors – Covariant and Contravariant Tensors – Mixed Tensors - Rank of Tensors - Symmetric and Anti Symmetric Tensors – Kronecker Delta – Levi Civita Symbol - Contraction – Tensor Product – Exterior Product – Metric Tensor						
Unit III	Infinite Series and Error Analysis					12 hours
Introduction to Sequence and Series – Summation of Series – Geometric Series – Arithmetic and Geometric Series – Difference Method – Convergence of Series – Absolute and Conditional Convergence – Convergence of a Serie Containing Only Real Positive Terms – Preliminary Test – Comparision Test – Ratio Comparision Test – Quotient Test – Integral Test – Cauchy’s Root Test – Grouping tems – Alternating Series Test – Operations with Series – Taylor and Maclaurin Series – Errors Analysis – Propagation of Errors - Normal Distribution of Error - Standard Error – Principle of Least Squares – Application of Solution to Linear Equation – Curve Fitting						

Unit IV	Complex Variables	14 hours
Complex Variables and Functions – Analytic Functions – Cauchy Riemann Condition with Proof – Complex Integration – Cauchy’s Integral Theorem – Cauchy’s Integral Formula – Taylor Series Expansion – Laurent Series Expansion – Singularities – Poles – Cauchy Residue Theorem – Computations of Residue – Evaluation of integrals using Residues – Principal Value Integrals		
Unit V	Ordinary Differential Equations	12 hours
First and Second Order Ordinary Differential Equations with Constant Coefficients – Initial Value Problem – Method of Finding Solutions – Superposition Principle – Wronskian – Second Order Differential Equations with Variable Coefficients – Definition of Ordinary and Singular Points – Power Series Solution – Solutions About Ordinary Point and Singular Point – Frobenius Method - Operators – Sturm Liouville Condition – Self Adjoint Operators – Discussions on Completeness Property (no proof).		
Unit VI	Contemporary Issues	2 hours
Expert Lectures, Online Seminars – Webinars		
Total Lecture Hours		60 hours
Text Book(s)		
1	Mathematical Methods for Physicists (a comprehensive guide) – George B. Arfken and Hans J. Weber and Frank E. Harris, Elsevier Academic Press, 7 th Edition, 2013.	
2	Mathematical Methods for Physics and Engineering – K. F. Riley, M. P. Hobson and S. J. Bence, Cambridge University Press, 3 rd Edition, 2006.	
3	Mathematical Physics – P. K. Chattopadhyay, New Age International Publishers, 2 nd Edition, 2013.	
4	Principles of Instrumental Analysis – Douglas A Skoog and James J. Leary- 4 th Edition, Harcourt Brace College Publishers – For Unit III Error Analysis	
Reference Books		
1	Advanced Engineering Mathematics – Erwin Kreyszig, Herbert Kreyszig and Edward J. Norminton, John Wiley & Sons, 10 th Edition, 2011	
2	Mathematical Methods in the Physical Sciences – Mary L. Boas, John Wiley & Sons, 3 rd Edition, 2006.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]		
1	https://nptel.ac.in/courses/115/106/115106086/	
2	https://nptel.ac.in/courses/115/103/115103036/	
Course Designed By: Dr. A. Ramalingam and Dr. S.S. Naina Mohammed (ss.nainamohammed@gmail.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	L	S	S	M
CO3	S	S	S	L	S	S	M
CO3	S	S	M	L	S	M	M
CO4	S	S	M	L	S	S	M
CO5	S	S	S	L	S	S	M

*S-Strong; M-Medium; L-Low

Course code	13C	INTEGRATED ELECTRONICS		L	T	P	C
Core Paper III				5	0	0	4
Pre-requisite	Students should have the basic knowledge about analog and digital electronics		Syllabus Version	2020-2021			
Course Objectives:							
The main objectives of this course are to:							
1. Acquire knowledge and apply it to various electronic devices							
2. Develop knowledge about analog and digital electronics							
3. Motivate the students to apply the principles of electronics in their day – to – day life							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Analyze various semiconductor devices and their applications					K3	
2	Study the characteristics of Op-amp and it's applications					K3	
3	Update the knowledge of signal processing					K4	
4	Develop the fundamental concepts and techniques used in data storage elements					K5	
5	Design different types of registers and counters					K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit I	Semiconductor Devices and IC fabrication					12 hours	
Semiconductor diodes – Characteristics – Ideal diode – Clipper and clamper circuits. Special diodes: Zener, Schottky and Tunnel diodes- Applications – Junction transistors – JFET, MOSFET, UJT and SCR – applications – Principle of Integrated Circuits – fabrication process – Linear and Digital Integrated Circuits							
Unit II	Operational Amplifier and Applications					12 hours	
Op Amp characteristics – DC & AC characteristics - Frequency Response of an Op Amp -Parameters of an Op Amp - Sign Changer - Scale Changer – Adder - Subtractor - Phase Shifter -Differential Amplifier – Integrator – Differentiator - Analog Computer Setup to Solve Linear Simultaneous Equations - Differential Equations in Physics - Logarithmic & Exponential Amplifiers - Active Filters							
Unit III	Signal Processing & Data Acquisition					12 hours	
Wave Form Generators and Wave Shaping Circuits - Sinusoidal Oscillators - Phase Shift Oscillator - Wein Bridge Oscillator - Crystal Oscillator - Multivibrators, Comparators - Schmitt Trigger-Square Wave & Triangular Wave Generators - Pulse Generators - IC 555 Timer and its Application – Signal and Signal Processing - Analog Multiplexer and Demultiplexer - D/A Converters - A/D Converters							
Unit IV	Flip - Flops					10 hours	
Types of Flip-flops – RS Flip-flop, Clocked RS Flip-flop, Clocked D Flip-flop, Positive-Edge-Triggered RS Flip-flop, Negative-Edge - Triggered RS Flip-flop, Edge-Triggered D Flip-flop, Positive-Edge - Triggered JK Flip-flop, Flip-flop timing, JK Master-Slave Flip-flop, Conversion of SR Flip-flop to JK Flip-flop							

Unit V	Registers, Counters and Memories	12 hours
Types of Registers – Serial in Serial out - Serial in Parallel out - Parallel in Serial out - Parallel in Parallel out - Counters – Asynchronous (Ripple) counters - Synchronous counters - Mod 2 to Mod 10 counters and Decade counters - Memories: RAM, ROM, PROM, EPROM and CCD		
Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	Microelectronics, Millman & Grabel, McGraw Hill, Second edition (2017)	
2	Digital Principles and Applications, Malvino & Leach, McGrawHill, Seventh edition (2011)	
3	Linear Integrated circuits, D. R. Choudhury & S. Jain, New Age International, New Delhi, Second edition (2003)	
Reference Books		
1	Integrated Electronics, Millman & Halkias, Tata McGraw Hill, 17th Reprint (2000)	
2	Electronics Principles & Applications, A.B. Bhattacharya New Central Book Agency (P) LTd., Kolkata (2007)	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/course.html/electronics/operational amplifier	
2	https://nptel.ac.in/course.html/digital circuits/	
Course Designed By: Dr. P. Sagunthala & Dr. U. Karunanithi (karunanithiu30@gmail.com)		

Mapping with Programme outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	S	M	L	S	M
CO2	S	S	S	M	M	L	M
CO3	S	M	M	S	S	M	L
CO4	M	S	M	L	S	M	S
CO5	S	M	S	M	L	M	S

*S-Strong; M-Medium; L-Low

Course code	13D	ADVANCED COMPUTATIONAL PHYSICS	L	T	P	C
Core Paper IV			5	0	0	4
Pre-requisite	The Students should have basic knowledge in differential equation and linear algebra.		Syllabus Version		2020-2021	
Course Objectives:						
Primary objectives:						
<ol style="list-style-type: none"> 1. To equip the computational skill using various mathematical tools. 2. To apply the software tools to explore the concepts of physical science. 3. To approach the real time activities using physics and mathematical formulations. 4. To apply various mathematical entities, facilitate to visualise any complicate tasks. 5. To enhance the problem-solving aptitudes of students using various numerical methods. 6. To promote computer programming skills with the help of MATLAB tools. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand and apply numerical methods to find out solution of algebraic equation using different methods under different conditions, and numerical solution of system of algebraic equation.					K2
2	Apply various interpolation methods and finite difference concepts.					K3
3	Work out numerical differentiation and integration whenever and wherever routine are not applicable.					K3
4	Identify modern programming methods and describe the extent and limitations of computational methods in physics					K4
5	Process, analyze and plot data from a variety of physical phenomena and interpret their meaning					K5
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Numerical Differentiation					12 hours
Finding Roots of a Polynomial - Bisection Method - Newton Raphson Method - Solution of Ordinary Differential Equation by Euler – Runge Kutta Fourth Order Method for solving first order Ordinary Differential Equations						
Unit II	Numerical integration					10 hours
Trapezoidal rule - Simpson's 1/3 rule - Simpson's 3/8 rule - Gaussian quadrature method (2 point and 3 point formula) - Giraffe's root square method for solving algebraic equation						
Unit III	Matlab Fundamentals					12 hours
Introduction – Matlab Features – Desktop Windows: Command, Workspace, Command History, Array editor and Current Directory – Matlab Help and Demos – Matlab Functions, Operators and commands, Basic Arithmetic in Matlab – Basic Operations with Scalars - Vectors and Arrays - Matrices and Matrix Operations - Complex Numbers - Matlab Built - In Functions - Illustrative Examples						

Unit IV	Matlab Programming	12 hours
Control Flow Statements: if else, else if, Switch Statements – For, While Loop Structures – Break Statement – Input / Output Commands – Script ‘m’ Files – Function ‘m’ Files – Controlling output		
Unit V	Matlab Graphics	12 hours
2D Plots - Planar Plots, Log Plots, Scatter Plots, Contour Plots - Multiple Figures, Graph of a Function – Titles, Labels, Text in Graph - Line Types, Marker types, Colors - 3D Graphics - Curve Plots - Mesh and Surface Plots - Illustrative Examples		
Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	Numerical methods in Science and Engineering - M.K. Venkataraman, National Publishing Co. Madras, 1996	
2	Getting Started With Matlab – Rudra Pratap, Oxford University Press-New Delhi	
Reference Books		
1	Numerical methods using Matlab – John Mathews & Kurtis Fink, Prentice Hall, New Jersey 2006	
2	Matlab Programming - David Kuncicky, Prentice Hall	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourses.nptel.ac.in/noc20_ma33/preview	
2	https://nptel.ac.in/course/103106074/	
3	https://nptel.ac.in/course/122106033/	
Course Designed By: Dr. R. Ilango (ilangoramu@gmail.com)		

Mapping with Programme outcomes							
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	L	S	S	M
CO2	S	L	M	M	L	S	S
CO3	S	M	S	M	M	M	L
CO4	M	S	L	S	S	L	M
CO5	L	M	M	M	S	S	S

*S - Strong; M - Medium; L – Low.



Second Semester

SECOND SEMESTER

Course code	23 A	L		T	P	C
QUANTUM MECHANICS I		5	0	0	4	
Core Paper V						
Pre-requisite	Students should have basic understanding in mathematical physics and classical mechanics	Syllabus Version		2020 - 2021		
Course Objectives:						
The main objectives of this course are to:						
1. Understand basics of state vector in abstract representation						
2. Solve bound state problems						
3. Learn angular momentum algebra and concept of spin in quantum mechanics						
4. Apply approximation methods						
Expected Course Outcomes:						
On successful completion of the course, the students will be able to :						
1	familiarize Dirac notation					K2
2	apply Schrodinger equations to exactly solvable simple problems					K3
3	learn quantum mechanical angular momentum algebra and spin					K4
4	compute corrections in energy and wavefunctions using approximation technique					K5
5	calculate transition probability and also selection rules for transition					K5
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Basic Formalism					8 hours
Postulates of Quantum Mechanics – Max Born Statistical Interpretation of Wavefunction – Probability Density – Wavefunction in Position Representation and Momentum Representation – Derivation of Schrodinger Time Independent Wave Equation – Stationary State – Dirac Notation – State Vector - Hilbert Space – Basis – Orthonormal Basis – Change of Basis – Unitary Transformation – Equation of Motion in Schrodinger Representation – Heisenberg Representation and Dirac Representation.						
Unit II	Applications of Schrodinger Wave Equations					10 hours
Bound State Problems – One Dimensional Infinite Square Well (0,L) – Three Dimensional Infinite Cubic Well – Concept of Degeneracy – One Dimensional Finite Square Well – Potential Step – Square Potential Barrier – Explanation of Alpha Decay – Solution of Linear Harmonic Oscillator by Schrodinger Approach (Differential Equation Method) and Heisenberg Approach (Creation and Annihilation Operator Method) – Central Potential – Hydrogen Atom (qualitatively)						
Unit III	Angular Momentum Algebra					12 hours
Orbital Angular Momentum Algebra – Spin Angular Momentum Algebra – Pauli Spin Matrices – Eigen Values and Eigen Vector of Pauli Spin Matrices – Properties of Pauli Spin Matrices – Total Angular Momentum Algebra – Complete Set Of Compactable Operators – Commutation Relations of J^2, J_z, J_+ and J_- – Eigen Values of of J^2, J_z - matrix representation of of J^2, J_z, J_+ and J_- - addition of angular momenta – Clebsch Gordon coefficients and its properties – CG Coefficients for Spin Half systems and Spin One systems.						

Unit IV	Stationary Approximation Method	14 hours
Time Independent Perturbation Theory – Non Degenerate Case – Ground State of Helium Atom – Degenerate Case - Stark Effect in Hydrogen Atom – Variation Method – The Hellmann Feynman Theorem – Estimation of Ground State of Helium Atom – Estimation of Ground State of Deuteron – WKB Approximation – Connection Formula – Validity – Barrier Penetration – Alpha Emission		
Unit V	Time Dependent Perturbation Theory	14 hours
Time Dependent Perturbation Theory – Formalism - Transition Probability – Transition Probability for a Constant Perturbation - Transition into a continuum of final states – Fermi Golden Rule – Transition Probability for a Harmonic Perturbation – Stimulated Emission – Principle of Detailed Balancing - Selection Rules - Rayleigh Scattering - Raman Scattering		
Unit VI	Contemporary Issues	2 hours
Expert Lectures, Online Seminars - Webinars		
Total Lecture Hours		60 hours
Text Book(s)		
1	Quantum Mechanics – Nouredine Zettili, John Wiley & Sons, Ltd, 2 nd Edition, 2009	
2	Quantum Mechanics – G. Aruldas, PHI Learning Private Limited, 2 nd Edition, 2009	
3	Introduction to Quantum Mechanics – 2 nd Edition – David J. Griffiths – Pearson Education International.	
Reference Books		
1	Quantum Mechanics - V. Devanathan - Narosa Publishing - New Delhi, 2005	
2	Quantum Mechanics - L.I. Schiff - McGraw Hill, 3rd Edition, 1968	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]		
1	https://nptel.ac.in/courses/122/106/122106034/	
2	https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/	
3	Nptel lecture – Quantum Mechanics by Prof. Ajay Gatak	
Course Designed By: Dr. A. Ramalingam & Dr. S.S. Naina Mohammed (ss.nainamohammed@gmail.com)		

Mapping with Programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	L	M	S	M
CO2	S	S	S	L	S	M	S
CO3	M	M	S	L	M	M	M
CO4	M	S	S	L	S	M	M
CO5	S	S	S	L	M	M	M

*S - Strong; M - Medium; L – Low.

Course code	23 B	MATHEMATICAL PHYSICS II			L	T	P	C
Core Paper VI				5	0	0	4	
Pre-requisite	Students should have basic understanding in mathematical physics I	Syllabus Version			2020 - 2021			
Course Objectives:								
The main objectives of this course are to:								
1. Understand basics of Fourier series, Fourier Transform and Laplace Transform								
2. Learn special functions								
3. Familiarize Greens function technique and integral equations								
4. Know about group theory applied in physical problems								
Expected Course Outcomes:								
On successful completion of the course, the students will be able to :								
1	Apply Fourier series and Fourier transform techniques to physics and engineering problems				K3			
2	Apply Laplace transform techniques to physics and engineering problems				K3			
3	Understand special functions used in quantum mechanics and electrodynamics course				K4			
4	Solve differential equations using Green's function technique				K5			
5	Familiarize basic group theory concepts used in spectroscopy and nuclear physics				K5			
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create								
Unit I	Fourier Series and Fourier Transform						12 hours	
Introduction to Fourier Series – Dirichlet's Theorem and Dirichlet's Conditions – Fourier Coefficients – Even and Odd Functions – Complex Form of Fourier Series - Change of Interval – Parseval's Relations – Applications of Fourier Series – Fourier Transform – Fourier Transform of Gaussian Function – Fourier Sine and Cosine Transform – Properties of Fourier Transforms – Parseval Theorem – Fourier Transforms of Derivatives – Applications to Differential Equations and Boundary Value Problems – Introduction to Discrete Fourier Transform.								
Unit II	Laplace Transform						8 hours	
Introduction to Laplace Transforms - Laplace Transform for Elementary Functions and Dirac Delta Function – Properties of Laplace Transform – Laplace Transform of Derivatives – Convolution Theorem - Inverse Laplace Transform – Properties – Dirac Delta Function - Properties of Laplace Transform – Solution to Differential Equations								
Unit III	Special Functions						12 hours	
Solution of Differential Equations of – Legendre, Hermite, Laguerre and Bessel Differential Equations using Power Series method – Generating Function, Rodrigues Formule, Recursion Relations, Orthogonality Relations.								
Unit IV	Green's Function and Partial Differential Equations						12 hours	
Dirac Delta Distribution – Non Homogeneous Boundary Value Problems and Green's Function – Green's Function for One – Dimensional Problems – Green's Function for Poisson's Equation and a Formal Solution of Electrostatic Boundary Value Problems – Green's Function for Quantum Mechanical Scattering Problem								

- Partial Differential Equation – Variable Separable Method – Solutions of Laplace Equations, Wave Equations and Heat Equation in Two and Three Dimensions		
Unit V	Group Theory	14 hours
Introduction to Group Theory – Group Multiplication Table – Cyclic Group - Subgroup – Cosets - Classes – Invariant Subgroup – Homomorphism and Isomorphism – The Group Symmetry of an Equilateral Triangle and a Square – Group Representation – Reducible and Irreducible Representation – Schur’s Lemma and Orthogonality Theorem – Character Tables – Introduction to Lie Groups and Lie Algebras – SU(2) and SO(3)		
Unit VI	Contemporary Issues	2 hours
Expert Lectures, Online Seminars – Webinars		
	Total Lecture Hours	60 hours
Text Book(s)		
1	Mathematical Methods for Physicists (a comprehensive guide) – George B. Arfken and Hans J. Weber and Frank E. Harris, Elsevier Academic Press, 7 th Edition, 2013.	
2	Mathematical Methods for Physics and Engineering – K. F. Riley, M. P. Hobson and S. J. Bence, Cambridge University Press, 3 rd Edition, 2006.	
3	Mathematical Physics – P. K. Chattopadhyay, New Age International Publishers, 2 nd Edition, 2013.	
Reference Books		
1	Advanced Engineering Mathematics – Erwin Kreyszig, Herbert Kreyszig and Edward J. Norminton, John Wiley & Sons, 10 th Edition, 2011	
2	Mathematical Methods in the Physical Sciences – Mary L. Boas, John Wiley & Sons, 3 rd Edition, 2006.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]		
1	https://nptel.ac.in/courses/115/106/115106086/	
2	https://nptel.ac.in/courses/115/103/115103036/	
Course Designed By: Dr. S.S. Naina Mohammed (ss.nainamohammed@gmail.com)		

Mapping with Programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	L	S	M	M
CO2	S	S	S	L	S	M	M
CO3	S	S	S	L	S	M	M
CO4	S	S	S	L	S	S	M
CO5	S	S	S	L	S	M	M

*S - Strong; M - Medium; L – Low.

Course code	23 C	ATOMIC AND MOLECULAR SPECTROSCOPY	L	T	P	C
Core Paper VII				5	0	0
Pre-requisite		Students should have basic understanding of electricity and magnetism, classical and quantum mechanics	Syllabus Version			2020 - 2021
Course Objectives:						
The main objectives of this course are to:						
1. understand the nature of electromagnetic radiation, molecular structure, nature of bonding and symmetry of molecular groups.						
2. know about atom and its spectral lines						
3. to acquaint molecular groups according to their moment of inertia and the spectra arising from each group						
4. learn concepts of different spectroscopic techniques.						
Expected Course Outcomes:						
On successful completion of the course, the students will be able to :						
1	familiarise basics on characterization of electromagnetic radiation and quantization of energy					K1
2	understanding different spectral lines arising from atoms and interaction of spectral lines with the external source					K2
3	able to design spectroscopic experiments, able to accurately record and analyze the results of such experiments					K3
4	learn different spectroscopic techniques to analyse molecular structure					K4
5	analyse linear, vibrational and rotational motion of the molecules and can evaluate corresponding energy transitions					K5
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Atomic & Microwave Spectroscopy					10 hours
Atomic Spectroscopy - Spectra of Alkali Metal Vapours - Normal Zeeman Effect - Anomalous Zeeman Effect - Magnetic Moment of Atom and the G Factor - Lande's 'g' Formula - Paschen Back Effect - Hyperfine Structure of Spectral Lines						
Microwave Spectroscopy - Experimental Methods - Theory of Microwave Spectra of Linear, Symmetric Top Molecules - Hyperfine Structure - Quadrupole Moment - Inversion Spectrum of Ammonia						
Unit II	Infrared & Raman Spectroscopy					12 hours
IR Spectroscopy: Practical Aspects - Theory of IR Rotation Vibration Spectra of Gaseous Diatomic Molecules - Applications - Basic Principles of FTIR Spectroscopy						
Raman Spectroscopy: Classical and Quantum Theory of Raman Effect - Rotation Vibration Raman Spectra of Diatomic and Polyatomic Molecules – Applications - Laser Raman Spectroscopy						
Unit III	Electronic Spectra: Fluorescence & Phosphorescence Spectroscopy					12 hours
Excitation of Diatomic Species - Vibrational Analysis of Band Systems of Diatomic Molecules - Deslandre's Table - Intensity Distribution - Franck Condon Principle - Rotational Structure of Electronic Bands - Resonance and Normal Fluorescence - Intensities of Transitions - Phosphorescence - Population of Triplet State and Intensity - Experimental Methods - Applications of Fluorescence and Phosphorescence						

Unit IV	NMR & NQR Spectroscopy	12 hours
NMR Spectroscopy: Quantum Mechanical and Classical Description - Bloch Equations - Relaxation Processes - Experimental Technique - Principle and Working of High Resolution NMR Spectrometer - Chemical Shift.		
NQR Spectroscopy: Fundamental Requirements - General Principle - Experimental Detection of NQR Frequencies - Interpretation and Chemical Explanation of NQR Spectroscopy		
Unit V	ESR & Mossbauer Spectroscopy	12 hours
ESR Spectroscopy: Basic Principles-Experiments - ESR Spectrometer-Reflection Cavity and Microwave Bridge - ESR Spectrum - Hyperfine Structure		
Mossbauer Spectroscopy: Mossbauer Effect - Recoilless Emission and Absorption - Mossbauer Spectrum - Experimental Methods - Hyperfine Interaction - Chemical Isomer Shift - Magnetic Hyperfine and Electric Quadrupole Interaction		
Unit VI	Contemporary Issues	2 hours
Expert Lectures, Online Seminars – Webinars		
Total Lecture Hours		60 hours
Text Book(s)		
1	Molecular Structure and Spectroscopy - G. Aruldas	
2	Introduction to Atomic Spectra - H. E. White, McGraw-Hill Inc., US (1934).	
Reference Books		
1	Spectroscopy: Volumes I, II and III - B.P. Straugham & S.Walker	
2	Fundamental of molecular spectroscopy - C.B.Banwell	
3	Introduction to molecular spectroscopy - G.M.Barrow	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]		
1	https://nptel.ac.in/courses/115/105/115105100/	
2	https://onlinecourses.nptel.ac.in/noc20_cy31/preview	
Course Designed By: Dr. A. Ramalingam & Dr. A.Anis Fathima (anismaaz@gmail.com)		

Mapping with Programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	M	S	S
CO2	S	S	S	M	M	S	S
CO3	S	S	S	M	M	M	M
CO4	S	S	S	S	M	S	M
CO5	S	S	S	S	M	S	M

*S - Strong; M - Medium; L – Low.

SEMESTER I & II

Course code	23P	PRACTICAL I - GENERAL PHYSICS (Examination at the end of Second Semester)	L	P		C
				I	II	
Core Practical		Students should have the fundamental knowledge of experimental Physics and Programming skills	0	3	5	4
Pre-requisite			Syllabus Version	2020 - 21		
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basics of experimental physics and compare the results with theoretical calculations.					K2
2	Gain knowledge of new conception in practical oriented problems and visualize the experiments through MATLAB programming.					K3
3	Equip the students in basic communication skills in the course of performing the laboratory experiments in groups and by interpreting the results					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
S. No.	LIST OF EXPERIMENTS (Any twelve experiments)					
1	Young's Modulus - Elliptical Fringes (Cornu's Method)					
2	Young's Modulus - Hyperbolic Fringes (Cornu's Method)					
3	Viscosity of a Liquid - Mayer's Oscillating Disc					
4	Determination of Stefan's Constant					
5	Rydberg's Constant - Solar Spectrum					
6	Thickness of Wire by Air Wedge and Diffraction					
7	Determination of Audio Frequencies - Bridge Method					
8	Thermionic Work function					
9	Thermal Conductivity-Forbe's Method					
10	Electronic Charge e by Millikan's Oil Drop Method					
11	Electronic Specific Charge e/m by Thomson's Method					
12	Thermistor - Temperature Coefficient and Band Gap Energy Determination					
13	Specific Heat of a Liquid – Ferguson's Method					
14	Biprism on Optical Bench - Determination of Wavelength					
15	He Ne Laser - Measurement of Wavelength using reflectance grating					
16	Thickness of the wire by diffraction using spectrometer					
17	He Ne Laser - Measurement of refractive index of liquids					
18	He Ne Laser - Power distribution measurement					
19	He Ne Laser - Thickness of wire					
20	Fabry-Perot Interferometer - Study of Fine Structure					
21	Geiger Muller Counter - Determination of Half Life period of Radioactive element					

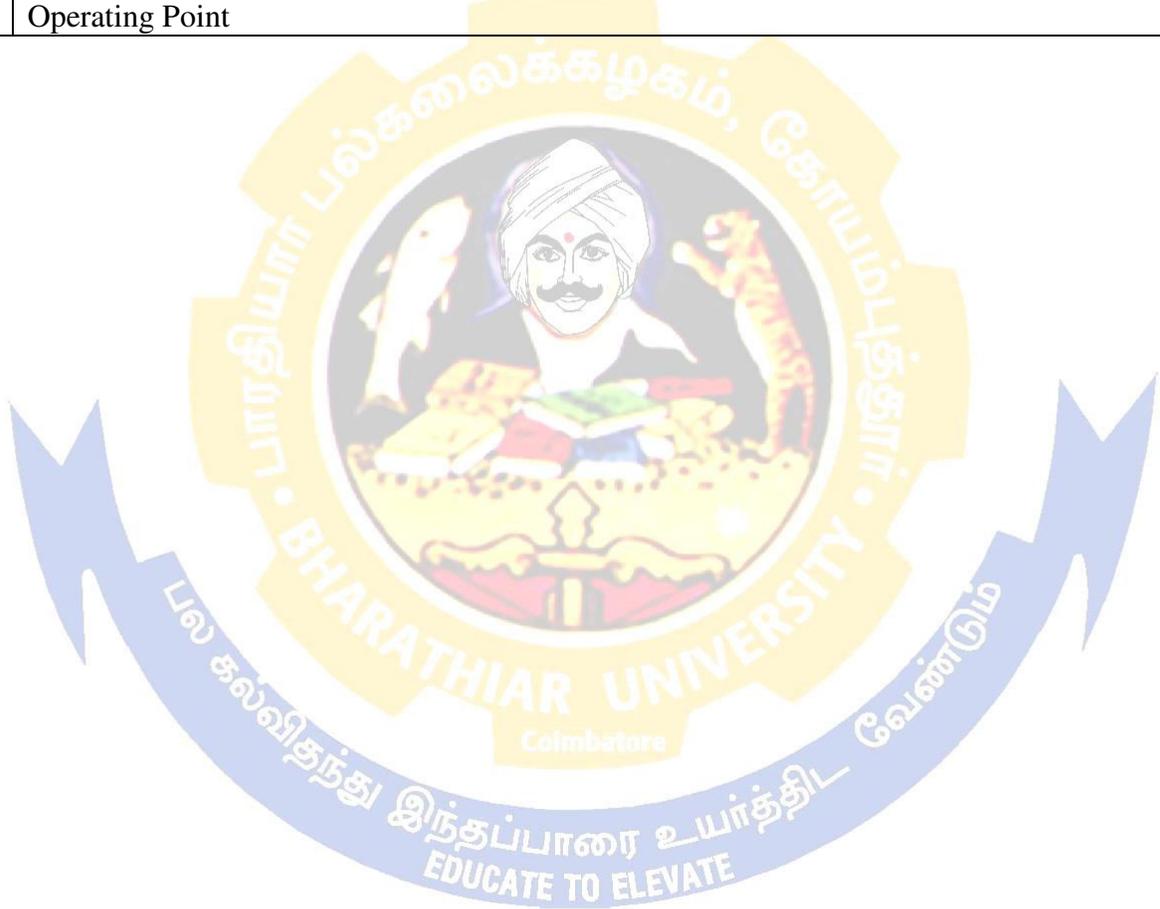
MATLAB Programming	
22	Matlab Programming - Roots of a Quadratic Equation & Solution of a System of Linear Equations
23	Matlab Programming - Solution of Ordinary Differential Equations – First Order
24	Matlab Programming – Runge - Kutta Method
25	Matlab Programming – Newton - Raphson Method
26	Matlab Programming - Mean, Median & Standard Deviation
27	Matlab Programming - Curve Fitting & Interpolation
28	Matlab Programming - Matrix Summation, Subtraction and Multiplication
29	Matlab Programming - Matrix Inversion and Solution of Simultaneous Equations



SEMESTER I & II

Course code	23Q	PRACTICAL II - ELECTRONICS (Examination at the end of Second Semester)	L	P		C
				I	II	
Core Practical		Students should have the fundamental knowledge in IC's and Programming skills	0	3	5	4
Pre-requisite			Syllabus Version	2020 - 21		
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Acquire knowledge on semiconductor devices and op amps characteristics					K2
2	Apply circuit systems to construct electronic devices					K3
3	Evaluate functioning of circuits					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
S. No.	LIST OF EXPERIMENTS (Any twelve experiments)					
1	Design of Regulated and Dual Power Supply and Construction using fixed voltage regulator and 723					
2	Basic Logic Gates - Digital IC's					
3	Parameters of Op Amp					
4	Design of Wave Form Generators- using Op Amp and Timer 555					
5	Design of Wein's Bridge Oscillator – Op Amp					
6	Design of Active Filters - Op Amp					
7	Design of Differential Amplifier – Op Amp					
8	Design of Phase Shift Oscillator – Op Amp					
9	Sign Changer, Scale Changer, Adder and Subtractor – Op Amp					
10	Analog Computer Setup – Solving Simultaneous Equations					
11	Design of UJT Relaxation Oscillator					
12	CRO-Differentiating, Integrating, Clipping and Clamping Circuits, Square Wave Testing					
13	Source Follower					
14	SCR – Characteristics and an application					
15	A.C. Amplifier - Inverting, Non-Inverting, Voltage Follower using Op Amp					
16	Function generator using IC 8038					
17	Measurement of Hall Coefficient of Semiconductor -Estimation of Charge Carrier Concentration					
18	Digital IC's - Counters, shift register (7476)					
19	Schmitt Trigger using discrete components and OP AMP/Timer 555					

MATLAB Programming	
20	Matlab Programming - Charging of Capacitor in an RC Circuit with three Time Constants
21	Matlab Programming – Full Wave Rectifier – Determination (a) Peak – to – Peak Value of Ripple Voltage, (b) DC Output Voltage (c) Discharge Time of the Capacitor (d) Period of Ripple Voltage
22	Matlab Programming-Plot of Voltage and Current of RLC Circuit Under Steady State Conditions
23	Matlab Programming- NPN Transistor - Plotting Input & Output Characteristics
24	Matlab Programming - Frequency Response of a Low Pass Op-Amp Filter Circuit
25	Matlab Programming–Diode-Forward Characteristics Plot & Load Line Plot-Estimation of Operating Point





Third Semester

THIRD SEMESTER

Course code	33A	QUANTUM MECHANICS II	L	T	P	C
Core Paper VIII			5	0	0	4
Pre-requisite	Students should have basic understanding in quantum mechanics I		Syllabus Version	2020 - 2021		
Course Objectives:						
The main objectives of this course are to:						
1. understand basics of scattering theory						
2. learn theory of radiation and density matrix						
3. apply approximation methods						
Expected Course Outcomes:						
On successful completion of the course, the students will be able to :						
1	understand the mathematical foundation of quantum mechanics					K2
2	apply Schrodinger equations to exactly solvable simple problems using approximation methods					K3
3	learn relativistic effects in quantum mechanics and quantum field theory					K4
4	compute corrections in energy and wavefunctions using approximation technique					K5
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Scattering Theory					8 hours
Scattering Amplitude - Expression in terms of Green's Function - Born Approximation and its Validity - Partial Wave Analysis - Phase Shifts - Scattering by Coulomb and Yukawa Potential						
Unit II	Application to Atomic Structure					12 hours
Identical Particles – constructing symmetric and antisymmetric wave functions - Slater determinant – Pauli's Exclusion principle - Central Field Approximation - Thomas Fermi Model - Hartree's Self Consistent Model - Hartree Fock Equation - Alkali Atoms - Doublet Separation - Intensities						
Unit III	Relativistic Wave Equation					12 hours
Klein Gordon Equation - Plane Wave Equation - Charge and Current Density - Application to the study of Hydrogen Like Atoms - Dirac Relativistic Equation for a Free Particle - Dirac Matrices - Dirac Equation in Electromagnetic Field - Negative Energy States						
Unit IV	Theory of Radiation (Semi Classical Treatment)					12 hours
Einstein's Coefficients - Spontaneous and Induced Emission of Radiation from Semi Classical Theory - Radiation Field as an Assembly of Oscillators - Interaction with Atoms - Emission and Absorption Rates - Density Matrix and its Applications						
Unit V	Introduction to Quantum Field Theory					14 hours
Elements of Quantum Field Theory – Review of Classical Field Theory – Lagrangian and Hamiltonian Formalism – Classical Fields – Quantization of the Fields – Schrodinger Fields – Quantization – Quantization into Bosons – Quantization into Fermions – Relativistic Fields - Scalar Fields – One Component Real Field – Fourier Decomposition – Quantization of Scalar Fields – Ground State and Normal Ordering – Basic Idea of Dirac Fields (no derivation – only qualitative discussion)						

Unit VI	Contemporary Issues	2 hours
Expert Lectures, Online Seminars – Webinars		
Total Lecture Hours		60 hours
Text Book(s)		
1	Quantum Mechanics – Nouredine Zettili, John Wiley & Sons, Ltd, 2 nd Edition, 2009	
2	Relativistic Quantum Mechanics and Quantum field Theory - V. Devanathan – Alpha Science International Ltd., Oxford, UK	
Reference Books		
1	Quantum Mechanics – G. Aruldas, PHI Learning Private Limited, 2 nd Edition, 2009	
2	Quantum Mechanics - L.I. Schiff - McGraw Hill, 3rd Edition, 1968	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]		
1	https://nptel.ac.in/courses/122/106/122106034/	
2	https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/	
Course Designed By: Dr. A Nishara Begum (anishara@yahoo.com)		

Mapping with Programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	L	M	S	M
CO2	S	S	S	L	S	M	S
CO3	M	M	S	L	M	M	M
CO4	M	S	S	L	S	M	M
CO5	S	S	S	L	M	M	M

*S - Strong; M - Medium; L – Low

Course code	33B	CLASSICAL ELECTRODYNAMICS		L	T	P	C
Core Paper IX				5	0	0	4
Pre-requisite	Students should have basic understanding in mathematical physics, classical mechanics and tensor notation			Syllabus Version		2020 - 2021	
Course Objectives:							
The main objectives of this course are to:							
1. calculate electric field and electric potential for a given configuration of charges in free space and matter							
2. understand magnetic properties of materials							
3. optical properties like reflection, refraction, interference, diffraction and polarization of electromagnetic waves							
4. learn basics of electromagnetic radiations and relativistic kinematics and dynamics							
Expected Course Outcomes:							
On successful completion of the course, the students will be able to :							
1	familiarize mathematical concepts and boundary conditions used in classical electrodynamics					K2	
2	analyze transmission of electromagnetic waves through wave guide					K3	
3	apply maxwell's equations to material medium and analyse its electrical and magnetic properties					K4	
4	derive formulas to experimentally measurable quantities (like electric and magnetic susceptibility)					K5	
5	evaluate electric, magnetic fields, electric potential and vector potentials for point charge and radiation emitted by moving charges					K5	
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit I	Electromagnetic Theory					8 hours	
Coulomb's law and Gauss's law – Laplace and Poisson Equations – Energy in Electrostatics - Boundary Value Problems - Laplace Equations in One and Three Dimensions – Uniqueness Theorem and Boundary Conditions – Method of Images and Multi pole Expansion							
Unit II	Electric Fields in Macroscopic Media					8 hours	
Dipole – Concept of Induced Dipole – Alignment of Polar Molecules - Polarization – The Fields of a Polarized Object – Bound Charges – Field inside a Dielectric - The Electric Displacement – Gauss's Law in the Presence of Dielectrics – Linear Dielectrics – Susceptibility, Permittivity and Dielectric Constant – Boundary Value Problems in Linear Dielectrics – Energy in Dielectric Systems – Forces on Dielectrics							
Unit III	Magnetostatics and Magnetic Fields in Matter					10 hours	
The Lorentz Force Law – The Biot Savart Law – Applications - The Divergence and Curl of B – Ampere's Law – Applications - Magnetic Vector Potential - Magnetostatic Boundary Conditions – Multipole Expansion of the Vector Potential – Magnetic Fields in Matter – Magnetisation – Concept of Bound Current – Magnetic Field inside a Matter – The Auxiliary Field H – Linear and Non Linear Media - Magnetic Susceptibility and Permeability							

Unit IV	Electrodynamics	16 hours
Equation of Continuity – Displacement Current – Maxwell’s Equations – Poynting Vector with proof – Momentum in Electro Magnetic Field – Maxwell’s equation in free space, Dielectric and Conductors – Reflection and Refraction, Polarization, Fresnel’s Law, Interference, Coherence and Diffraction – Dispersion Relation in Plasma – Scalar and Vector Potential - Gauge Transformation – Coulomb Gauge and Lorentz Gauge – Transmission Lines and Guided waves – TE waves in a Rectangular Wave Guide		
Unit V	Radiation and Relativistic Electrodynamics	16 hours
Continuous Charge Distribution – Retarded Potentials and Advanced Potentials – Jefimenko’s Equations – Lienard Wiechert Potentials - Radiation – Electric Dipole Raditions – Magnetic Dipole Radiations – Power Radiated by Point Charge – Abraham – Lorentz Formula - Lorentz Invariance of Maxwells Equations - Four Vector – Four Velocity – Relativistic Energy and Momentum – Relativistic Kinematics – Relativistic Dynamics – The Field Tensor – Electrodynamics in Tensor Notation – Relativistic Potentials (Scalar and Vector Potentials)		
Unit VI	Contemporary Issues	2 hours
Expert Lectures, Online Seminars – Webinars		
Total Lecture Hours		60 hours
Text Book(s)		
1	Introduction to Electrodynamics – David J. Griffiths, Pearson, 4 th Edition, 2012	
2	Classical Electromagnetism – Jerrold Franklin, Dover Publications, Inc., 2 nd Edition, 2017	
3	Basics of Electromagnetism – I. E. Irodov, CBS Publishers & Distributors, 2001	
Reference Books		
1	Classical Electrodynamics – J. D. Jackson, Wiley Eastern, 3 rd Edition, 2004	
2	Classical Electrodynamics – W. Greiner, Spring Verlag New York, Inc., 1998	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]		
1	https://nptel.ac.in/courses/122/106/122106034/	
2	https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/	
Course Designed By: Dr. A. Ramalingam (ramligri@rediffmail.com)		

Mapping with Programme outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	L	S	M	S
CO2	S	S	S	L	M	M	S
CO3	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S
CO5	S	S	S	M	M	M	S

*S - Strong; M - Medium; L – Low.

Course code	33C	STATISTICAL MECHANICS			
Core Paper X		L	T	P	C
		5	0	0	4
Pre-requisite	Students should have basic understanding in classical and quantum mechanics	Syllabus Version			2020 - 2021
Course Objectives:					
The main objectives of this course are to:					
1. understand basics of probability, statistics and distribution functions					
2. know about classical and quantum statistics					
3. compute probability distributions for MB, BE and FD statistics					
4. learn phase transition and familiarise basics of non-equilibrium statistical mechanics					
Expected Course Outcomes:					
On successful completion of the course, the students will be able to :					
1	familiarise basic mathematical tools like probability, statistics and approximation technique				K2
2	understand ensemble, connection between microstate and macrostates				K3
3	understand other branches in physics better				K4
4	calculate partition function and compute thermodynamics relations				K5
5	apply to multi disciplinary areas				K6
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create					
Unit I	Mathematical Foundations to Statistical Mechanics				8 hours
Random Variables - Probability – Probability and Frequency Probability of an Ensemble – Basic Rules of Probability Theory – Mean Values of Discrete and Continuous Random Variables – Sterling’s Approximation. Variance, Dispersion – Probability Distribution – Binomial – Poisson – Mean and Fluctuations – Gaussian Distribution – Standard Deviation – Central Limit Theorem.					
Unit II	Review of Thermodynamics, Classical Statistics				10 hours
Review of Classical Thermodynamics – Zeroth Law, First Law, Second Law and Third Law and Its Consequences - Thermodynamics Potentials – Maxwell’s Relations – Equipartition Theorem (without Proof) – Dulong Petit’s Law - Microstates – Macrostates - Phase Space – Density Distribution in Phase Space - Liouville’s Theorem, Proof and its Consequences – Statistical Equilibrium - Postulates of Statistical Mechanics - Classical Statistics - Maxwell Boltzmann Distribution – Maxwell Distribution of Speeds – Root Mean Square Speed – Average Speed – Most Probable Speed.					
Unit III	Stationary Ensembles and Density Matrix				12 hours
Ensemble and Classification - Micro Canonical Ensemble – Density of States – Application - Classical Ideal Gas - Two Level System – Concept of Negative Temperature - Canonical Ensemble – Derivation of Gibbs Canonical Distribution - Partition Function – Mean and Fluctuations - Applications – Classical Ideal Gas - – Discussion of Gibb’s Paradox and Sakkur Tetrode Equation - Classical Harmonic Oscillator – Rigid Rotator - Statistics of Paramagnetism - Curie Law - Quantum Systems – State – Pure and Mixed State – Density Matrix – Entropy – Boltzmann Gibbs Entropy – Information Theory – Shannon Entropy – Introduction to Classical and Quantum Information Theory (Qualitatively).					

Unit IV	Quantum Statistics	14 hours
Quantum Statistics – Bose Einstein Distribution – Fermi Dirac Distribution – Comparison – Wavefunctions Exchange and Symmetry - Applications – Black Body Radiation and Planck Distribution Law – Einstein Theory of Solids – Debye Theory of Solids – Quantum Mechanical Paramagnetic Susceptibility - Energy and Pressure of Ideal Bose Einstein Gas - Energy and Pressure of Ideal Fermi Dirac Gas – Free Electron Model and Electronic Emission – Bose Einstein Condensation.		
Unit V	Phase Transition and Basics of Nonequilibrium Statistical Mechanics	14 hours
Phase Equilibria – Equilibrium Conditions – Classification of Phase Transition – Phase Diagram – Clausius Claperon Equation – Van der Waal’s Equation – Second Order Phase Transitions – Ginzburg Landau Theory – Phase Transition in Ferromagnetic Materials – Liquid Helium - Onsagar Relations – Fluctuations – Energy, Pressure and Enthalpy – Ising Model – One Dimension – Bragg William Approximation – Effusion - Diffusion – Random walk and Brownian Motion – Qualitative Discussion of Principle of Detailed Balance, Focker Planck’s Equation and Boltzmann’s H Theorem (without proof).		
Unit VI	Contemporary Issues	2 hours
Expert Lectures, Online Seminars - Webinars		
Total Lecture Hours		60 hours
Text Book(s)		
1	Fundamentals of Statistical Mechanics – B. B. Laud, New Age International Publishers, 2 nd Edition, 2018.	
2	Introduction to Statistical Physics – Kerson Huang, CRC Press, 2 nd Edition, 2010.	
Reference Books		
1	An introductory course of Statistical Mechanics – P. B. Pal, Narosa Publishing House, 2008.	
2	Statistical Mechanics - R. K. Pathria, Elsevier, 2 nd Edition, 2005.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]		
1	https://nptel.ac.in/courses/115/106/115106111/	
2	https://ocw.mit.edu/courses/physics/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/lecture-notes/	
Course Designed By: Dr. A. Ramalingam & Dr. S.S. Naina Mohammed (ss.nainamohammed@gmail.com)		

Mapping with Programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	S	S	S
CO2	S	S	S	L	S	S	S
CO3	S	S	S	L	M	S	S
CO4	S	S	S	L	M	S	M
CO5	M	S	M	L	M	M	M

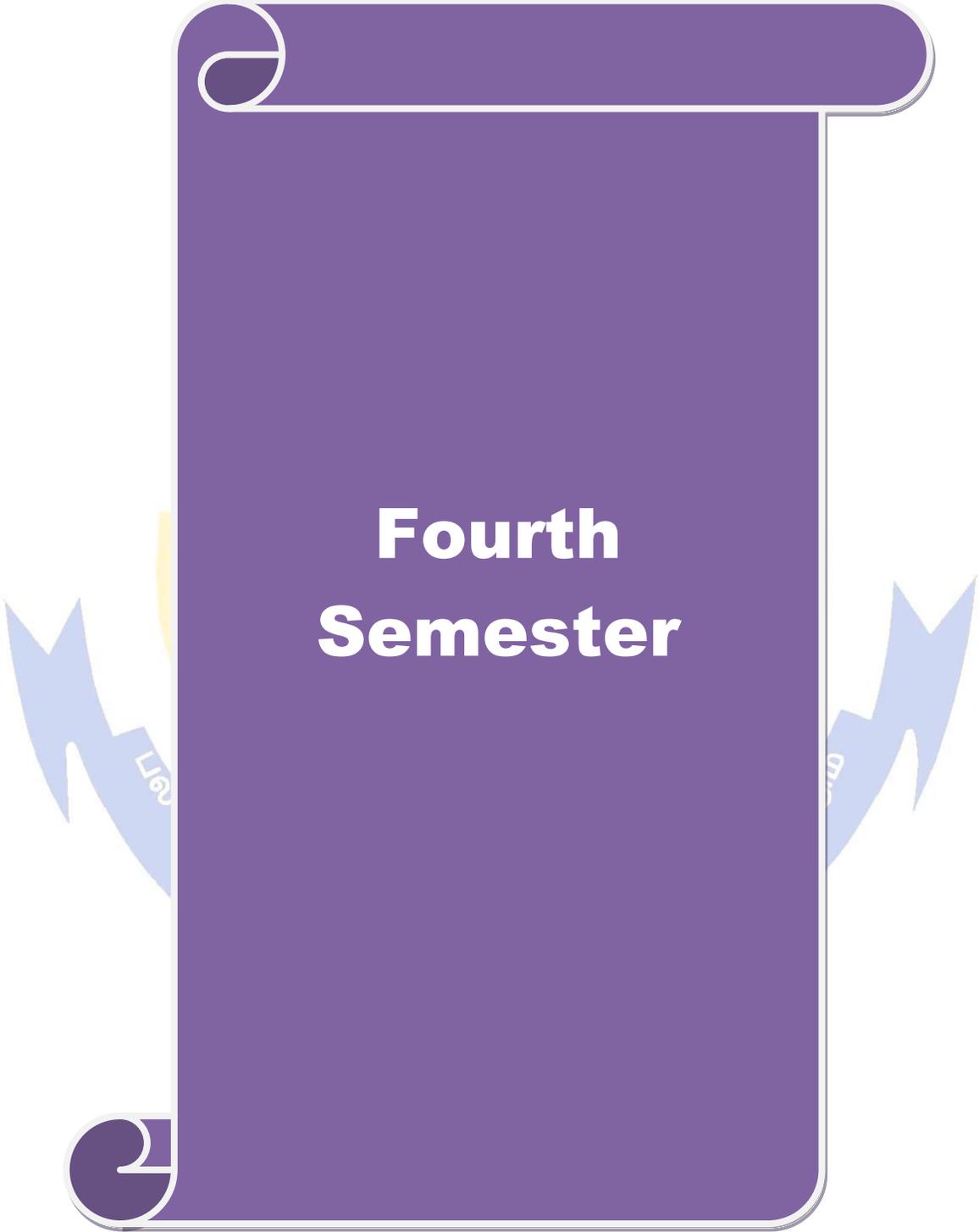
*S - Strong; M - Medium; L – Low.

Course code	33D	CONDENSED MATTER PHYSICS		L	T	P	C
Core Paper XI				5	0	0	4
Pre-requisite	Students should have basic knowledge in band theory and electronic configuration			Syllabus Version		2020-2021	
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> gain an understanding of the interplay between classical and quantum mechanical phenomena understand microscopic/atomic processes acting between many atoms/molecules that produces the typical properties of different solid-state matter 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	to know the continuance in condensed matter physics in some central areas					K1	
2	provide the basic knowledge and also give an overview of current problems within the field of condensed matter/materials science mainly on functional materials					K5	
3	learn about phenomenon of magnetism					K2	
4	predict magnetic properties of atoms and molecules based on their electronic configurations					K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit I	Crystal Structure					12 hours	
Crystal classes and system - 2D, 3D lattices - Bravais lattices – Point groups – Space groups – Reciprocal lattice – Ewald's sphere construction – Braggs law – Atomic scattering factor - Diffraction – Structure factor – Experimental techniques – Laue, Powder, Rotation methods - Bonding of common crystal structures – NaCl, CsCl, ZnS and Diamond – Packing density – hcp, ccp,- random stacking and polytypism							
Unit II	Lattice Vibrations and Thermal Properties					12 hours	
Vibration of monoatomic lattices – Lattices with two atoms per primitive cell – Quantization of lattice vibrations – Phonon momentum – Inelastic scattering of neutrons by phonons – Lattice heat capacity – Einstein model – Density of modes in one-dimension and three- dimension – Debye model of the lattice heat capacity – Thermal conductivity – Umklapp process							
Unit III	Free Electron Theory, Energy Bands and Semiconductor Crystals					12 hours	
Energy levels and density of orbitals – Fermi-Dirac distribution – Free electron gas in three-dimensions – Heat capacity of the electron gas – Electrical conductivity and Ohms law – Motion in magnetic fields – Hall effect – Thermal conductivity of metals – Nearly free electron model – Electron in a periodic potential – Semiconductors – Band gap – Effective mass – Intrinsic carrier concentration							
Unit IV	Diamagnetism, Paramagnetism, Ferromagnetism and Antiferromagnetism					10 hours	
Langevin classical theory of Diamagnetism and paramagnetism – Weiss theory – Quantum theory of paramagnetism – Demagnetization of a paramagnetic salt – Paramagnetic susceptibility of							

conduction electrons – Hund’s rules – Ferromagnetic order – Curie point and the exchange integral – Temperature dependence of saturation magnetization – Magnons – Antiferro magnetic order – Ferromagnetic domains – Origin of domains – Coercive force and hysteresis	
Unit V	Dielectrics, Ferroelectrics and Superconductivity
12 hours	
Macroscopic electric field – Local electric field at an atom – Dielectric constant and polarizability – Clausius Mossotti equation – Polarization catastrophe – Ferroelectric domains– Occurrence of Superconductivity – Meissner effect – London equation – Coherence length – BCS theory – Flux quantization – Type I and Type II Superconductors – Josephson superconductor tunneling – DC and AC Josephson effect – SQUID – Applications of superconductors	
Unit VI	Contemporary Issues
2 hours	
Expert lectures, online seminars - webinars	
Total Lecture hours	60 hours
Text Book(s)	
1	C. Kittel, Introduction to Solid State Physics, 5th Ed. (Wiley Eastern, New Delhi, 1977)
2	N. W. Ashcrof and N. D. Mermin, Solid State Physics (International Edition, Philadelphia, 1976)
3	J. S. Blakemore, Solid State Physics, Second Edition (Cambridge University Press, Cambridge, London, 1974)
4	A. J. Dekker, Solid State Physics (Mac Millan, Madras, 1971)
Reference Books	
1	M. M. Woolfson, An Introduction to X-ray Crystallography (Cambridge University Press, Cambridge, 1991)
2	T. P. Sheahen, Introduction to High-Temperature Superconductors (Plenum press, New York, 1994)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/113/104/113104014/
2	https://www.udemy.com/course/physics-intro-to-electricity-magnetism/
4	https://nptel.ac.in/courses/115/104/115104088/
Course Designed By: Mrs. S. Sasikala (sasiphysics86@gmail.com)	

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	L	S	M	M	M	S
CO3	L	S	S	M	M	S	L
CO3	M	S	S	L	M	M	S
CO4	L	M	M	S	S	M	S
CO5	S	S	M	L	M	M	S

*S - Strong; M - Medium; L – Low.



Fourth Semester

FOURTH SEMESTER

Course code	43A	NUCLEAR & PARTICLE PHYSICS		L	T	P	C
Core Paper XII				5	0	0	4
Pre-requisite	The students should have basic knowledge in nuclear structure, nuclear models and different elementary particles.			Syllabus Version		2020-2021	
Course Objectives:							
1.To impart higher level knowledge and understanding of nuclear physics and technology.							
2. Enhance student ability to develop mathematical models of defined physical systems.							
3. Enable students to analyse mathematical models of physical systems for enhancement of system performance and arrive at limitations of physical systems.							
4.To respond the global energy and environmental needs and objectives							
Expected Course Outcomes:							
On the successful completion of the course, students							
1	will have a versatile and solid background in fundamental physics and its application.					K2	
2	Have the capability of doing back-of-the envelope calculations in a diversity of situations					K5	
3	Can apply the theory of nuclear physics for newer applications					K3	
4	Can promote the exchange of ideas and research within the nuclear/atomic science community					K2	
5	Gain skills to pursue physics as a teaching and research career					K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create							
UNIT I		NUCLEAR STRUCTURE				10 hours	
Distribution of Nuclear Charge-Nuclear Mass-Mass Spectroscopy-Mass Spectrometer- Theories of Nuclear Composition (proton-electron, proton-neutron)- Bound States of Two Nucleons-Spin States- Pauli's Exclusion Principle-Tensor Force-Static Force- Exchange Force.							
UNIT II		RADIOACTIVITY				12 hours	
Alpha Decay: Properties of α Particles-Gamow's Theory of α Decay-Geiger Nuttal Law- α Ray Energies-Fine Structure of α Rays- α Disintegration Energy-Long Range α Particles. Beta Decay: Properties of β Particles-General Features of β Ray Spectrum- Pauli's Hypothesis-Fermi's Theory of β Decay – Forms of Interactions and Selection Rules. Gamma Decay: Absorption of γ Rays by Matter-Interaction of γ Rays with Matter-Measurement of γ Ray Energies-Internal Conversion							
UNIT III		NUCLEAR MODELS				12 hours	
Liquid Drop Model: Bohr Wheeler Theory of Fission-Condition for Spontaneous Fission-Activation Energy. Shell Model: Explanation of Magic Numbers-Prediction of Shell Model-Prediction of Nuclear Spin and Parity-Nuclear Statistics-Magnetic Moment of Nuclei-Nuclear Isomerism. Collective Model: Explanation of Quadrupole Moments							

UNIT IV	NUCLEAR REACTIONS	12 hours
Kinds of Reactions and Conservation Laws-Energy of Nuclear Reaction-Iso Spin- Continuum Theory of Nuclear Reaction-Resonance-Breit and Wigner Dispersion Formula - Stages of a Nuclear Reaction- Statistical Theory of Nuclear Reaction-Kinematics of Stripping and Pickup Reaction.		
UNIT V	PARTICLE PHYSICS	12 hours
Leptons-Hadrons-Mesons-Hyperons – P ions - Mesons, Resonances- Strange Mesons and Baryons-Gell-Mann Okuba Mass formula for Baryons - CP Violation in Neutral Kaon (K ₀) Decay- Symmetry and Conservation Laws-Quark Model-Reaction and Decays.		
UNIT:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		60 hours
Text Book(s) for Study		
1	Nuclear and Particle Physics-Pandya and Yadav	
2	Nuclear Physics-J.C. Tayal -Umesh Prakashan- Gujarat	
Text Book(s) for Reference		
1	Nuclear Physics- D.C. Sharma-K. Nath & Co-Meerut 1600	
2	Concepts of Nuclear Physics-Bernard L. Cohen-Tata McGraw Hill- New Delhi 1600,1978	
3	Introductory Nuclear Physics-Kenneth S. Krane-John Wiley & Sons	
4	Physics of Nucleus and Particles-Volume I& II-B. Nermeir & Sheldon	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/115/104/115104043/	
2	https://nptel.ac.in/courses/115/106/115106087/	
3	https://nptel.ac.in/courses/115/103/115103101/	
Course Designed By: Mrs. S. Sasikala (sasiphysics86@gmail.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	M	M	S	M
CO2	M	S	L	M	L	S	L
CO3	S	M	S	S	M	M	L
CO4	M	S	L	M	S	M	L
CO5	S	L	M	M	S	L	M

*S-Strong; M-Medium; L-Low

Course code	43B	COMMUNICATION ELECTRONICS		L	T	P	C
Core Paper XIII				5	0	0	4
Pre-requisite	Students should have adequate knowledge in electromagnetic radiation	Syllabus Version		2020-2021			
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> Understand basic concepts of communication and optical communication system Identify different types of modulation and multiplexing formats Compute a simple optical power budget 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	become effective communicators and critical consumers of messages preparing them for life.					K2	
2	integrate the strengths of the liberal arts tradition with the theoretical foundation to enter in the research.					K1	
3	gain knowledge in microwave analysis and design techniques					K2	
4	apply knowledge of mathematics, science and engineering fundamentals to the solution of complex engineering problems in electronic circuits and communication system					K3	
5	Familiar with design consideration of fiber optics system.					K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	Antennas & Wave Propagation					10 hours	
Terms and Definition - Effect of Ground on Antennas - Grounded /4 - Ungrounded antenna Antenna- Antenna Arrays-Broadside and End Side Arrays-Antenna Gain- Directional High Frequency Antennas - Sky Wave Propagation - Ionosphere- Eccles & Larmor Theory-Magneto Ionic Theory-Ground Wave Propagation							
Unit:2	Microwaves					8 hours	
Microwave Generation - Multi cavity Klystron-Reflex Klystron – Magnetron - Travelling Wave Tubes (TWT) and other Microwave Tubes – MASER - Gunn Diode							
Unit:3	Radar and Television					12 hours	
Elements of a Radar System-Radar Equation-Radar Performance Factors-Radar Transmitting Systems-Radar Antennas-Duplexers-Radar Receivers and Indicators - Pulsed Systems-Other Radar Systems-Colour TV Transmission and Reception							
Unit:4	Communication Electronics					14 hours	
Analog and Digital Signals - Modulation - Types of Modulation- Amplitude modulation theory - Frequency spectrum of the AM wave - Representation of AM - Power relations in the AM wave - Generation of AM - Basic requirements- Description of frequency and phase modulation - Mathematical representation of FM – Frequency spectrum of FM wave							

Unit:5	Optical Fibres	14 hours
Propagation of Light in an Optical Fibre - Acceptance Angle-Numerical Aperture- Step and graded Index Fibres-Optical Fibre as a Cylindrical Wave Guide-Fibre Losses and Dispersion-applications.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	Electronic Communication System-George Kennedy & Davis -Tata McGraw Hill 4th edition1989	
2	Optical fibre and fibre optic communication systems- S K Sarkar - S.Chand Pub-2007 edition	
3	Electronics Devices and circuits– Sanjeev Gupta & Santhosh Gupta, Dhanpat Rai Publications.	
Reference Books		
1	Principles of Communication Systems-Taub Schilling-TMH 1986	
2	Communication Systems-Simon Haykin-John Wiley & Sons 2005	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	http://nptel.ac.in/courses/115/107/115107095/	
2	http://nptel.ac.in/courses/108/104/108104113/	
3	http://nptel.ac.in/courses/108/101/108101112/	
Course Designed By: Dr. R. Thiagarajan (thiyagu_phy@rediffmail.com)		

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	L	M	M	S	L
CO3	S	M	M	S	M	L
CO3	L	M	M	S	S	S
CO4	M	L	S	S	S	M
CO5	L	M	M	S	M	S

*S - Strong; M - Medium; L – Low.

Course code	43C	LASER PHYSICS AND NONLINEAR OPTICS		L	T	P	C
Core Paper XIV				5	0	0	4
Pre-requisite	Students should have fundamentals of mathematical formulations, wave theory and operation of laser			Syllabus Version	2020-2021		
Course Objectives:							
The main objectives of this course are to:							
1. familiar with basics of nonlinear optics and interaction of electromagnetic waves with matter particle							
2. understand the mechanism of laser radiation and its propagation in different media							
3. get insight into the crystalline property modifications by electromagnetic interaction							
4. aware the role of laser in industrial and research activities							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	familiar with the properties of different types of laser and its operation						K2
2	understand the process of optical amplification and gain saturation						K2
3	apply the theoretical concepts of laser optics for industrial purposes						K3
4	differentiate the efficiency of continuous and pulsed laser mechanism						K4
5	explore the significance of non linear optical phenomena and its applications						K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit I	Lasers - Fundamentals and Types						10 hours
Basic Construction and Principle of Lasing - Einstein Relations and Gain Coefficient - Creation of a Population Inversion - Three Level System - Four Level System - Threshold Gain Coefficient for Lasing - Laser types - He Ne Laser - CO ₂ Laser - Nd:YAG Laser - Semiconductor Laser							
Unit II	Laser Operation						8 hours
Optical Resonator - Laser Modes - Axial modes - Transverse modes - Modification in Basic Laser Structure - Basic Principle of Mode Locking - Active Mode Locking - Passive Mode Locking - Q Switching - Pulse Shaping							
Unit III	Laser Beam Characteristics						12 hours
Wavelength - Coherence - Mode and Beam Diameter - Polarizations - Introduction to Gaussian Beam width - Divergence - Radius of Curvature - Rayleigh Range - Guoy Phase Shift - 3D Gaussian Beams - ABCD Law for Gaussian Beam - Complex Radius of Curvature - Tensorial ABCD Law							
Unit IV	Focusing of Laser Beam						14 hours
Diffraction - Limited spot size - M ² Concept of Beam Quality - Spherical Aberration- Thermal Lensing Effects - Depth of Focus - Tight focusing of laser beam - Angular Spectrum Representation of Optical Near Field - Aplanatic lens - Focusing of Higher order laser modes - Radially Polarized Doughnut mode - Azimuthally Polarized Doughnut mode							

Unit V	Non-Linear Optics	14 hours
Introduction - Nonlinear Optical Media - The Nonlinear Wave Equation - Scattering Theory - Born Approximation – Second Order Nonlinear Optics – Second Harmonic Generation (SHG) and Rectification - The Electro Optic Effect – Three Wave Mixing - Frequency and Phase Matching - Third Harmonic Generation - Optical Kerr Effect – Self Focusing – Four Wave Mixing (FWM) - Optical Phase Conjugation (OPC) - Use of Phase Conjugators in Wave Restoration		
Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	Nonlinear Optics - D.L. Mills - Basic Concepts, Springer, Berlin, 1998	
2	Lasers and Nonlinear Optics - B.B. Laud – 2 nd Edition New Age International (P) Ltd.	
Reference Books		
1	Laser Material Processing - M. Steen, J. Mazumder – Springer (2010)	
2	Fundamentals of Photonics - Bahaa E. A. Saleh, Malvin Carl Teich - John Wiley & Sons, Inc.	
3	Solid State Laser Engineering - Walter Koechner, 6 th Edition, Springer	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/115/101/115101008/	
2	https://spie.org/education/courses/coursedetail/SC047?f=InCompany	
3	https://ipenche.chania.teicrete.gr/an-introduction-to-laser-physics-and-systems/	
Course Designed By: Dr. A Nishara Begum (anishara@yahoo.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	M	S	L	S
CO2	S	M	M	S	M	L	M
CO3	M	M	M	S	S	S	S
CO4	M	L	S	S	S	M	M
CO5	M	S	M	S	M	S	S

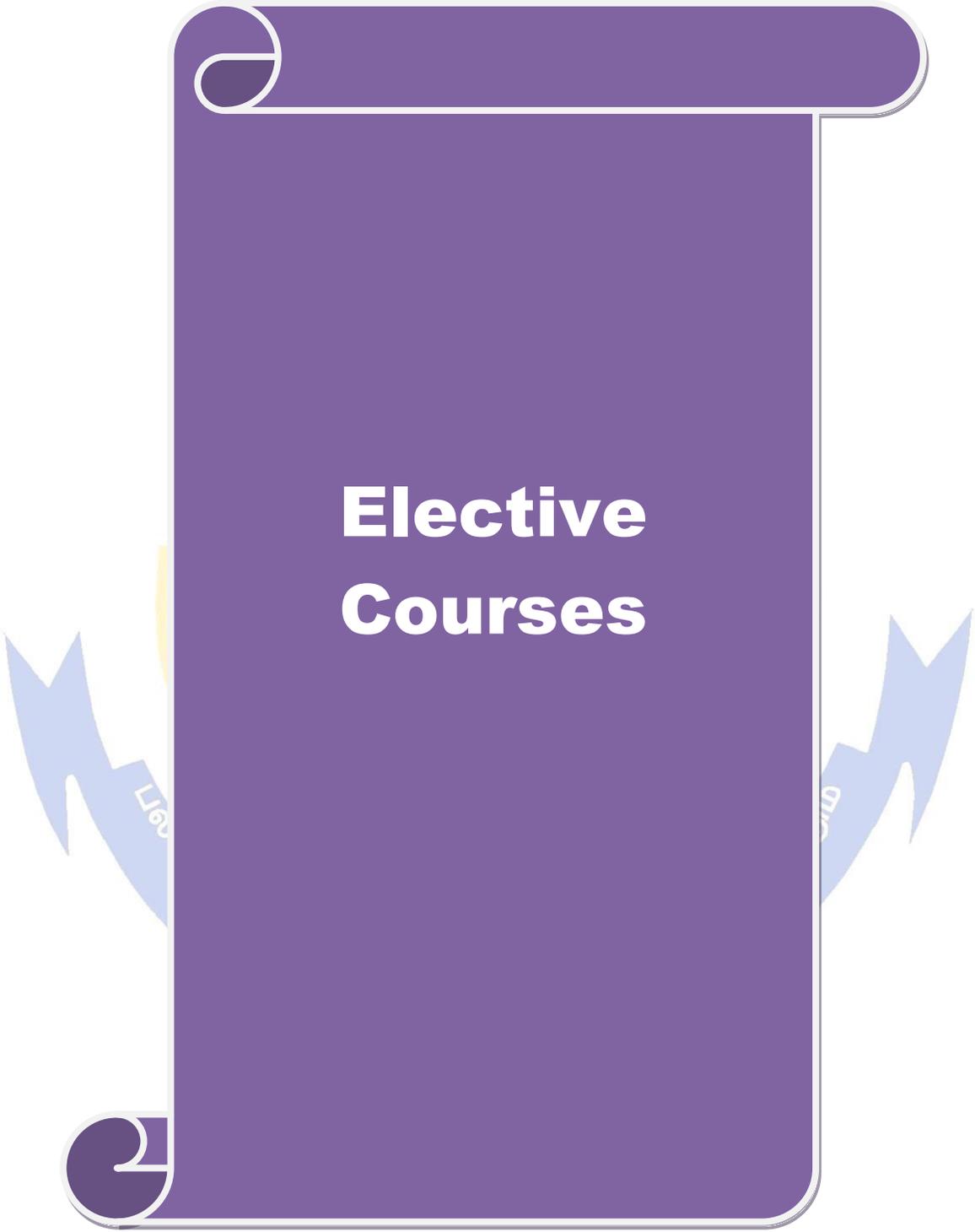
*S - Strong; M - Medium; L – Low.

SEMESTER III & IV

Course code	43P	PRACTICAL III - ADVANCED PRACTICALS (Examination at the end of Fourth Semester)	L	P		C
				III	IV	
Core Practical		Students should have the fundamental knowledge of	0	3	5	4
Pre-requisite		Optics, Electricity, Magnetism and Programming skills	Syllabus Version		2020 - 21	
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Explore the concepts involved in optics					K3
2	Gain knowledge of new conception in practical oriented problems and visualize the experiments through MATLAB programming.					K3
3	acquire strong laboratory skills					K6
4	Enhance the day to day requirements in industries, research fields.					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
LIST OF EXPERIMENTS (Any twelve experiments)						
S. No.						
1	Arc Spectra-Constant Deviation Spectrograph-Copper, Iron & Brass					
2	Michelson Interferometer- λ , d and Thickness of Mica Sheet					
3	Susceptibility-Guoy and Quincke's Method					
4	Compressibility of a Liquid-Ultrasonic Method					
5	Hall Effect and its application					
6	e/m-Zeeman Effect					
7	e/m-Magnetron Method					
8	B-H Curve-Anchor Ring					
9	B-H Curve-Solenoid					
10	Double Slit-Wavelength Determination					
11	G.M Counter-Characteristics					
12	Kelvin's Double Bridge-Determination of Very Low Resistance & Temperature Coefficient of Resistance.					
13	He-Ne Laser determination of particle size.					
14	Conductance of photoconductor, photovoltaic cell (solar cell) and photodiode					
MATLAB Programming						
15	Matlab Programming-Radioactive Decay					
16	Matlab Programming-Numerical Integration					
17	Matlab Programming-Double Integration					
18	Matlab Programming-Solution of Ordinary Differential Equations – 2 nd Order					
19	Matlab Programming-Computer Simulation of Equations of Motion for a System of Particles					
20	Matlab Programming-Computer Simulation of 1-D and 2-D Lattice Vibrations					
21	Matlab Programming-Computer Simulation of Kronig-Penney Model					
22	Matlab Programming-Numerical simulation of Wave-Functions of Simple Harmonic Oscillator					
23	Matlab Programming-Simulation of Wave Functions for a Particle in Critical Box					
24	Matlab Programming-Solution of Diffusion Equation					

SEMESTER III & IV

Course code	43 Q	PRACTICAL IV – SPECIAL ELECTRONICS (Examination at the end of Second Semester)	L	P		C
				I	II	
Core Practical		Students should have the fundamental knowledge in Op-amp and Microprocessor	0	3	5	4
Pre-requisite			Syllabus Version	2020 - 21		
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Acquire knowledge on op amps characteristics and Microprocessor					K2
2	Apply circuit systems to construct electronic devices					K3
3	produce electronic professionals to work as Electronic circuit Designer					K5
4	Enhance the day to day requirements in industries, research fields.					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
S. No.	LIST OF EXPERIMENTS (Any twelve experiments)					
1	Op-Amp: Simultaneous Addition & Subtraction					
2	Op-Amp: Instrumentation Amplifier-Temperature Measurement					
3	Op-Amp: Instrumentation Amplifier-Light Intensity-Inverse Square Law					
4	Op-Amp: V to I & I to V Converter					
5	Op-Amp: Circuits Using Diodes-Half Wave, Full Wave, Peak Value, Clipper, Clamper					
6	Op-Amp: Log and Antilog Amplifier					
7	Op-Amp: Analog Computation-Second Order Differential Equation					
8	Op-Amp Comparator-Zero Crossing Detector, Window Detector, Time Marker					
9	IC 555 Timer Application-Monostable, Linear Astable 10.A/D Converters-Any One Method					
10	Converters-Binary Weighted & Ladder Methods					
11	IC Counters with Feedback					
12	Microprocessor: LED Interfacing Name Display (rolling)					
13	Microprocessor: Stepper Motor Interfacing					
14	Microprocessor: Traffic Control Simulation					
15	Microprocessor: ADC Interface-Wave Form Generation					
16	Microprocessor: Hex Keyboard Interfacing					
17	Microprocessor: Musical Tone Generator Interface					
18	Microcontroller: Blinking of LEDs either 8051 or 16F84 20 Microcontroller: Controlling LED with switch					
19	Microcontroller: DC motor control					
20	Microcontroller: triangle wave generator					



Elective Courses

ELECTIVE - I

Course code	1EA	ROBOTICS, ARTIFICIAL INTELLIGENCE AND INFORMATION THEORY	L	T	P	C
			4	0	0	4
Pre-requisite		Students should have basic understanding in basic physics, mathematical physics and computer knowledge	Syllabus Version		2020 - 2021	
Course Objectives:						
The main objectives of this course are to:						
1. understand basics of robotics						
2. introduce basics of artificial intelligence						
3. learn fundamentals of python programming, cyber security and ethical hacking						
4. facilitate students to learn and apply Arduinio IDE and introduce basics of information theory						
Expected Course Outcomes:						
On successful completion of the course, the students will be able to :						
1	understand basics of robotics and robotic sensors					K2
2	learn fundamentals of artificial intelligence					K2
3	develop an idea to write programme using python, basics of cyber security and hacking					K3
4	learn and impliment interfacing between experiments and Arduinio IDE					K5
5	familiarize basics of classical and quantum computers					K2
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create						
Unit I	Basics of Robotics					12 hours
Robot – Definition of Robot – Industrial Robot – Laws of Robotics – Motivating Factors – Advantages and Disadvantages of Robots – Characteristics of an Industrial Robot – Components of an Industrial Robot – Comparison of the Human and Robot Manipulator – Robot Wrist and End of Arm Tools – Robot Terminology – Robotic Joints – Classification of Robots – Robot Classification on the Basis of Coordinate System, Power Source and Method of Control - Robot Selection – Robot Workcell – Robotics and Machine Vision – Robotic Accidents , Safety, Maintenance and Installation – Robotic Sensors – Types of Sensors in Robots – Exteroceptors – Tactile Sensors – Proximity Sensors – Range Sensors – Machine Vision Sensors – Velocity Sensors – Proprioceptors						
Unit II	Artificial Intelligence					10 hours
Introduction to Artificial Intelligence (AI) – Need for AI – Applications domains of AI – tools – Challenges and Future of AI – Fundamentals of Machine Learning and Deep Learning – Machine Learning algorithms to find associations across Biological Data, Cellular Image Classification and Identification of Genetic Variations – AI in Bio Physics Research – AI in drug Design – AI in next generation Sequencing – AI in Protein Structure – AI in Protein Folding Analysis						
Unit III	Basics of Python Programming, Cyber Security and Ethical Hacking					12 hours
Introduction – Python – Data Types – Variables and Operators – Conditions and Loops – Structure of a Python Program– Packages and Function – Writing Simple Python Codes – Cyber Security - Security Environment – Threats – Cyber Crime – Vulnerabilities in Software – Open Access Data – Open Source Software – Ethical Hacking – Hacker and Cracker – Computer Fraud – Malware Threats – Viruses and Worms – Trojans – Spyware – Malware Counter Measures – Ethical and Legality						

Unit IV	Programming Basics with C using Arduino IDE, Sensors and Actuators	14 hours
Installing and Setting up the Arduino IDE – Basic Syntax – Data Types / Variables / Constant – Operators Conditional Statements and Loops – Using Arduino C Library Functions for Serial, Delay and Other Invoking Functions – Strings and Mathematics Library Functions – Basics of Analogy and Digital Sensors – Interfacing Temperature Sensors, Ultrasound Sensor, Infrared Sensor, LED and Buzzer with Arduino – Introduction to ESP8266 NODEMCU Wifi Module – basic knowledge of Programming NODEMCU using Arduino IDE		
Unit V	Information Theory	10 hours
Classical Information Theory – Classical Bits - Classical Computers – Classical Turing Machine – von Neumann Computer – Classical Logic Gates and Logic Circuits – Quantum Information Theory – Quantum Bits (Qbits) – Superposition Principle – Collapse of Wavefunction – EPR Paradox – Bell’s inequality with proof – Quantum Turing Machine – Quantum Gates - Basics of Quantum Teleportation and Cryptography		
Unit VI	Contemporary Issues	2 hours
Expert Lectures, Online Seminars – Webinars		
Total Lecture Hours		60 hours
Text Book(s)		
1	Industrial Automation and Robotics – A. K. Gupta, S. K. Arora and J. R. Westcott, Mercury Learning and Information LLC, 2017	
2	Arduino Cookbook – Michael Margolis, O’ Reilly Media, Inc., 2011	
3	An Introduction to Python – Fred L. Drake and Guido Van Russom, Network Theory Limited	
4	Artificial Intelligence: A modern approach – Stuart Russell and Peter Norvig, Prentice Hall, 3 rd Edition, 2009	
Reference Books		
1	Principles of Information Security – Michael E Whitman and Herbert J Mattord, Vikas Publishing House, 4 th Edition, 2011	
2	Ethical Hacking: A Beginners Guide to Learning the World of Ethical Hacking – Lakshay Eshan, Shockwave Publishing, 2018	
3	Quantum Computation and Quantum Information – Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press, 2000	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]		
1	https://nptel.ac.in/courses/106105166/	
2	http://www.theory.caltech.edu/people/preskill/ph229/	
Course Designed By: Dr. S.S. Naina Mohammed (ss.nainamohammed@gmail.com)		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	S	M	L	S	S
CO2	S	M	S	L	L	M	M
CO3	S	M	S	L	M	M	M
CO4	S	M	S	S	M	S	S
CO5	S	M	S	L	M	M	M

*S - Strong; M - Medium; L – Low.

ELECTIVE - I

Course code	1EB	ELEMENTS OF NANOSCIENCE AND NANOTECHNOLOGY				
		L	T	P	C	
		4	0	0	4	
Pre-requisite		The students should have basic understanding in materials			Syllabus Version	2020-2021
Course Objectives:						
The main objectives of this course are able						
<ol style="list-style-type: none"> 1. to learn about basic of nanoscience and technology 2. to acquire the knowledge about classification of nanomaterials 3. to learn about properties and characterization techniques of nanomaterials. 4. to understand the various applications of nanomaterials in different fields. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	understand the fundamentals properties and different types of nanomaterials				K2	
2	learn quantum dots, wells and wires				K3	
3	study the morphological and size of the nanoparticles using various analytical techniques				K4	
4	tune the size and shape of the nanomaterials for diverse applications				K5	
5	synthesize nanomaterials using various physical, chemical and biological approaches				K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Overview of Nanoscience				10 hours	
Nano revolution of the 20th century - Properties at Nanoscale (optical, electronic and magnetic) Theory - definitions and scaling						
Unit II	Different Classes of Nanomaterials				12 hours	
Metal and Semiconductor Nanomaterials - Quantum dots, Wells and Wires - Molecule to Bulk Transitions Bucky Balls and Carbon Nanotubes						
Unit III	Synthesis of Nanomaterials				12 hours	
Top down (Nanolithography, CVD) – bottom up (sol gel processing, chemical synthesis) - Wet Deposition Techniques – Self assembly (Supramolecular approach) - Molecular Design and Modeling						
Unit IV	Characterization				12 hours	
TEM, SEM and SPM Technique - Fluorescence Microscopy and Imaging						
Unit V	Applications				12 hours	
Solar Energy Conversion and Catalysis - Molecular Electronics and Printed Electronics Nanoelectronics - Polymers with a special architecture - Liquid Crystalline Systems - Linear and Nonlinear Optical and Electro Optical properties - Applications in Displays and other devices - Advanced Organic Materials for Data Storage – Photonics – Plasmonics - Chemical and Biosensors - Nanomedicine and Nano Biotechnology						

Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		60 hours
Book(s) for Study		
1	Nanocrystals: Synthesis, Properties and Applications - C.N.R. Rao, P.J. Thomas and G.U. Kulkarni, Springer (2007)	
2	Nanostructured Materials and Nanotechnology - Hari Singh Nalwa, Academic Press, 2002	
Book(s) for Reference		
1	Nanocrystals: Synthesis, Properties and Applications, C.N.R. Rao, P.J. Thomas and G.U. Kulkarni, Springer (2007)	
2	Nanoscience: Nanotechnologies and Nanophysics - C. Dupas, P. Houdy, M. Lahmani, Springer Verlag Berlin Heidelberg, 2007	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	http://www.ncpre.iitb.ac.in/slotbooking/SOP/62SOP.pdf	
2	https://en.wikipedia.org/wiki/Nanomaterials	
3	https://www.nano.gov/you/nanotechnology-benefits	
Course Designed By: Dr M. Parthibavarman (varmanphysics85@gmail.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	S	L	S
CO2	M	S	S	S	S	S	M
CO3	S	M	S	M	L	M	S
CO4	L	L	M	L	M	S	S
CO5	M	S	M	S	S	M	L

*S-Strong; M-Medium; L-Low

ELECTIVE - I

Course code	1EC	INTRODUCTORY ASTRONOMY, ASTROPHYSICS & COSMOLOGY	L	T	P	C
			4	0	0	4
Pre-requisite		Students should have basic knowledge in general relativity	Syllabus Version	2020-2021		
Course Objectives:						
The main objectives of this course are to:						
1. Learn how the systematic method and quantitative influence are used in Cosmology						
2. Explicate large scale universe are evolved						
3. Characterize light year, astronomical unit and transmit these to the size of the planets						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Apply physical principles in a broad range to astronomical situations.					K3
2	Be able to formulate scientific problems in mathematical terms and apply analytical and numerical methods towards its solution.					K5
3	Develop skills to design observing projects with research telescopes and projects drawing upon data in the literature and in archives.					K4
4	Establish competence in focused areas of astrophysical theory and experiment					K5
5	Build up skills in cosmological models to analyze physical properties of universe.					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	History of Astronomy					10 hours
Introductory History of Astronomy - Ptolemy's Geocentric Universe – Copernicus Heliocentric Universe - Tycho Brahe and Galileo's Observations - Kepler's Laws of Planetary Motion - Newtonian Concept of Gravity - Highlights of Einstein's Special and General Theory of Relativity - Curved Space Time - Evidence of Curved Space Time - Bending of Light - Time Dilation						
Unit II	Stars & Galaxies					12 hours
Stars and Galaxies – Distances - Trigonometric Parallax - Inverse Square Law- Magnitude of Stars – Apparent Magnitude - Absolute Magnitude and Luminosity – Color and Temperature - Composition of Stars - Velocity, Mass and Sizes of Stars - Types of Stars - Temperature Dependence - Spectral Types - Hertzsprung-Russell (HR) Diagram - Spectroscopic Parallax						
Unit III	Lives and Death of Stars					12hours
Stellar Evolution - Mass Dependence - Giant Molecular Cloud – Proto star-Main Sequence Star – Sub giant, Red Giant, Supergiant - Core Fusion - Red Giant (Or) Supergiant – Planetary Nebula (Or) Supernova - White Dwarfs - Novae And Supernovae- Neutron Stars – Pulsars - Black Holes - Detecting Black Holes-The Sun- Its Size and Composition- Sun's Interior Zones – Sun's Surface -Photosphere- Chromospheres – Corona - Sun's Power Source-Fusion Reaction Mechanism						
Unit VI	Cosmology - I					12 hours
Introduction to Cosmology - Basic Observations and implications - Olbers Paradox - Expanding Universe - Gravitational Red shift - Doppler Effect - Hubble's Law and the age of Universe - Cosmological Principle - The Perfect Cosmological Principle - Observation and interpretation						

of Cosmic Microwave background Radiation (CMBR) - Evidence Supporting the General Big Bang Theory - Salient features of steady state theory		
Unit V	Cosmology - II	12 hours
Fate of the Universe - Dependence on Mass (Curvature of Space) - Critical density – Open Universe - Closed Universe – Homogenous and Isotropic Friedmann – Robertson - Walker Universes - Deriving the Geometry of the Universe from the Background Radiation – Flatness Problem – Horizon Problem - Inflation and its effect on the universe - The Cosmological Constant		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	The Life and Death of Stars, Kenneth R. Lang	
2	Physical Foundations of cosmology, Viatcheslav Mukhanov.	
Reference Books		
1	Lectures on Astronomy, Astrophysics, And Cosmology, Luis A. Anchordoqu	
2	Lecture Notes of Department of Physics, University of Wisconsin-Milwaukee	
3	Astrophysics of the Solar System, K.D. Abhayankar	
4	An Introduction to Planetary Physics, Kaula.W.M	
5	Astrophysics of the Sun, Harold Zirin.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/115/105/115105046/	
2	http://www.nptelvideos.in/2012/12/astrophysics-cosmology.html	
3	https://onlinecourses.swayam2.ac.in/arp19_ap73/preview	
Course Designed By: Dr. A. Ramalingam (ramligri@rediffmail.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	L	S	S	M	S	M
CO3	M	M	S	S	L	L	S
CO3	M	S	S	S	L	M	S
CO4	S	L	M	L	S	S	S
CO5	L	M	S	M	S	L	M

*S-Strong; M-Medium; L-Low

ELECTIVE - II

Course code	2EA	PLASMA PHYSICS	L	T	P	C
			5	0	0	4
Pre-requisite	Students should have basic knowledge in fundamentals of Plasma Physics		Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to:						
1. explore the plasma universe by means of in-situ and ground-based observations						
2. understand the model plasma phenomena in the universe						
3. explore the physical processes which occur in the space environment						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	calculate fundamental properties of a plasma given appropriate information				K2	
2	apply basic electromagnetism to derive the kinetic theory of plasmas				K3	
3	will able to distinguish single particle approach and fluid approach				K4	
4	apply concepts and analyze plasma diagnostics techniques				K4	
5	interpret geomagnetic field measurements in terms of currents flowing in Earth's ionosphere and magnetosphere				K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Fundamental Concepts about Plasma				10 hours	
Kinetic pressure in a partially ionized - 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 - Quasi neutrality of plasma - Debye shielding distance - Optical properties of plasma						
Unit II	Motion of Charged Particles in Electric and Magnetic Field				12 hours	
Particle description of plasma – Motion of charged particle in electrostatic field- Motion of charged particle in uniform magnetic field - Motion of charged particle in electric and magnetic fields - Motion of charged particle in inhomogeneous magnetic field- Motion of charged particle in magnetic mirror confinement - motion of an electron in a time varying electric field - Magneto hydrodynamics – Magneto hydrodynamic equations - Condition for magneto hydrodynamic behavior						
Unit III	Plasma Oscillations and Waves				12 hours	
Introduction, theory of simple oscillations - electron oscillation in a plasma - Derivations of plasma oscillations by using Maxwell's equation - Ion oscillation and waves in a magnetic field - thermal effects on plasma oscillations - Landau damping - Hydro magnetic waves - Oscillations in an electron beam						
Unit IV	Plasma Diagnostics Techniques				12 hours	
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						

Unit V	Possible Applications of Plasma Physics	12 hours
Magneto hydrodynamic Generator - Basic theory - Principle of Working - Fuel in MHD Generator - Generation of Microwaves Utilizing High Density Plasma – Plasma Diode		
Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	Plasma Physics - Plasma State of Matter - S.N. Sen, Pragati Prakashan, Meerut	
2	Principles of Plasma Diagnostics - I. H. Hutchinson	
Reference Books		
1	Introduction to Plasma Physics - F.F.Chen, Plenum Press, London	
2	Introduction to Plasma Physics - M.Uman	
3	Plasma Diagnostic Techniques - R.H. Huddlestone & S.L. Leonard	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.youtube.com/watch?v=wO2HS7hcSb8	
2	https://ocw.mit.edu/courses/nuclear-engineering/22-611j-introduction-to-plasma-physics-i-fall-2003/lecture-notes/	
Course Designed By: Dr. R. Thiyagarajan (thiyagu_phy@rediffmail.com))		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	S	S	S
CO2	S	S	S	M	S	S	M
CO3	S	S	M	L	M	M	L
CO4	S	S	S	M	S	M	M
CO5	S	S	S	M	M	M	M

*S-Strong; M-Medium; L-Low

ELECTIVE - II

Course code	2EB	CRYSTAL GROWTH METHODS AND CHARACTERIZATION	L	T	P	C
				5	0	0
Pre-requisite		The students should have basic understanding in Solid state physics	Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to:						
1. provide an extended knowledge on advanced condensed matter topic like crystal growth methods						
2. provide the necessary understanding on the theories involve in the nucleation and growth process						
3. provide fundamental concepts behind the solution, melt and vapour growth techniques						
4. provide necessary knowledge on the functioning of various characterization tools						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	understand the process of crystal nucleation and growth					K2
2	know about various crystal growing techniques					K3
3	understand the methodologies of solution and gel growth techniques					K2, K3
4	understand the concepts behind the melt and vapour growth techniques					K2, K3
5	know about different characterization techniques					K4, K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	NUCLEATION THEORY					10 hours
Importance of crystal growth – Classification of crystal growth methods – Nucleation Theory - Kinds of nucleation – Homogeneous nucleation - Heterogeneous nucleation - secondary nucleation - Classical theory of nucleation: Gibbs Thomson equations for vapour and solution – Kinetic theory of nucleation – Energy of formation of a spherical nucleus and cylindrical nucleus.						
Unit II	SOLUTION GROWTH TECHNIQUES					12 hours
Growth from low temperature solutions - Selection of solvents and solubility – Meir's solubility diagram – Saturation and Supersaturation – Metastable zone width – Growth by restricted evaporation of solvent, slow cooling of solution and temperature gradient methods - Gel Growth Technique - Principle – Various types – Structure of gel – Importance of gel – Experimental procedure – Chemical reaction method – Single and double diffusion method – Chemical reduction method – Complex and de complexion method – Advantages of gel method - Growth from high temperature solutions - Flux growth – Hydrothermal growth method						
Unit III	MELT GROWTH TECHNIQUES					12 hours
Basics of melt growth - Bridgman method – Growth apparatus - Crucibles, Heater, Measurement and Control of Temperature – growth process – Applications of Bridgman method - Czochralski technique – Growth apparatus – seed preparation – pulling rate – shape of crystal melt interface – Growth process						
Unit IV	VAPOUR GROWTH TECHNIQUES					12 hours
Physical Vapour Transport (PVT) – Processes of sublimation and condensation principle – crystal growth in closed and semi open ampoules – Chemical Vapour Transport – Criteria for the choice of transport reaction – Transported materials and transporting agents – Temperature variation method for crystal growth - Stationary temperature profile - Linearly time varying temperature profile and Oscillatory temperature profile						

Unit V	CHARACTERIZATION TECHNIQUES	12 hours
X Ray Diffraction (XRD) – Powder and single crystal – UV Visible - Fourier Transform Infrared (FT- IR) and Raman spectroscopic analysis – TG DTA/DSC Thermal Analysis - Vickers Micro hardness - Chemical Etching		
Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	J. C. Brice, Crystal Growth Processes, John Wiley and Sons, New York, 1986.	
2	P. SanthanaRagavan and P. Ramasamy, Crystal Growth Processes and Methods, KRU Publications, Kumbakonam, 2001.	
3	H.L. Bhat, Introduction to Crystal Growth Principles and Practice CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2015.	
Reference Books		
1	Govindhan Dhanaraj, Kullaiah Byrappa, Vishwanath Prasad, Michael Dudley (Eds.), Hand book of Crystal Growth Springer Heidelberg Dordrecht London New York, 2010.	
2	B.R. Pamplin, Crystal Growth, Pergamon Press, Oxford, 1975.	
3	K. Sangwal, Elementary Crystal Growth (Edited), SAAN Publishers, Lublin, 1994.	
4	Sam Zhang, Lin Ki, Ashok Kumar, Materials Characterization Techniques, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2009.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/113/105/113105025/	
2	https://nptel.ac.in/courses/104/104/104104011/	
3	https://onlinecourses.nptel.ac.in/noc19_cy35/preview	
Course Designed By: Dr. K Srinivasan (nivas_5@yahoo.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	M	S	M	S	S
CO3	M	M	S	S	M	S	S
CO3	S	S	S	S	M	S	S
CO4	S	S	S	S	M	S	S
CO5	S	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

ELECTIVE - II

Course code	2EC	ATMOSPHERIC PHYSICS	L	T	P	C
			5	0	0	4
Pre-requisite			Syllabus Version		2020-2021	
		Students should have basic knowledge in thermodynamics				
Course Objectives:						
The main objectives of this course are to:						
1. familiarize microphysical principles and determine the structures of the atmosphere and clouds						
2. apply principles of cloud microphysics to the solution of atmospheric problems						
3. impart knowledge on clouds, precipitation and air pollution						
4. study meteorological systems and global energy balance						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	know the composition and structure of atmosphere					K2
2	understand and apply radar meteorology					K3
3	able to interpret clouds and precipitation					K4
4	describe the meteorological systems, global energy balance and to calibrate air pollution					K5
5	create a scope to identify new areas of research in the field of atmospheric science					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Physical & Dynamic Meteorology					12 hours
Physical Meteorology: Structure of Earth's Atmosphere and Composition - Law of Thermodynamics of the Atmosphere - Adiabatic Process - Potential Temperature - Clausius Clapyeron Equation - Laws of Black Body Radiation - Solar and Terrestrial Radiation – Albedo - Green House Effect - Heat Balance of Earth Atmosphere System						
Unit II	Dynamic Meteorology					10 hours
Fundamental Forces - Structure of Static Atmosphere - Momentum, Continuity and Energy Equations - Thermodynamics of the Dry Atmosphere - Elementary Applications of the Basic Equations - Circulation Theorem – Vorticity - Potential Vorticity and Potential Vorticity Equations						
Unit III	Climate & Monsoon Dynamics					12 hours
Climate Classification - Polar, Artic, Antarctic, Temperate & Tropical Climates Wind, Temperature & Pressure Distribution over India in the Lower, Middle and Upper Atmosphere during Pre – Post - and Mid - Monsoon Season - Dynamics of Monsoon Depression and Easterly Waves - Intra Seasonal and Inter annual Variability of Monsoon – Quasi Bi Weekly and 30 - 60 Day Oscillations - Walker Circulation, Southern Oscillations & El Nino						
Unit IV	Atmospheric Pollution					12 hours
Role of Meteorology in Atmospheric Pollution - Atmospheric Boundary Layer - Air Stability - Local Wind Structure - Ekman Spiral - Turbulence & Boundary Layer Scaling - Residence Time and Reaction Rates of Pollutants - Sulphur Compounds - Carbon Compounds - Organic compounds –Aerosols - Toxic Gases and Radio Active Particles - Trace Gases						

Unit V	Radar Meteorology	12 hours
Basic Meteorology - Radar Principles and Technology - Radar Signal Processing & Display - Weather Radar - Observation of Precipitating Systems - Estimation of Precipitation - Radar observation of Tropical Storms & Cyclones - Use of Weather Radar in Aviation - Clear Air Radars - Observation of a Clear Air Phenomena		
Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	The Atmosphere - Frederick K. Lutgens and Edward J. Tarbuk	
2	Dynamic Meteorology - J.R. Holton, Academic Press NY	
Reference Books		
1	The Physics of Monsoons - R.N. Keshvamurthy & M. Shankar Rao, Allied Publishers	
2	Principles of Air Pollution Meteorology – Tom Lyons & Prillscott, CBS Publishers & Distributors	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/119/106/119106008/	
2	https://nptel.ac.in/courses/119/102/119102007/	
3	https://nptel.ac.in/courses/119/108/119108004/	
Course Designed By: Mrs. B. Thilaga Rajeswari (raajee1979@gmail.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	L	M	M	S	S	S	S
CO3	S	L	S	M	S	S	M
CO3	S	S	L	S	M	S	L
CO4	L	L	S	S	L	S	M
CO5	M	L	M	S	M	M	S

*S-Strong; M-Medium; L-Low

ELECTIVE - III

Course code	3EA	EXPERIMENTAL TECHNIQUES & DATA ANALYSIS	L	T	P	C
			4	0	0	4
Pre-requisite	Students should know the fundamentals of Electronic Circuits		Syllabus Version	2020-2021		
Course Objectives:						
The main objectives of this course are to:						
1. acquainted with the concept of errors.						
2. make awareness about the constructions and working principle of sensors and transducers.						
3. recognize the parameters those are measurable in electronic instruments.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Develop an appropriate experimental research design for an engineering case study					K5
2	Taking into account practical limitations					K6
3	Apply knowledge of statistical analysis to assess a hypothesis by selecting appropriate statistical tests and interpreting the test results accurately					K3
4	Propose an appropriate statistical model for a given dataset and interpret the goodness of fit					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Introduction					12 hours
Introduction - Measurement of errors: accuracy, precision, resolution, sensitivity - absolute and relative errors - Types of errors - gross error, systematic error and random error - standards of measurements - classification of standards, time and frequency standards, electrical standards						
Unit II	Electrical Transducer Classification					10 hours
Active and Passive transducers - resistive, inductive, capacitive, thermocouple and Piezoelectric transducers - Digital transducers						
Unit III	Amplifiers and signal Conditioning					12 hours
Instrumentation amplifiers - Isolation amplifiers - Chopper amplifiers - Voltage to frequency and voltage to current converters - Frequency multipliers - logarithmic amplifiers - S/H Circuits Active filters - Low pass, High pass, Band pass and Band stop filters						
Unit IV	Analysis					12 hours
Wave Analyzers - Audio frequency Wave analyzer - Heterodyne wave analyzer - Harmonic distortion analyzers - Resonant harmonic distortion analyzer - Heterodyne harmonic distortion analyzer - Fundamental suppression harmonic distortion analyzer - Spectrum analyzer - Spectra of CW, AM, FM and PM waves						
Unit V	Electronic Measuring Instruments					12 hours
Q meter - Vector impedance meter - Digital frequency meter - Digital voltmeter - Phase meter - RF power and voltage measurement - Power factor meter - Vector voltmeter - Display and Recording: X-Y Recorders - Magnetic Tape recorders - Storage Oscilloscope						

Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	Electrical & Electronics Measurement & Instrumentation - A. K. Sawhney	
2	Electronic Instrumentation – H.S. Kalsi TMH	
Reference Books		
1	Modern Electronic Instrumentation - W.D.Cooper	
2	Instrumentation Devices and Systems - C.S. Rangan, G.R. Sharma and VSV Mani, Tata McGraw Hill Publications	
3	Introduction to Instrumentation and Control - A.K. Ghosh - Prentice Hall India Publications	
4	Modern Electronic Instrumentation and Measurement Techniques - A.O. Hefnick and W.D. Cooper., Prentice Hall India Publications.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://onlinecourse.nptel.ac.in/noc19_ee38/preview	
2	https://nptel.ac.in/courses/117/102/117102059/	
3	https://www.udem.com/course/electronic-measurements-and-instrumentation/	
Course Designed By: Dr. B. Gnanavel (gnanavelphd@gmail.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	L	M	S	M	M	S	S
CO3	M	L	S	S	S	S	M
CO3	M	S	S	L	M	M	M
CO4	S	S	M	M	M	S	S
CO5	L	M	S	S	M	M	S

*S-Strong; M-Medium; L-Low

ELECTIVE - III

Course code	3EB	THIN FILM PHYSICS	L	T	P	C
			4	0	0	4
Pre-requisite	Students should have basic knowledge in the state of matter particles		Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to:						
1. understand the basic concepts of thin films technology						
2. acquire the knowledge about thin film coating, its characterization and its applications						
3. explain the electric, electronic, magnetic, and structural behavior of functional materials, the experimental methods used to investigate their functionality, mathematical and computational techniques used to model their properties						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	gain knowledge on the mechanism, process for the synthesis and evolution of thin films					K2
2	understand principles, advantages and drawbacks of different thin film deposition methods					K2
3	familiarize basics of defects and dislocations, and learn how it can be identified and removed					K3
4	learn characterization techniques to analyze sample					K4
5	apply the knowledge of thin film in research level applications					K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Preparation of Thin Film					10 hours
Nature of Thin Film - Deposition Technology - Distribution of Deposit - Resistance Heating - Thermal Evaporation - Flash Evaporation						
Unit II	Deposition techniques					12 hours
Electron Beam Method - Cathodic Sputtering - Glow Discharge Sputtering - Low Pressure Sputtering - Reactive Sputtering - RF Sputtering - Chemical Vapour Deposition (CVD) - Chemical Deposition						
Unit III	Film Thickness & Its Control					12 hours
Mass Methods - Optical Method - Photometry - Ellipsometry - Interferometry - Other Methods - Substrate Cleaning - Microscopic Defect and Dislocation - Edge Dislocation - Screw Dislocation - Boundary Defect - Stress Effect - Removal of Defect - Defect and Energy State						
Unit IV	Thin Film Analysis					12 hours
Electron Diffraction Technique - High Energy Electron Diffraction - Low Energy Electron Diffraction - Electron Microscopy - Scanning Electron Microscopy - X Ray Photoelectron Spectroscopy - Mass Spectroscopy - Thermodynamics of Nucleation - Nucleation Theories - Film Growth - Incorporation of Defects, Impurities in Film - Deposition Parameters and grain size						
Unit V	Thin Film Growth Process					12 hours
Epitaxy - Thin Film Structure - Substrate Effect - Epitaxial Deposit - Twinning and Multi twinning - Phase Transition - Dissociations - Film Thickness Effect - Crystal Growth Process						

Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
		Total Lecture hours
		60 hours
Text Book(s)		
1	Thin Film Fundamentals - A. Goswami, New Age International-New Delhi	
2	Thin Film Phenomena - K.L.Chopra	
Reference Books		
1	Handbook of Thin Film Technology-L.T. Meissel& R. Glang-McGrawHill	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.youtube.com/watch?v=o9uRmL38R6A	
2		
Course Designed By: Dr. R. Thiyagarajan (thiyagu_phy@rediffmail.com))		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	S	M	S	S
CO2	S	M	M	S	M	M	S
CO3	S	S	S	S	M	M	S
CO4	S	L	S	S	M	S	M
CO5	M	L	M	S	L	M	M

*S-Strong; M-Medium; L-Low

ELECTIVE - III

Course code	3EC	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
			4	0	0	4
Pre-requisite	The students should have fundamental knowledge about digital electronics		Syllabus Version		2020 -2021	
Course Objectives:						
1. To study the Architecture of μ P8085 & μ C8051 2. To study the addressing modes & instruction set of 8085 & 8051. 3. To introduce the need & use of Interrupt structure of 8085 & 8051. 4. To develop skill in simple applications development with programming 8085 & 8051						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	learn instruction set of microprocessor					K2
2	perform experiments using Intel 8051 microcontrollers and interfacing experiments such as seven segment display, stepper motor control, traffic light control					K3
3	identify architecture of microprocessor and microcontroller and use microcontrollers in instrumentation applications					K4
4	know the various peripheral devices of Intel 8051 and interfacing them					K5
5	create interface between laboratory experiments and microcontroller, and write instruction code					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Introduction & Instruction Set of 8085					12 hours
Pin Diagram – Architecture – De multiplexing the Bus – Generation of Control Signals – Fetching, Decoding and Execution of Instruction – Instruction set – Addressing modes – Instruction format – Memory Read Machine Cycle – Simple Programs						
Unit II	Interfacing Concepts					12 hours
Peripheral I/O Instructions – Device Selection and Data Transfer – Input Interfacing – Parallel and Serial Interface - Introduction to Programmable Peripheral Interface 8255 – Pin Diagram – Architecture – Modes of Operation: I/O and BSR – Architecture and Operation of 8251 (USART) - 8085 Interrupts						
Unit III	Applications Of μP					10 hours
Time Delay Program – Traffic Light Control System – Water Level Controller – Stepper Motor Control – Interfacing DAC – Interfacing ADC – Temperature Measurement						
Unit IV	Introduction & Assembly Programming of 8051					12 hours
Microcontrollers and Embedded Processors – Microcontrollers for Embedded Systems – Overview of 8051 Family – 8051 Instruction Set and Registers - Introduction to 8051 Assembly Programming – the Program Counter and ROM – Data Types and Directives – Flag Bits and PSW Register – Register Bank and Stack – Loop and Jump Instructions – I/O Port Programming Addressing Modes – Simple Programs						
Unit V	Interfacing and Real time Applications of μC					12 hours
Interfacing LCD to the 8051 – Interfacing ADC – Interfacing Sensors to 8051 – Interfacing Stepper Motor – 8051 Interfacing to the Keyboard – Interfacing DAC to the 8051 - Real time applications						

Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	Microprocessor Architecture, Program And Its Application With 8085 - R.S. Gaonkar, New Age International (P) Ltd	
2	Microprocessor and Its Application - S. Malarvizhi, Anuradha Agencies Publications	
3	The 8051 Microcontroller And Embedded Systems Using Assembly And C - Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, PHI, 2 nd Edition, 2006	
Reference Books		
1	The 8085 Microprocessor, Architecture, Programming and Interfacing – K Uday Kumar, S. Uma Shankar, Pearson	
2	Fundamentals of Microprocessors and Microcontrollers - B. Ram, Dhanpat Rai Publications	
3	Fundamentals of Microprocessors and Microcontrollers - B. Ram, Dhanpat Rai Publications	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/108/105/108105102/	
2	https://nptel.ac.in/courses/106/108/106108100/	
3	https://nptel.ac.in/courses/108/103/108103157/	
Course Designed By: Dr M. Parthivarman (varmanphysics85@gmail.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	M	S	S	S	M
CO3	S	M	M	L	M	S	S
CO3	L	S	L	M	S	S	S
CO4	S	S	S	L	L	M	M
CO5	L	S	M	S	S	S	M

*S-Strong; M-Medium; L-Low

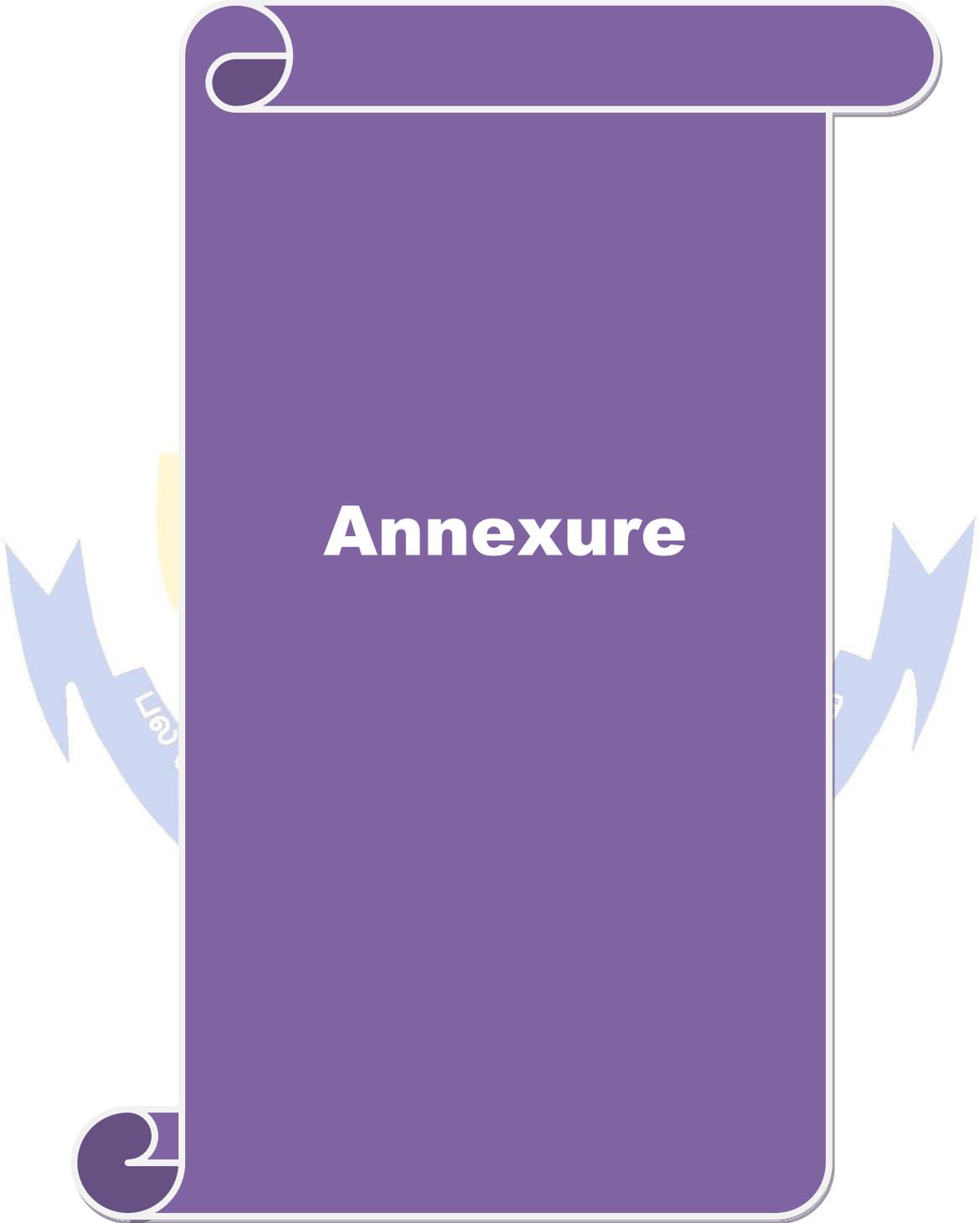
ELECTIVE - III

Course code	3ED	PHYSICS OF NON-CONVENTIONAL ENERGY RESOURCES	L	T	P	C
			4	0	0	4
Pre-requisite	The students should have basic knowledge about conventional energy resources		Syllabus Version	2020 -2021		
Course Objectives:						
The main objectives of this course are to:						
1. To develop the human recourse in non-conventional Energy resources						
2. To create several self-employment opportunities in renewable energy and energy efficiency sectors for modestly-trained and self-trained human resources exist in all geographic locations of the country						
3. It will help to develop the skills required in renewable energy and energy management fields						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	understand various renewable energy technologies					K2
2	understand characteristics of solar radiation and solar energy devices					K3
3	learn and apply geothermal energy and fuel cells					K3
4	get awareness of non conventional sources of energy technologies					K4
5	acquirer the knowledge of storage technologies from the autonomous renewable energy sources and various possible mechanisms about renewable energy projects					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit I	Introduction to Non conventional Energy					10 hours
Introduction – Various non conventional energy resources – Availability – Classification - Relative merits and Demerits Solar Cells - Theory of Solar Cells - Solar Cell Materials - Solar Cell Array - Solar Cell Power Plant - Limitations						
Unit II	Solar Thermal Energy					12 hours
Solar Thermal Energy - Solar radiation - Flat Plate Collectors and their Materials - Applications and Performance - Focusing of Collectors and their Materials - Applications and Performance - Solar Thermal Power Plants - Thermal Energy Storage for Solar Heating and Cooling - Limitations						
Unit III	Geothermal Energy and Fuel Cells					12 hours
Geothermal Energy - Resources of Geothermal Energy - Thermodynamics of Geo Thermal Energy Conversion - Electrical Conversion – Non electrical Conversion - Environmental Considerations - Magneto Hydrodynamics (MHD) - Principle of Working of MHD Power Plant - Performance and Limitations – Fuel Cells - Principle of Working of Various Types of Fuel Cells and their Working - Performance and Limitations						
Unit IV	Wind Energy and Power Generation					12 hours
Wind Power and its Sources - Site Selection – Criterion - Momentum Theory - Classification of Rotors - Concentrations and Augments - Wind Characteristics - Performance and Limitations of Energy Conversion Systems						

Unit V	Bio mass	12 hours
Bio mass - Availability of Bio mass and its Conversion Theory - Ocean Thermal Energy Conversion (OTEC) – Availability - Theory and Working Principle - Performance and Limitations - Wave and Tidal Wave - Principle of Working - Performance and Limitations		
Unit VI	Contemporary Issues	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	Introduction to Non-Conventional Energy Resources -Raja etal, SciTech Publications	
2	Non-conventional Energy Resources -D.S. Chauhan, New Age International	
Reference Books		
1	Renewal Energy Resources - John Twideu and Tony Weir, BSP Publications, 2006	
2	Energy Resources: Conventional & Non-Conventional - M.V.R. Koteswara Rao, BSP Publications, 2006	
3	Renewal Energy Technologies: A Practical Guide for Beginners C.S. Solanki-PHI Learning	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/121/106/121106014/	
2	https://onlinecourses.nptel.ac.in/noc20_ge06/preview	
3	https://nptel.ac.in/courses/103/107/103107157/	
Course Designed By: Dr. A. Ramalingam (ramligri@rediffmail.com)		

Mapping with Programme Outcomes							
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	L	M
CO3	S	M	S	L	S	S	S
CO3	M	M	L	M	S	S	L
CO4	S	M	S	L	L	S	M
CO5	L	M	S	S	S	M	M

*S-Strong; M-Medium; L-Low



Annexure

BHARATHIAR UNIVERSITY: COIMBATORE 641046
DEPARTMENT OF PHYSICS
Physics Bard of Studies (PG)

Chairperson: Dr. A NISHARA BEGUM, Assistant Professor
 PG & Research Department of Physics
 Chikkaiah Naicker College, Erode - 638 004

Mobile Number: +919443544946

Email ID: anishara@yahoo.com

S.No	Name& Designation	Institution
1	Dr. A Nishara Begum Chairperson	Assistant Professor PG & Research Department of Physics Chikkaiah Naicker College, Erode - 638 004
2	Dr. K. Srinivasan Ex-Officio Member	Ex-Officio Member Professor and Head, Physics Bharathiar University, Coimbatore
3	Dr. P. Sagunthala Ex-Officio Member	Associate Professor of Physics Sri Vasavi College, Erode
4	Mrs. T.V. Banumathi Member	Professor and Head, Physics Sri GVG Visalakshi College for Women Udumalpet
5	Dr. A. Ramalingam Member	Assistant Professor of Physics Government Arts College, Udumalpet
6	Mrs. S. Sasikala Member	Assistant Professor of Physics Navarasam Arts and Science College for Women Archalur, Erode
7	Mrs. B. Thilaga Rajeswari Member	Assistant Professor of Physics Navarasam Arts and Science College for Women Archalur, Erode
8	Dr. V. Rajendran Principal Member	Principal Dr. NGP Arts and Science College Coimbatore
9	Dr. V. Velusamy Other University Member	Assistant Professor of Physics Arignar Anna Government Arts College Namakkal
10	Dr. R. Ilango TNGCTA Member	Associate Professor of Physics Government Arts College, Udumalpet
11	Dr. M. Ramamurthy AUT Member	Associate Professor of Physics SRMV College of Arts and Science Coimbatore
12	Dr. B. Gnanavel ACTA Member	Assistant Professor PG & Research Department of Physics Chikkaiah Naicker College, Erode - 638 004

S.No	Name& Designation	Institution
13	Dr. R. Thiyagarajan Spl. Invitee (Ex-Chairperson)	Assistant Professor PG & Research Department of Physics Chikkaiah Naicker College, Erode - 638 004
14	Mr. K.L. Meganathan Student Alumnus	PG & Research Department of Physics Chikkaiah Naicker College, Erode - 638 004
15	Mr. G. Sivakumar Industrialist	1790 LGB Colony Ramanathapuram, Coimbatore
16	Dr. N. Gopkumar Other State Member	Associate Professor of Physics Mahatma Gandhi College Thiruvananthapuram, Kerala

