A.V.V.M. Sri Pushpam College (Autonomous), Poondi – 613 503
PG & Research Department of Physics
M.Sc. Programme in Physics
OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM
SCHEME OF PROGRAMME AND SYLLABUS
(For the candidates admitted from 2023-2024 onwards)

Vision and Mission of the college

Vision

To provide quality academic programmes and value oriented higher education to the rural community, equip them to encounter current regional, national and global demands upholding moral standards and intellectual competency.

Mission

- To provide conducive environment for quality teaching-learning process and innovative research.
- To bestow substantial educational experience that is intellectually, socially, and personally transformative.
- To strive to bring out the latent potentiality and core competency of the learners
- To foster the culture of research-based learning, independent academic inquiry by encouraging the students to involve in research activities ranging from hands on training, student projects, publications etc.,
- To nurture essential skills, competent minds and compassionate hearts.
- To impart a practical, demanding and overall development of the personality generated by love, consideration and care for the society.
- To serve the society by extending needful outreach programmes to the rural populace.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

- Make the learners realise the transformative power of education.
- Acquire profound disciplinary, applied, integrative knowledge and intellectual competency and domain specific and generic skills.
- Pursue lifelong learning and generate innovative solutions for the problems at individual and social level.
- Create a collaborative and inclusive environment, and serve the betterment of the society with moral integrity.
- Motivate to become a committed professional with necessary ethics as a leader as well as a team player.

PROGRAMME OUTCOMES for M.Sc. Programme

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of a Post graduate programme of study.

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO3: Problem Solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's earning to real life situations.

PO4: Analytical & Scientific Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

PO5: Research related skills: Ability to analyze, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open minded and reasoned research perspective; Sense of inquiry and capability for asking relevant questions / problem arising / synthesizing / articulating / ability to recognize cause and effect relationships / define problems. Formulate hypothesis, Test / analyze / Interpret the results and derive conclusion, formulation and designing mathematical models.

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

PROGRAMME SPECIFIC OUTCOMES for M.Sc. Physics Programme

On the completion of the program the learners will be able to

PSO1: Profound expertise in physics, interpret advanced under contemporary concepts, principle and theories to solve real problems.

PSO2: Acquire sufficient skills in physics to become employable.

PSO3: Identify and formulate problems critically and integrate resources to reach decisions.

PSO4: Develop and write innovative scientific research projects on emerging contemporary issues based on physics concepts.

PSO5: Broaden scientific approach not only with respect to physics but also in all aspects related to ethical, moral and the social values in personal and social life.

PSO6: Function effectively in team of physicists to create a collaborative and inclusive environment to achieve a goal.

PSO7: Expertise in independent and life-long learning through online physics courses to fit in an ever-changing world.

Curriculum Structure for PG Programmes (OBE- CBCS) - 2023

	Nature of Course	Total No. of Courses	Total marks	Total credits	Total credits for the Programme
Part – A	Core Course	13	1300	51	80 (CGPA)
	Elective Course	05	500	15	
	Extra Disciplinary Course	01	100	3	
	Core Industry Module (CIM)	01	100	3	
Part – B (i)	Skill Enhancement Course(SEC)	04	400	8	
Part – B (ii)	Ability Enhancement Compulsory Course (AECC) – Soft Skill	04	400	8	10 (Non CGPA)
	Internship / Industrial Activity	--	--	2	
	Total	**28**	**2800**	**90**	**90**
Value Added Course (VAC)		01	100	--	
Extra Credit Course - **MOOC / Field visit / Hands on Training**		--	--	Max: 4	

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree

Course Structure: M.Sc., Physics (2023)

S. No.	Semester	Category	Course Code	Title of the Course	Maximum Marks			Minimum Marks for Pass			Hours/ Week	Credits
					CIA	EE	Total	CIA	EE	Total		
1	I	Core	23P1PHC1	Classical Mechanics and Relativity	25	75	100	10	30	50	6	4
2		Core	23P1PHC2	Mathematical Physics	25	75	100	10	30	50	6	4
3		Core	23P1PHCP1	Practical I	25	75	100	10	30	50	6	4
4		Elective	23P1PHEL1A/ 23P1PHEL1B	Linear and Digital ICs and Applications/ Bio- Physics	25	75	100	10	30	50	4	3
5		Elective	23P1PHEL2A/ 23P1PHEL2B	Crystal Growth and Thin Films/ Medical Physics	25	75	100	10	30	50	4	3
6		SEC1	23P1PHSEC1	Energy Physics	25	75	100	10	30	50	2	2
7		AECC1	23P1PHAECC1	Communicative Skill and Personality Development	25	75	100	10	30	50	2	2
		Extra Credit	Field visit / Hands on Training		-	-	-	-	-	-	-	-
8	II	Core	23P2PHC3	Electromagnetic Theory	25	75	100	10	30	50	6	4
9		Core	23P2PHC4	Numerical Methods and Computer Programming	25	75	100	10	30	50	6	4
10		Core	23P2PHCP2	Practical II	25	75	100	10	30	50	6	4
11		Elective	23P2PHEL3A/ 23P2PHEL3B	Physics of Nanoscience and Technology/ Non Linear Dynamics	25	75	100	10	30	50	4	3
12		Elective	23P2PHEL4A/ 23P2PHEL4B	Microprocessor 8086 and Microcontroller 8051/ Biomedical Instrumentation	25	75	100	10	30	50	4	3
13		SEC 2	23P2PHSEC2	Astrophysics	25	75	100	10	30	50	2	2
14		AECC 2	23P2PHAECC2	Language Lab	25	75	100	10	30	50	2	2

S. No.	Semester	Category	Course Code	Title of the Course	Maximum Marks			Minimum Marks for Pass			Hours /Week	Credits
					CIA	EE	Total	CIA	EE	Total		
15	III	Core	23P3PHC5	Quantum Mechanics	25	75	100	10	30	50	6	4
16		Core	23P3PHC6	Statistical Mechanics	25	75	100	10	30	50	5	4
17		Core	23P3PHCP3	Practical – III	25	75	100	10	30	50	6	4
18		CIM	23P3PHCIM	Industrial Module - Non-conventional Energy Sources	25	75	100	10	30	50	5	3
19		EDC	23P3PHEDC	Fundamentals of Nanotechnology	25	75	100	10	30	50	4	3
20		SEC3	23P3PHSEC3	Physics of Medical Instruments	25	75	100	10	30	50	2	2
21		AECC3	23P3PHAECC3	Research Methodology	25	75	100	10	30	50	2	2
		Internship / Industrial Activity (Carried out in summer vacation at the end of I Year – 30 hours)									-	2
		Extra Credit	MOOC (Massive open online course)		-	-	-	-	-	-	-	-
22	IV	Core	23P4PHC7	Nuclear and Particle Physics	25	75	100	10	30	50	6	4
23		Core	23P4PHC8	Condensed Matter Physics	25	75	100	10	30	50	5	4
24		Core	23P4PHCP4	Practical IV	25	75	100	10	30	50	6	4
25		Elective	23P4PHEL5A/ 23P4PHEL5B	Spectroscopy/ Plasma Physics	25	75	100	10	30	50	4	3
26		Core	23P4PHC9PR	Project with Viva Voce	25	75	100	10	30	50	5	3
27		SEC4	23P4PHSEC4	Advanced Optics	25	75	100	10	30	50	2	2
28		AECC4	23P4PHAECC4	Comprehensive Knowledge	-	100	100	-	-	50	2	2
				Total			**2800**					**90**
		VAC		PCB Designing	-	100	100	-	50	50	SS	-
		Extra Credit MOOC (Massive open online course)			-	-	-	-	-	-	-	-

Internship/ Industrial Activity:

Students must complete in-plant training in any industry or organization where a programme-related procedure is being used, and this training must be done during the summer vacation at the end of I Year. A minimum of 30 hours should be spent on training. Students must submit a report on their training together with a certificate from the relevant industry or organization authority.

Ability Enhancement Compulsory Course (AECC): (Communicative Skill and Personality Development, Language Lab, Research Methodology and Comprehensive Knowledge)

Mode of Assessment for these courses is Viva-Voce examination.

Components of Evaluation:

Internal Marks: 25

External Marks: 75

Total: 100

Field visit / Hands on Training:

In order to achieve experiential learning, these programmes with a minimum of 15 hours of contact time are offered as Extra Credit Courses in the ISemester.

Evaluation of visit report will be held at the end of IISemester.

Components of Evaluation:

Internal Marks : 25

External Marks : 75

Total : 100

MOOC:

Massive Open Online Course is offered in the III and IVSemester as an Extra Credit Course. Students can avail any one or more of the courses available in MOOC to equip their skill and knowledge themselves. To receive the extra credit, students must provide their MOOC course completion certificate at the end of the second year.

Skill Enhancement courses (SEC) offered by the Physics Department

1.Energy Physics

2.Astro Physics

3.Physics of Medical Instruments

4.Advanced Optics

Extra Disciplinary Course (EDC) offered by the Physics Department

1. Fundamentals of Nanotechnology

Value Added Course offered by the Physics Department:

"PCB Designing" will be conducted for II PG students as a certificate Course.

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1PHC1**	**CLASSICAL MECHANICS AND RELATIVITY**	**6**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	✓
Entrepreneurship Oriented		Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

The main objectives of this course are to:

1. To understand the fundamentals of classical mechanics.
2. To gain knowledge about Lagrangian and Hamiltonian formulations.
3. To introduce the concepts of small oscillations.
4. To introduce the concepts of kinematics of rigid body.
5. To get knowledge in relativity.

SYLLABUS

Unit	Content	No. of Hours
I	**Principles of Classical Mechanics and Lagrangian Formulation** Mechanics of a system of particles – Conservation theorems and symmetry properties – Constraints – Generalized coordinates – Principle of Virtual work – D'Alembert's principle – Lagrange's equations of motion – conservative and non-conservative forces – Applications: Atwood's machine, Simple pendulum, One dimensional harmonic oscillator and Projectile motion.	18
II	**Hamiltonian Formulation and Canonical Transformation** Hamiltonian function (H) – Physical significance – Hamilton's canonical equations of motion – Applications: Simple pendulum, Linear harmonic oscillator – Hamilton's variational principle – Proof – Derivation of Lagrange's equations – Principle of Least Action – deduction – Canonical Transformations – Generating function – Bilinear invariant condition.	18
III	**Small Oscillations :** Theory of small oscillations – Secular equation and Eigen value equation – Normal modes and Normal frequencies - Frequencies of free vibration and normal coordinates – Two coupled pendulum - Vibrations of a linear tri-atomic molecule – Forced vibrations.	18
IV	**Kinematics of Rigid body :** Independent coordinates – Euler's angles – Components of Angular velocity in terms of Euler's angles – Angular momentum of a rigid body – Moments of inertia tensor – Rotational kinetic energy of a rigid body – Euler's equations of motion for rigid body.	18

V	**Relativity :** Inertial and non-inertial frames – Lorentz transformation equations – Length contraction and time dilation – Relativistic addition of velocities – Einstein's mass-energy relation – Minkowski space and Lorentz transformations – Four vectors – position, momentum and acceleration four vectors and their transformations.	18

Textbook:

1. Classical mechanics - H. Goldstein, C. P. Poole and J. Safko, (Pearson, New Delhi,2011).
2. Classical Mechanics - G. Aruldhas, (Prentice Hall of India, New Delhi, 2015)
3. Classical Mechanics - N.C. Rana and P.S. Joag, (Tata McGraw Hill, New Delhi, 2017).
4. Classical Mechanics - J.C. Upadhyaya, (Himalaya Publishing House, Bangalore, 2019).
5. Classical Mechanics - S.L. Gupta. V. Kumar and H.V. Sharma, (Pragati Prakashan, New Delhi, 2019).

References:

1. Classical Mechanics - T.L. Chow, (CRC, New York, 2013).
2. Mechanics - S. Dutta, (Pearson, New Delhi, 2012).
3. Classical Mechanics - B.D. Gupta and Satya Prakash, (Kedar Nath Ram NathPublishers, Meerut, 2020).
4. Classical Mechanics of Particles and Rigid Bodies – K.C. Gupta, (New AgeInternational Publishers, New Delhi, 2018).
5. Introduction to Classical Mechanics - R.G. Takwale and P.S. Puranik, (Tata McGrawHill, New Delhi, 2017).

Web resources:

1. https://ocw.mit.edu/courses/8-01sc-classical-mechanics-fall-2016/
2. https://nptel.ac.in/courses/115106123
3. https://www.classcentral.com/course/swayam-introduction-to-classical-mechanics-19905

Pedagogy: Teaching / Learning methods

• Lecture	• Tutorial	• Assignment	• Quiz
• PPT Presentation	• Group Discussion	• e-content Seminar	

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Acquire knowledge in basic formalism and geometrical aspects of classical mechanics.	K2
CO2	Solve problems involving Lagrangian and Hamiltonian formulations.	K4
CO3	Get better understanding on small oscillations and rigid body dynamics.	K2, K4
CO4	Understand the concepts of relativity.	K2, K3
CO5	Use classical concepts to solve quantitative problems in Applied Physics.	K3

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	2	2	1	1	1
CO2	3	1	1	3	2	1	2
CO3	3	1	2	2	1	1	1
CO4	3	1	2	1	1	1	1
CO5	3	1	2	2	1	1	1

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1PHC2**	**MATHEMATICAL PHYSICS**	**6**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	√
Entrepreneurship Oriented		Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability	√		
Addresses Human Values			
Addresses Professional Ethics			

CourseObjectives

Themainobjectives ofthis courseare:

1. To develop knowledge in mathematical physics and its applications.
2. To develop expertise in mathematical techniques required in physics.
3. To develop knowledge in mathematical physics and its applications.
4. To enhance problem solving skills.
5. To enables students to formulate, interpret and draw inferences from mathematical solutions.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Vector Analysis and Linear Vector Spaces** Concept of gradient,divergence and curl-Gauss's divergence theorem,Greens theorem and stokes theorem(statement and proof) –Basic concepts – Definitions- examples of vector space – Linear independence - Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure.	18
II	**Complex analysis** Review of Complex Numbers -De Moivre's theorem-Functions of a Complex Variable- Differentiability -Analytic functions- Harmonic Functions- Complex Integration- Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion- Zeros and poles – Residue theorem and its Application: Potential theory - Electrostatic fields and complex potentials - Parallel plates, coaxial cylinders	18
III	**Matrices** Matrices and their properties, Rank of a Matrix –Conjugate of a matrix- Adjoint of a matrix –inverseof matrix – Trace of a matrix – Transformation of matrices - Characteristic equation - Eigen values and eigen vectors - Theorems on Matrices; Reduction of a matrix to diagonal	18

	form (Diagonalisation) - Hermitian and unitary matrices – Cayley - Hamilton's theorem; Problems.	
IV	**Fourier Transforms and Laplace transforms** Definitions -Fourier transform and its inverse - Transform of Gaussian function. Fourier transform of derivatives - Cosine and sine transforms - Convolution theorem. Application: Diffusion equation: Flow of heat in an infinite and in a semi - infinite medium. Laplace transform and its inverse - Transforms of derivatives and integrals – Differentiation and integration of transforms - Laplace equation: Potential problem in a semi - infinite strip.	18
V	**Differential Equations** Second order differential equation- Sturm-Liouville's theorem - Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations – Legendre polynomials - Generating function - Rodrigue formula – Orthogonality properties.	18
Self Study	Potential theory - Heat problems - Parallel plates and coaxial cylinders- Wave equation: Vibration of an infinite string and of a semi - infinite string.Dirac delta function- One dimensional Green's function and Reciprocity theorem -Sturm-Liouville's type equation in one dimension & their Green's function	18

Textbook:

1. Mathematical Physics, B.D. Gupta, Vikas Publishing House Pvt. Ltd.
2. Mathematical Physics, B.S. Rajput, 20th Edition, Pragati Prakashan.
3. Mathematical Physics, H.K. Dass and Rama Verma, S. Chand and Company Ltd, 2010
4. Matrices and Tensors in Physics, A.W. Joshi, Wiley Eastern Limited, 3rd Edition, 1995.
5. Mathematical physics, P.K. Chattopadhyay, Wiley East 1990

References:

1. Vector Analysis -Schaum's outline series
2 Applied mathematics for engineers and physicists (TMH, Singapore 1967)

Web resources:

1. https://www.pdfdrive.com/mathematical-physics-d12240074.html
2. https://www.astrosen.unam.mx/~aceves/Metodos/ebooks/riley_hobson_bence.pdf
3. https://books.google.com.bd/books?id=IzJdPqEn6VYC&printsec=frontcover#v=onepage&q&f=false

Pedagogy: Teaching / Learning methods

- Lecture
- Tutorial
- Assignment
- PPT presentation
- Quiz
- Group Discussion
- e-content Seminar

CourseOutcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	understand the applications of Vector and Vector space, matrix algebra	K1, K2
CO2	grasp the basic elements of complex, analysis, including the important integral theorems	K2, K3
CO3	determine the residues of a complex function and use the residue theorem to compute certain types of integrals	K3
CO4	practice formulating good questions andexplaining to others	K4
CO5	solve problems individually and collaboratively	K5

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	3	3	2	3
CO2	2	1	3	3	3	1	2
CO3	3	3	3	3	3	1	2
CO4	3	2	3	3	3	1	2
CO5	3	3	3	3	3	1	1

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1PHCP1**	**PRACTICAL - I**	**6**	**4**

Course Objectives

Themainobjectives ofthis courseareto:

1. To gain practical skills on general experiments in optics, solid state physics etc.
2. To gain knowledge on spectrometer based experiments (charge of electron, polarizability of liquids, Rydberg's constant)
3. To have an in depth knowledge on the conductivity of thin film samples.

List of Experiments – Any 10 Experiments

1. Determination of q, n. σ by forming Elliptical fringes.
2. Determination of q, n, σ by forming hyperbolic fringes.
3. Determination of Stefan's constant.
4. Hartmann's formula – Wavelength calculation.
5. Determination of Dielectric constant using Lecher wire.
6. Determination of e/m by magnetron method.
7. Determination of Polarizability of liquids using Spectrometer.
8. Determination of Charge of an electron by Spectrometer.
9. Identification of Prominent lines by Spectrum Photograph – Iron Arc Spectrum.
10. Identification of Prominent lines by Spectrum Photograph – Copper Arc Spectrum.
11. Ultrasonic diffraction – Velocity and Compressibility.
12. Determination of Rydberg's Constant using Spectrometer.
13. Determination of e/m by Thomson method.
14. Determination of Conductivity of thin film sample – four probe method.
15. Determination of wavelength – Laser diffraction through grating.

Course Outcomes

On completion of this course,

• Students acquire skills on carrying out general experiments in optics, solid state physics etc.
• Students can do Young's modulus experiment using elliptical and hyperbolic fringes.
• Students can determine the wavelength of prominent lines using spectrometer.
• Students can determine the conductivity of thin film samples.
• Students can determine the polarizability of liquids.

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	1	1	1	1
CO2	3	1	1	1	1	1	1
CO3	3	1	1	1	1	1	1
CO4	3	1	1	1	1	1	1
CO5	3	1	1	1	1	1	1

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1PHEL1A**	**Major Elective – I Linear and Digital ICs and Applications**	**4**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	√
Entrepreneurship Oriented		Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability			
Addresses Human Values			
Addresses Professional Ethics	√		

Course Objectives

The main objectives of this course are:

1. To introduce the basic building blocks of linear integrated circuits.
2. To teach the linear and non-linear applications of operational amplifiers.
3. To introduce the theory and applications of PLL.
4. To introduce the concepts of waveform generation and introduce one special function ICs. Exposure to digital IC‘s

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER** Introduction, Classification of IC‘s, basic information of Op-Amp 741 and its features, the ideal Operational amplifier, Op-Amp internal circuit and Op-Amp. Characteristics	12
II	**APPLICATIONS OF OP-AMP** LINEAR APPLICATIONS OF OP-AMP: Solution to simultaneous equations and differential equations, Instrumentation amplifiers, V to I and I to V converters. NON-LINEAR APPLICATIONS OF OP-AMP: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multivibrators, Triangular and Square waveform generators.	12
III	**ACTIVE FILTERS &TIMER AND PHASE LOCKED LOOPS** ACTIVE FILTERS: Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters, band pass, band reject and all pass filters. TIMER AND PHASE LOCKED LOOPS: Introduction to IC 555 timer, description of functional diagram, monostable and astable operations and	12

	applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage controlled oscillator (IC 566), low pass filter, monolithic PLL and applications of PLL	
IV	**VOLTAGE REGULATOR & D to A AND A to DCONVERTERS** VOLTAGE REGULATOR: Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator. D to A AND A to D CONVERTERS: Introduction, basic DAC techniques -weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters -parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC.	12
V	**CMOS LOGIC,COMBINATIONAL CIRCUITS USING TTL 74XX ICs&SEQUENTIAL CIRCUITS USING TTL 74XX ICs** CMOS LOGIC: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic. COMBINATIONAL CIRCUITS USING TTL 74XX ICs: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), SEQUENTIAL CIRCUITS USING TTL 74XX ICs: Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194),), 4- bit asynchronous binary counter (IC 7493).	12

Textbooks:

1. D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt. Ltd., New Delhi, India
2. Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, New Delhi.
3. B.L. Theraja and A.K. Theraja, 2004, A Textbook of Electrical technology, S. Chand & Co.
4. V.K. Mehta and Rohit Mehta, 2008, Principles of Electronics, S. Chand & Co, 12th Edition.
5. V. Vijayendran, 2008, Introduction to Integrated electronics (Digital & Analog), S. Viswanathan Printers & Publishers Private Ltd, Reprint.

ReferenceBooks

1. Sergio Franco (1997), Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi.
2. Gray, Meyer (1995), Analysis and Design of Analog Integrated Circuits, Wiley International, New Delhi.
3. Malvino and Leach (2005), Digital Principles and Applications 5th Edition, Tata McGraw Hill, New Delhi
4. Floyd, Jain (2009), Digital Fundamentals, 8th edition, Pearson Education, New Delhi.
5. Integrated Electronics, Millman &Halkias, Tata McGraw Hill, 17th Reprint (2000)

WEB SOURCES

1. https://nptel.ac.in/course.html/digital circuits/
2. https://nptel.ac.in/course.html/electronics/operational amplifier/
3. https://www.allaboutcircuits.com/textbook/semiconductors/chpt-7/field-effect-controlled-thyristors/
4. https://www.electrical4u.com/applications-of-op-amp/
5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

Pedagogy: Teaching / Learning methods

- Lecture
- Tutorial
- Assignment
- PPT presentation
- Quiz
- Group Discussion
- e-content Seminar

Course Outcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems	K1, K5
CO2	Develop skills to design linear and non-linear applications circuits using Op-Amp and design the active filters circuits.	**K3**
CO3	Gain knowledge about PLL, and develop the skills to design the simple circuits using IC 555 timer and can solve problems related to it.	**K1, K3**
CO4	Learn about various techniques to develop A/D and D/A converters.	**K2**
CO5	Acquire the knowledge about the CMOS logic, combinational and sequential circuits	**K1, K4**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	3	3	2	3
CO2	2	1	3	3	3	1	2
CO3	3	3	3	3	3	1	2
CO4	3	2	3	3	3	1	2
CO5	3	3	3	3	3	1	1

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1PHEL1B**	**Major Elective – I Biophysics**	**4**	**3**

Nature of the course

Employability Oriented		Relevant to Local need	√
Entrepreneurship Oriented		Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability	√		
Addresses Human Values			
Addresses Professional Ethics			

Course Objectives

The main objectives of this course are:

1. To understand the physical principles involved in cell function maintenance.
2. To understand the fundamentals of macromolecular structures involved in propagation of life.
3. To understand the biophysical function of membrane and neuron.
4. To understand various kinds of radiation and their effects on living system and to know the hazards posed by such radiations and the required precautions.
5. To understand the physical principles behind the various techniques available for interrogating biological macromolecules.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**CELLLULAR BIOPHYSICS** Architecture and Life Cycle of cells – Organelles of Prokaryotic and Eukaryotic cell – Cell size and shape – Fine structure of Prokaryotic and Eukaryotic cell organization – Compartment & assemblies membrane system – Extracellular matrix - Molecular mechanisms of Vesicular traffic - Electrical activities of cardiac and neuronal cells.	12
II	**MOLECULAR BIOPHYSICS** Macromolecular structure: Protein structure – amino acids, peptide bonds, primary, secondary, tertiary and quaternary structures of proteins Nucleic acid structure: nucleosides and nucleotides, RNA structure, DNA structure and conformation. Special Bio-macromolecules: Metalloproteins, nucleoproteins, ribozymes, chaperons and prions.	12

III	**MEMBRANE AND NEURO BIOPHYSICS** Models membranes - Biological membranes and dynamics – Membrane Capacitors – Transport across cell and organelle membranes – Ion channels. Nervous system: Organization of the nervous system –Membrane potential – Origins of membrane potential - Electrochemical potentials – Nernst equation – Goldman equation.	12
IV	**RADIATION BIOPHYSICS** X-Ray: Effects on bio-macromolecules – Gamma Radiation: Molecular effects of gamma radiation, Radiation effects on nucleic acids and membranes, Effects on cell and organelles – UV radiation: Effects on bio-macromolecules and proteins – Radiation hazards and protection – use of radiations in cancer.	12
V	**PHYSICAL METHODS IN BIOLOGY** Spectroscopy: UV-Visible absorption spectrophotometry – Optical Rotatory Dispersion (ORD) – Structure Determination: X-ray Crystallography, Electron spin resonance (ESR) and biological applications. Chromatography: Thin layer chromatography (TLC), Gas liquid chromatography (GLC) – Centrifugation: Differential centrifugation, density gradient centrifugation. Electrophoresis: Gel electrophoresis, polyacrylamide gel electrophoresis.	12

Text Book:

1. The cell: A molecular approach, Geoffrey M. Cooper, ASM Press, 2013.
2. Biophysics, Vasantha Pattabhi, N. Gautham, Narosa Publishing, 2009
3. Biophysics, P. S. Mishra VK Enterprises, 2010.
4. Biophysics, M. A Subramanian, MJP Publishers, 2005.
   Bioinstrumentation, L. Veerakumari, MJP Publishers, 2006

Reference Book:

1. Chemical Biophysics by Daniel A Beard (Cambridge University Press, 2008).
2. Essential cell biology by Bruce Albert et al (Garland Science)
3. Biophysics, W. Hoppe, W. Lohmann, H. Markl and H. Ziegler. Springer Verlag, Berlin (1983).
4. Membrane Biophysics by Mohammad Ashra fuzzaman, Jack A. Tuszynski, (Springer science & business media).
5. Biological spectroscopy by Iain D. Campbell, Raymond A. Dwek

Web Resources:

1. General Bio: http://www.biology.arizona.edu/DEFAULT.html
2. Spectroscopy: http://www.cis.rit.edu/htbooks/nmr/inside.htm
3. Electrophoresis: http://learn.genetics.utah.edu/content/labs/gel/
4. Online biophysics programs: http://mw.concord.org/modeler/
5. https://blanco.biomol.uci.edu/WWWResources.html

COURSE OUTCOMES:
At the end of the course, the student will be able to:

CO1	Understand the structural organization and function of living cells and should able to apply the cell signaling mechanism and its electrical activities.	K2, K3
CO2	Comprehension of the role of biomolecular conformation to function.	**K1**
CO3	Conceptual understanding of the function of biological membranes and also to understand the functioning of nervous system.	**K2, K5**
CO4	To know the effects of various radiations on living systems and how to prevent ill effects of radiations.	**K1, K5**
CO5	Analyze and interpret data from various techniques viz., spectroscopy, crystallography, chromatography etc.,	**K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	3	3	2	3
CO2	2	1	3	3	3	2	2
CO3	3	3	3	3	3	2	2
CO4	3	2	3	3	3	1	2
CO5	3	3	3	3	3	2	2

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1PHEL2A**	**Major Elective – II Crystal Growth and Thin Films**	**4**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	√
Entrepreneurship Oriented		Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability	√		
Addresses Human Values			
Addresses Professional Ethics			

Course Objectives

The main objectives of this course are:

1. To Provide the basic ideas of thin film technology and its applications
2. To introduce the knowledge of the different methods of crystal growth, knowledge about the growth method and itscharacterization.
3. To impart the idea about find the new materials for growth of crystals and thin films

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Fundamentals and Applications of thin films** Introduction–Advantagesofthinfilmdevicesovertheirbulkcounterparts – Thin film growth stages: Nucleation stage – Island stage – Coalescencestage – Channel, hole and continuous film stage – Properties of thin films: Sheet resistance – Porosity – Surface roughness – Adhesion – Applications of thin films: Thin film sin photovoltaic technologies–dyesensitized solar cells – Thin films in electronic devices – Thin films in disinfectant technologies –Optical coatings–Chemical and mechanical applications.	12
II	**Physical Deposition Methods** Basics of vacuum – Physical Vapour Deposition (PVD) – Thermalevaporation – Electron beam evaporation – Pulsed Laser Ablation – Molecular Beam Epitaxy –Hot Wall Epitaxy –Sputtering techniques-DC and RF sputtering – Ion plating – Ion-beam assisted deposition –Applications– Atomiclayer Deposition..	12

III	**Chemical deposition methods** Chemical methods – Electro deposition and electroless plating – Chemical bath deposition – Spray pyrolysis – Spin coating – Dip coating – SILAR –Electro spinning – Hydrothermal – Sol - gel synthesis – Slurry coatings –Screen printing – Langmuir - Blodgett film – Chemical vapor deposition (CVD)– Classification of techniques–Metalorganictype, plasmaassisted, laserassisted – Applications.	12
IV	**Materials Properties Measurement** Thickness of coatings, structural, micro structural, compositional, electrical and optical characterizations: Surface Profilometry – Multiple beaminterferometry (Fizeau method) Energy dispersive analysis of X-ray (EDAX) – Atomic force microscopy (AFM) – Four-point probe techniquefor sheet resistance measurement. Mechanical properties : adhesion, microandnanohardness, wear,roughness–Vickers hardnesstest – Determination of hardness coefficient – Thermo gravimetric analysis(TGA)– Differential thermal analysis(DTA)	12
V	**Crystal Growth Methods** Nucleation –types of nucleation -Classical theory of nucleation – Lowtemperature solution growth: solubility – Saturation – Supersaturation – Expression for super saturation – Miers T-C diagram – Slow coolingmethod – Slow evaporation method – Gel method – Chemical reactionmethod – single and double diffusion method - Advantages of gel method .Melt growth method: Bridgman technique – Czochralski technique –Verneuil method– Merits and demerits.	12

Textbook:

1. J.C.Brice,CrystalGrowthProcesses,JohnWileyandSons,NewYork(1986).
2. K.Ravichandran,K.Swaminathan,B.Sakthivel,Introduction toThin Films,Research IndiaPublications,NewDelhi(2013)- ISBN:978-93-841444-05-0.
3. R.F.Bunshah,"Hand book of deposition technologies for films and coatings, science, technologyandapplications",NewYorkNoyespublications,1994

References:

1. P. SanthanaRagavan and P. Ramasamy, Crystal Growth Processes and Methods,KRU Publications, Kumbakonam(2001)
2.Goswami, Thin Film Fundamentals, New Age International(P) Limited, NewDelhi (1996).
3. T.S.Sudarsan,"SurfaceModificationTechnologies",Editor:MarcelDekkerINC,1989.

Web resources:

1. https://www.thin-film.com
2. https://www.sciencedirect.com/journal/thin-solid-film
3. https://www.youtube.com/watch?v=aY1VxwIbr6E
4. https://www.youtube.com/watch?v=v7J8aJMJ1so

Pedagogy: Teaching / Learning methods

• Lecture	• Tutorial	• Assignment	• Quiz
• PPT Presentation	• Group Discussion	• e-content Seminar	

Course Outcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	Realize thenecessitygrowthofthin filmsand theirgrowthstages	K2
CO2	Designphysicaldepositionmethodandtheirprocesstocoatingthin films	K3, K4
CO3	Designchemicaldepositionmethodandtheirstepstocoatingthinfilms	K3, K4
CO4	Analysis thepropertiesofmaterials presentinthe thinfilmandgrowncrystals.	K2,K4
CO5	Apply the idea aboutthe growthofcrystalsbysuitable methods	K3,K4,

CognitiveLevel:K1-Remember;**K2-**Understanding;**K3-**Apply;**K4-**Analyze;
K5–Evaluate;**K6–**Create

Mapping of Course Out comes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3	2	2	3	2	2
CO2	3	2	3	3	3	2	2
CO3	3	3	3	3	3	2	2
CO4	2	2	3	3	3	2	2
CO5	2	3	3	3	3	2	2

3-StronglyCorrelated;2-ModeratelyCorrelated;1-WeaklyCorrelated; 0– No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1PHEL2B**	**Major Elective – II MEDICAL PHYSICS**	**4**	**3**

Nature of the course

Employability Oriented	✓	Relevant to Local need	✓
Entrepreneurship Oriented		Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

The main objectives of this course are to:

1. To gain the knowledge about the applications of electricity and magnetism in medicine.
2. To understand the role of lasers in medicine.
3. To understand the radioactive sources for medicine.
4. To be aware on the biological effects of ionizing radiation.

SYLLABUS

Unit	Content	No. of Hours
I	**Terminology, Modeling and Measurement** Terminology, Modeling and Measurement – Applications of Electricity and Magnetism in Medicine – Electrical Shock, High frequency Electricity in Medicine – Low – frequency Electricity and Magnetism in Medicine.	12
II	**Light in Medicine** Measurement of light and its units, Application of visible light in Medicine, Applications of Ultraviolet and Infrared light in Medicine, Lasers in Medicine – Physics of diagnostic X Rays – Making an X-ray image – Radiation to patient from X-rays – Producing live X- ray images – Fluoroscopy.	12
III	**Radio isotopes in Medicine (Nuclear Medicine)** Sources of Radioactivity for Nuclear Medicine – Basic Instrumentation and its clinical applications – Nuclear Medicine imaging devices – Therapy with radioactivity – Radiation doses in Nuclear Medicines.	12
IV	**Radiation Protection in Medicine** Biological effects of ionizing radiation – Radiation protection in Diagnostic Radiology – Radiation protection in Radiation therapy – Radiation protection in Nuclear Medicine – Radiation Accidents.	12
V	**Computers in Medicine** History taking – Laboratory Automation – Electrocardiogram interpretation – Patient monitoring– Drug-test interactions – prescribing drug dosage – Pulmonary function testing – Medical record systems –	12

	Hospitals book keeping – Other uses of computers in medicine.	

Text books:

1. Medical Physics: by John R. Cameron & James G. Skofronick, A Wiley – Interscience Publication, John Wiley & Sons.
2. R. F. Mold, Radiation Protection in Hospitals, Adam Hilger Ltd., Bristol, 1985.
3. K.N.Govindarajan Advanced Medical Radiation dosimetry, Prentice-Hall of India Pvt.Ltd, 2004

Reference Books:

1. W. H. Blahd, Nuclear Medicine, McGraw Hill Co., New Delhi, 2002.
2. W. N. Wagner, Principles of Nuclear Medicine, W. B. Saunders Co., London, 1990.
3. Marie Claire. Cantone, Christoph. Hoeschen, Radiation Physics for Nuclear Medicine, Springer, 2010.
4. R. F. Mould, Radiotherapy Treatment Planning, Medical Physics Hand Book Series No. 7, Adam Hilger Ltd., Bristol, 1981.

Web resources:

1. https://aapm.onlinelibrary.wiley.com/journal/24734209
2. https://www.efomp.org/index.php?r=pages&id=public.
3. https://www.news-medical.net/health/The-Role-of-Physics-in-Medicine.aspx.

Pedagogy: Teaching / Learning methods

• Lecture	• Tutorial	• Assignment	• PPT Presentation
• Quiz	• Group Discussion	• e-content Seminar	

Course Outcomes

On completion of this course, students will

CO Number	CO Statement	Cognitive Level
CO1	Be aware on the applications electricity and magnetism in medicine.	K1, K2, K3
CO2	Gain knowledge on the role of lasers in medicine.	K2, K3
CO3	Acquire knowledge on the role of radioactivity in medicine.	K2, K3
CO4	Be equipped to tackle radiation accidents.	K3, K4
CO5	Equip themselves to use computers in medicine.	K4, K5

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	2	2	3	3	3
CO2	3	3	2	2	3	2	2
CO3	2	2	2	2	3	1	1
CO4	3	1	1	1	2	1	2
CO5	3	3	2	2	3	3	3

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1PHSEC1**	**Skill Enhancement Course – Energy Physics**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√
Entrepreneurship Oriented	√	Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability	√		
Addresses Human Values			
Addresses Professional Ethics			

Course Objectives

The main objectives of this course are:

1. To know where all physics principles have been put to use in daily life.
2. To get knowledge on solar energy.
3. To understand the concepts of Indian scientists who have made significant contributions to Physics

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**INTRODUCTION TO ENERGY SOURCES: E**nergy consumption as a measure of prosperity– energy sources and their availability – conventional energy sources – non-conventional and renewable energy sources – comparison – merits and demerits. **SOLAR ENERGY:**Solar energy Introduction – solar constant – solar radiation at the Earth's surface – Solar radiation measurements – solar energy storage and storage systems – solar pond – solar cooker – solar water heater – solar greenhouse – solar cells.	15
II	**SOLAR ENERGY CONVERSION** :Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo - electric conversion - process flow of silicon solar cells- different approaches on the process- texturization, diffusion, Antireflective coatings, metallization.	15

Books for Study

1. G.D.Rai, Non-Conventional Sources of Energy, Khanna Publishers, 2009, 4thEdn.
2. S P Sukhstme, J K Nayak, Solar Energy, Principles of Thermal Collection and Storage, McGraw Hill, 2008, 3rdEdn.
3. D P Kothari, K P Singal, RakeshRajan, PHI Learning Pvt Ltd, 2011, 2ndEdn.

Books for Reference

1. John Twidell& Tony Weir, Renewable Energy Resources, Taylor & Francis, 2005, 2nd Edn.
2. S.A. Abbasi and NasemaAbbasi, Renewable Energy sources and their environmental impact, PHI Learning Pvt. Ltd, 2008.
3. M. P. Agarwal, Solar Energy, S. Chand & Co. Ltd., New Delhi,1982

Pedagogy: Teaching / Learning methods

• Lecture	• Tutorial	• Assignment	• PPT Presentation
• Quiz	• Group Discussion	• e-content Seminar	

CourseOutcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	Get knowledge on the energy conservation and solar energy	K2, K3, K6
CO2	Acquire knowledge on wind energy and biomass energy	K1, K2, K3,

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3	1	3	3	1	3
CO2	2	3	1	3	3	1	3

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1PHAECC1**	**Ability Enhancement Compulsory Course - Communicative Skill And Personality Development**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need	√	Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need	√	Addresses Human Values	√
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. Cultivate positive personality traits for successful life.
2. Groom Winning Attitude among the learners.
3. Assist the learners to identify their own potential and realize their aspirations.
4. Enable a holistic development.
5. Facilitate optimum means of improving personal performance.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	1. Personality- Definition. 2. Determinants of Personality. 3. Perceptual Process. 4. Personality Traits. 5. Developing Effective Habits. 6. Self Esteem (Freud and Erikson). 7. Self Appraisal and Self Development. 8. Dos and Don'ts to develop positive self esteem. 9. Interpersonal Relationship. 10. Difference between Aggressive, Submissive and Assertive behaviour. 11. Mind Mapping, Competency Mapping, 360 degree assessment. **12.** Presentation Skills – Opening, ending, Handling nerves, Handling audience, Power Storytelling, Visual aids, Question and answer session	15
II	1. Projecting Positive Body Language. 2. Conflict Management. 3. Change Management.	15

	4. Stress Management. 5. Time Management. 6. Goal Setting. 7. Assertiveness and Negotiating Skill. 8. Problem Solving Skill. 9. Decision Making Skills. 10. Leadership Qualities of a Successful Leader. 11. Attitudes – Positive Attitudes. 12. Public Speaking – Engaging, Connecting, and Influencing the audiences. 13. Employability Skill – Group Discussion, Interview Questions, Psychometric analysis.	

Textbook:

1. Andrews, Sudhir. *How to Succeed at Interviews*. 21st (rep) New Delhi:Tata McGrew Hill 1988.
2. Hurlock.E.B (2006) :*Personality Development*, 28th Reprint. New Delhi: Tata McCraw Hill.
3. Kumar, Pravesh.*All about Self Motivation*. New Delhi:Goodwill Publication House. 2005**.**
4. Preston,David Lawrence.*365 Steps to Self-Confidence*. Mumbai: Jaico Publishers, 2007
5. Stephen.P.Robbins and Timothy. A.Judge: *Organisation Behaviour.*16thEdition.Prentice Hall. 2014

References:

1. Grellet ,Françoise. *Developing Reading Skills*. Cambridge: Cambridge University Press, 2007.
2. Kristine, Brown and Susan Hood.*Academic Encounters Life in Society Reading, Study Skills, Writing*. , New Delhi:Cambridge University Press,2010.
3. Little ,Graham R .*Operations Team Leadership*. Mumbai :Jaico Publishers, 2006.
4. Nurnberg ,Maxwell and Morris Rosenblum *How to Build a Better Vocabulary*. New York :Warner Books, 1989.
5. O' Connell ,Sue with LousieHashemi.*Cambridge First Certificate: Listening and Speaking* –, Cambridge University Press, Cambridge, 2000.
6. Pfeifer , William Sanborn and T.V.S.Padmaja*Technical Communication : A Practical Approach,* (Sixth edition) New Delhi: Pearson, 2006.
7. Withrow, Jean, Gay Brookers and Martha Cumings .*Inspired to Write*. New York: Cambridge University Press, 2004.

Web resources:

https://www.managementstudyguide.com/personality-development.htm
https://www.artofliving.org/in-en/personality-development
https://study.com/academy/lesson/what-is-conflict-management-definition-styles-strategies.html
https://www.hays.com.au/career-advice/upskilling/soft-skills
https://www.skillsyouneed.com/presentation-skills.html

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Group Discussion, e-content, Seminar, Tasks, Role play, Debate, Group Activities etc.

Course Out comes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	understand the significance of developing progressive and positive personality	**K1,K2**
CO2	Gain self-confidence and broaden perception of life.	**K3**
CO3	Maximize their potential and steer that into their career choice.	**K4**
CO4	Enhance one's self image and self-esteem.	**K3, K5**
CO5	Find a means to achieve excellence and derive fulfillment.	**K6**

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated;0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2PHC3**	**Electromagnetic Theory**	**6**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	✓
Entrepreneurship Oriented		Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

Themainobjectives ofthis courseareto:

1.To acquire the knowledge in Electrostatics.
2. To gain the knowledge in Magnetostatics.
3. To develop skills on solving analytical problems related with Maxwell's equations.
4. To introduce the concepts of propagation of electromagnetic waves.
5. To introduce the knowledge about relativistic electrodynamics.

SYLLABUS

Unit	Content	No. of Hours
I	**Electrostatics** Gauss law –Divergence of E – Curl of E – Scalar potential – Multipole expansion of electric field –Poisson's and Laplace's equation – Laplace's equation in three dimensions – Uniqueness theorem – Green's theorem – Boundary value problem – Formalsolution of electrostatic field – Dielectrics – Molecular polarizability and electrical susceptibility – Electrostatic energy in the presence ofdielectrics.	18
II	**Magnetostatics** Lorentz force – Biot-Savart's law – Application tostraight conductor and solenoid – Ampere's circuital law – Magnetic vector potential – Magnetic scalar potential –Multipole expansionof the vector potential – Magnetization – Magnetic moment – Force and torque on a current distribution in an external field – Boundary conditions – Magnetized sphere.	18
III	**Maxwell's Equations** Electromagnetic induction – Faraday's law – Equation of continuity – Displacement current – Derivation of Maxwell's electromagnetic equations – Gauge invariance – Wave equation and plane wave solution – Lorentz and coulomb's gauges – Poynting's theorem – Lorentz force law in potential form.	18

IV	**Wave Propagation** The wave equation for E and B – Plane waves in non-conducting media – Linear and circular polarization, reflection and refraction at a plane interface – Waves in conducting medium — Wave guides – Propagation of waves in a rectangularwave guide – Inhomogeneous wave equation and retarded potentials – Radiation from a localized source – Oscillating electric dipole.	18
V	**Relativistic Electrodynamics** Lorentz transformation for space and time in four vector form – Invariance of D'Alembertian operator – Invariance of Maxwell's field equations in terms of four vectors –Electromagnetic field tensors – Maxwell's equations in co-variance four tensors form –Lorentz transformation of electromagnetic fields – Invariance of electromagnetic field.	18
	Elementary Plasma Physics The Boltzmann equation – Electron Plasma oscillations – Magneto-hydrodynamic waves – Alfven waves and magnetosonic waves.	Self-Study

Textbook:

1. Introduction to Electrodynamics – David J. Griffiths, (Pearson, New York, 2013).
2. Introduction to Electromagnetic Theory – K.L. Chopra and G.C. Agarwal, (Kedarnath and Ramnath, Meerut, 2010).
3. Electromagnetic Theory and Electrodynamics – Sathyaprakash, (Kedarnath and Ramnath, New Delhi, 2016).
4. Electrodynamics – S.L. Gupta, V. Kumar and S.P. Singh, (Pragati Prakashan Publishers, Meerut, 2023).
5. Electromagnetic waves and Radiating fields – Jordon and Balmain, (Krieger publishing company, 2003).

References:

1. Classical Electrodynamics – J. D. Jackson, (Wiley Eastern publishing ltd, New York,2021).
2. Introduction to Electromagnetic fields and Waves – P. Lorrain, D.R. Corson and F.Lorrain, (W. H. Freeman and company, New York, 1998).
3. Electromagnetics – B.B. Laud, (New Age International Publishers, New Delhi, 2011).
4. Electromagnetic Theory and Applications - A.K. Saxena, (Narosa, New Delhi, 2013).
5. Foundations of Electromagnetic Theory – J.R. Reitz, F.J. Milford and R.W. Christy, (Pearson, New Delhi, 2010).

Web resources:

1. https://onlinecourses.nptel.ac.in/noc21_ee83/preview
2. https://www.classcentral.com/course/swayam-electromagnetic-theory-5223
3. https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/

Pedagogy: Teaching / Learning methods

• Lecture	• Tutorial	• Assignment	• Quiz
• PPT Presentation	• Group Discussion	• e-content seminar	

CourseOutcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Develop their problem-solving skills on electrostatics.	K1
CO2	Understand the concepts of magnetostatics.	K1
CO3	Acknowledge the applications of Maxwell's equations.	K2, K3
CO4	Gain knowledge on electromagnetic waves.	K2
CO5	Gain knowledge in relativistic electrodynamics.	K2

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1	3	1	2	1	1	1	1
CO2	3	1	2	1	1	1	1
CO3	3	1	2	1	1	1	1
CO4	3	1	2	1	1	1	1
CO5	3	1	2	1	1	1	1

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2PHC4**	**Numerical Methods and Computer Programming**	**6**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	√
Entrepreneurship Oriented		Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability	√		
Addresses Human Values			
Addresses Professional Ethics			

Course Objectives

Themainobjectives ofthis courseare:

1. To introduce the basic concepts of solving algebraic and transcendental equations.
2. To introduce the numerical techniques of interpolation in various intervals in real lifesituation.
3. To acquaint the student with understanding of numerical techniques of differentiation.
4. To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
5. To understand the knowledge of various techniques and methods of solving interpolation

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Errors and Curve fitting** Errors and their computations – General formula for errors – Errors of observation and measurement – Round of errors and Computer Arithmetic – Empirical formula – Method of group averages and problems –Principle of least squares and problems– Least square fitting – Straight line–Parabola, exponential curve	18
II	**Numeric Solutions of Algebraic and Linear system of Equations** The iteration method – The bisection method – The method of false position –Newton - Raphson method. Simultaneous Linear algebraic equations: Direct methods– Gauss elimination method – Gauss – Jordan method – Iterative method – jacobi's method – Gauss seidel iterative method-C Program for Newton Raphson method.	18
III	**Interpolation** Finite differences – Interpolation – Gregory – Newton forward and backward interpolationformula – central differences – Gauss's forward and backward interpolation formula – Stirling's formula – Divided differences – Newton's	18

	divided difference formula – Lagrange's interpolation formula – inverse interpolation-C Program for Lagrange's interpolation formula**.**	
IV	**Numerical differentiation, Integration.** Introduction – Numerical differentiation – Errors in numerical differentiation – Maximum and Minimum values of a tabulated function – Numerical integration –Trapezoidal rule - Simpson's rule – Extended Simpson's rule – Romberg integration. C-Program for Trpezoidal and Simpson's formula**.**	18
V	**Solution of ordinary differential equations** Solution by Taylor's series – Picard's method of successive approximation – Euler's method –Modified Euler's method – Runge Kutta method – Second and fourth order. C-Program for Euler's method, Runge Kutta method for Second and Fourth order.	18
Self study	Flow-chart-Executable and non executable statements-C program for Newton's forward and backward interpolation.	

Textbooks:

1. Introductory methods of Numerical Analysis – S.S. Sastry, IVEd, PHI learning pvt ltd, 2006
2. Unit I – IV – Numerical methods in Science and Engineering - G. Venkatraman, NationalPublishing Co., Chennai, 2001
3. V.Rajaraman, 1993, Computer oriented Numerical Methods,3rd Edition. PHI, NewDelhi
4. Numerical Methods -Maccormic, Prentice Hall

Reference Books:

1. Numerical Methods for Scientific and Engineering Computation – M.K. Jain, S.R.K. Iyengar,R.K.Jain, New age international, New Delhi, 1983.
2. Numerical Methods – P. Kandasamy, K. Thilagavathi and Gunavathy S. Chand & Co,

Web resources:

1.www.pdfdrive.com/introductory-methods-of-numerical-analysis-by-ss-sastry-e148704487.html

1. https://blasingame.engr.tamu.edu/z_zCourse_Archive/P620_14C/P620_14C_zReference/PDF_Txt_Hnbk_Num_Meth.pdf

Pedagogy: Teaching / Learning methods

- Lecture
- Tutorial
- Assignment
- PPT presentation
- Quiz
- Group Discussion
- e-content Seminar

Course Outcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	Remember the concepts of errors and its effect on computation.	K1, K2
CO2	Students acquire knowledge and problem-solving skillsintranscendentalequations,numericalintegration,differentiationandinterpolation.	K2, K3
CO3	Apply the finite difference and interpolation concepts.	K3
CO4	Analyze the efficiency of iteration methods.	K4
CO5	Solve problems individually.	K5

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	3	3	2	3
CO2	2	3	3	3	3	3	2
CO3	3	3	3	3	3	3	2
CO4	3	2	3	3	3	2	2
CO5	3	3	3	3	3	2	3

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2PHCP2**	**Practical II**	**6**	**4**

Course Objectives

The main objectives of this course are to:

1. To gain practical skills on analog electronics.
2. To gain knowledge on digital electronic experiments.
3. To have an in depth knowledge on linear integrated circuits.

List of Experiments – Any10 Experiments

1. Characteristics of JFET
2. FET Amplifier
3. Phase – shift oscillator
4. Characteristics of UJT
5. Relaxation oscillator – UJT
6. Operational Amplifier- applications (inverting, Non inverting, unit gain and closed loop gain)
7. Operational Amplifier – Summing and Difference amplifiers
8. Operational Amplifier – Differentiating and integrating circuits
9. Solving linear equations using Op- amp.
10. Dual Power Supply- construction
11. 4-bit Parallel Binary Adder.
12. Feedback amplifier
13. Half adder and full adder
14. Half subtractor and full subtractor
15. 555 Timer – Monostable multivibrator.

Course Outcomes

On completion of this course

- Students acquire skills in doing experiments in analog electronic experiments.
- Students have skills in designing digital electronic circuits.
- Students can do experiments using operational amplifiers.
- Students have the ability to solve simultaneous linear equations using Opamp.
- Students will be able to handle passive and active components effectively on doing the experiments.

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	1	1	1	1
CO2	3	1	1	1	1	1	1
CO3	3	1	1	1	1	1	1
CO4	3	1	1	1	1	1	1
CO5	3	1	1	1	1	1	1

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2PHEL3A**	**Major Elective – III Physics of Nanoscience and Technology**	**4**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	√
Entrepreneurship Oriented		Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability	√		
Addresses Human Values			
Addresses Professional Ethics			

Course Objectives

The main objectives of this course are:

1. Physics of Nanoscience and Technology is concerned with the study, creation, manipulation and applications at nanometer scale.
2. To provide the basic knowledge about nanoscience and technology.
3. To learn the structures and properties of nanomaterials.
4. To acquire the knowledge about synthesis methods and characterization techniques and its applications.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Background and emergence of Nanotechnology** Nanotechnology –Emergence of nanotechnology – Nanomaterials – Classification of nanomaterials based on composition, number of dimensions in nanoscale and morphology – Characteristics of nanomaterials – Surface to volume ratio – Its effect on properties of nanomaterials – Nanoparticles – Nanoclusters – Nanocomposites – Nanohybrids – An overview on the applications of nanomaterials.	12
II	**Quantum dots and Carbon nanotubes** Quantum dots (QDs) – Quantum confinement –Production and applications of QDs –Quantum wires – Quantum wells – Carbon allotropes – Discovery of C_{60} – Fullerenes – Types of fullerenes – Bucky balls – Carbon nanotubes (CNTs) – Single walled CNTs – Multiwalled CNTs – Properties of CNTs –Synthesis of CNTs –Plasma-arc discharge method – Laser ablation technique – Chemical vapour deposition method – Potential applications of CNTs.	12
III	**Preparation of nanomaterials** Nanomaterials – Preparation– Top-down method – Ball milling– Photolithography– Electron beam lithography – Molecular beam epitaxy –	12

	Bottom-up technique – Soft-chemical method – Sol-gel synthesis – Electro chemical deposition – Atomic layer deposition- Molecular self assembly– Langmuir-Blodgett film (2D nanostructure) preparation.	
IV	**Analytical techniques for nanomaterials characterization** Structural characterization – Principle of X-ray powder diffraction – Determination of structural parameters – Optical studies – UV-Vis-NIR spectrometry – Band gap determination by Tauc's plot method – FTIR spectroscopy –Surface morphological analysis– Scanning electron microscopy (SEM) – Scanning tunnelling microscope (STM)– Transmission Electron Microscope (TEM)–Photoluminescence spectroscopy –X-ray photoelectron spectroscopy (XPS).	12
V	**Applications of nanomaterials** Nanoelectronics – Molecular diodes and transistors – Quantum electronic devices –Nanophotonics –Photonic crystals –Nanoelectromechanical systems (NEMS) –Nanomaterials in energy conversion and storage – Nanomaterials as antibacterial agents – Nanomaterials as photocatalysts –Energy efficient windows – Nanomaterial in industrial applications – Bio-medical applications : Targeted drug delivery –Nanomaterial based radiation therapy – Photodynamic therapy (PDT) – Tissue engineering – Bioimaging.	12

Textbooks:

1. K. Ravichandran, K. Swaminathan, P. K. Praseetha, P. Kavitha 'Introduction to nanotechnology', Jazym Publications, Tiruchirappalli.
2. Essentials of Nanotechnology, Preedep.
3. Nanostructures and Nanomaterials, synthesis, properties and applications, Imperial college press, London.
4. Nanoscience and nanotechnology K.P.Mathur, 1stEdition 2007, RajatPublications, NewDelhi

Reference Books:

1. M. Ratner, Nanotechnology; A Gentle introduction, Prentice – Hall ISBN 0-13-101400-5, 2003.
2. Nanotechnology; Basic Science and Emergining Technologies, CRC Press
3. Charles P.Poole Jr and Frank J. Owens. "Introduction to Nanotechnology" Wiley, 2003.
4. A.S.Edelstein and R.C. Cornmarata, Nanomaterials; synthesis, Properties and Applications, 2 Ed, Iop (U.K), 1996.

Web resources:

1. www.its.caltec.edu/feyman/plenty.html
2. http://www.library.ualberta.ca/subject/nanoscience/guide/index.cfm
3. http://www.understandingnano.com
4. http://www.nano.gov
5. http://www.nanotechnology.com

Pedagogy: Teaching / Learning methods

- Lecture
- Tutorial
- Assignment
- PPT presentation
- Quiz
- Group Discussion
- e-content Seminar

Course Outcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	Understand the basic of nanoscience and explore the different types of nanomaterials and should comprehend the surface effects of the nanomaterials.	K1, K2
CO2	Explore various physical, mechanical, optical, electrical and magnetic properties nanomaterials.	K2, K3
CO3	Understand the process and mechanism of synthesis and fabrication of nanomaterials.	K3
CO4	Analyze the various characterization of Nano-products through diffraction, spectroscopic, microscopic and other techniques.	K2,K4
CO5	Apply the concepts of nanoscience and technology in medical field	K2, K5

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	3	3	2	3
CO2	2	3	3	3	3	3	2
CO3	3	3	3	3	3	3	2
CO4	3	2	3	3	3	2	2
CO5	3	3	3	3	3	2	3

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2PHEL3B**	**Major Elective – III Non-linear Dynamics**	**4**	**3**

Nature of the course

EmployabilityOriented		Relevant to Local need	✓
Entrepreneurship Oriented		Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

Themainobjectives ofthis courseareto:

1. To school the students about the analytical and numerical techniques of nonlinear dynamics.
2. To make the students understand the concepts of various coherent structures.
2. To train the students on bifurcations and onset of chaos.
3. To educate the students about the theory of chaos and its characterization.
4. To make the students aware of the applications of solitons, chaos and fractals.

SYLLABUS

Unit	Content	No. of Hours
I	**GENERAL :** Linear waves-ordinary differential equations(ODEs)-Partial differential equations(PDEs)- Methods to solve ODEs and PDEs-Numerical methods – Linear and Nonlinear Oscillators-Nonlinear Waves-Qualitative features	12
II	**COHERENT STRUCTURES :** Linear and Nonlinear dispersive waves - Solitons – KdV equation – Basic theory of KdV equation –Ubiquitous soliton equations – AKNS Method, Backlund transformation, Hirotabilinearization method, Painleve analysis - Perturbation methods-Solitons in Optical fibres - Applications.	12
III	**BIFURCATIONS AND ONSET OF CHAOS :** One dimensional flows – Two dimensional flows – Phase plane – Limit cycles – Simple bifurcations – Discrete Dinamical system – Strange attractors – Routes to chaos.	12
IV	**CHAOS IN NONLINEAR ELECTRONIC CIRCUITS:** Linear and Nonlinear circuit elements – Resonant RLC circuit – Chua's diode – Practical implementation of Chua's diode – Bifurcations and chaos.	12
V	**APPLICATIONS :** Soliton based communication systems – Solition based computation – Synchronization of chaos – Chaos based communication – Cryptography – Image processing – Stochastic –	12

	Resonance – Chaos based computation – Time Series analysis.	

Textbooks:

1. 1. M. Lakshmanan and S. Rajasekar, Nonlinear Dynamics: Integrability, Chaos and Patterns. Springer, 2003.
2. A. Hasegawa and Y. Kodama, Solitons in Optical Communications. Oxford Press, 1995.
3. Drazin, P. G. Nonlinear Systems. Cambridge University Press, 2012. ISBN: 9781139172455.
4. Wiggins, S. Introduction to Applied Nonlinear Dynamical Systems and Chaos. Springer, 2003. ISBN: 9780387001777.
5. Strogatz, Steven H. Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering. Westview Press, 2014. ISBN: 9780813349107.

References:

1. G. Drazin and R. S. Johnson. Solitons: An Introduction. Cambridge University Press, 1989.
2. M. Lakshmanan and K. Murali. Chaos in Nonlinear Oscillators. World Scientific, 1989.
3. S. Strogatz**.** Nonlinear Dynamics and Chaos. Addison Wesley, 1995.
4. Hao Bai-Lin, Chaos (World Scientidic, Singapore, 1984).
5. Kahn, P. B., Mathematical Methods for Scientists & Engineers (Wiley, NY, 1990).

Web Resources:

1. 1. https://www.digimat.in/nptel/courses/video/108106135/L06.html
2. http://digimat.in/nptel/courses/video/115105124/L01.html
3. https://www.digimat.in/nptel/courses/video/108106135/L01.html
4. http://complex.gmu.edu/neural/index.html
5. https://cnls.lanl.gov/External/Kac.php

Pedagogy: Teaching / Learning methods

• Lecture	• Tutorial	• Assignment	• Quiz
• PPT Presentation	• Group Discussion	• e-content seminar	

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Gain knowledge about the available analytical and numerical methods to solve various nonlinear systems.	K1, K4
CO2	Understand the concepts of different types of coherent structures and their importance in science and technology.	**K2**
CO3	Learn about simple and complex bifurcations and the routes to chaos	**K1, K2**
CO4	Acquire knowledge about various oscillators, characterization of chaos and fractals.	**K1**
CO5	Analyze and evaluate the applications of solutions in telecommunication, applications of chaos in cryptography, computations and that of fractals.	**K3, K5**

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	1	1	1	1
CO2	3	1	2	1	1	1	1
CO3	3	1	2	1	1	1	1
CO4	3	1	2	1	1	1	1
CO5	3	1	2	1	1	1	1

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2PHEL4A**	**Major Elective – IV Microprocessor 8086 and Microcontroller 8051**	**4**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	
Entrepreneurship Oriented	√	Relevant to regional need	
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	
Addresses Gender Sensitization		Addresses Professional Ethics	
Addresses Environment and Sustainability			
Addresses Human Values	√		

Course Objectives

Themainobjectives ofthis courseareto:

1. To introduce students with the architecture, operation and read write instruction of typical microprocessors
2. To provide the knowledge of interfacing of 8085 with I/O devices and to create solutions for real time application.
3. To provide insight into architectural details and various register function of microcontroller.
4. To understand basic instruction set and to develop a ALP using 8051 microcontroller.
5. To provide the knowledge of interfacing of 8051 microcontroller with real time application.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**8085 PROGRAMMING, PERIPHERAL DEVICES AND THEIR INTERFACING** Instruction set - Addressing modes - Data transfer schemes - Interrupts of 8085 - Programmable peripheral interface (PPI) - Control group and control word- Programmable DMA controller - Programmable interrupt controller – Programmable communication interface - Programmable counter /interval timer	12
II	**8085 INTERFACING APPLICATIONS** Seven segment display interface - Interfacing of Digital to Analog converter and Analog to Digital converter - Measurement of electrical quantities –Voltage and current -Measurement of physical quantities Temperature.	12
III	**8051 MICROCONTROLLER HARDWARE** Introduction – Features of 8051 – 8051 Microcontroller Hardware: Pin-out 8051, Central Processing Unit, Internal RAM, Internal ROM, Register set	12

	of 8051 – Memory organization of 8051 – Input/ Output pins– External data memory and program memory: External program memory, External data memory.	
IV	**8051 INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING** Addressing modes – Data moving (Data transfer) instructions: Instructions to Access external data memory, external ROM / program memory, PUSH and POP instructions, Data exchange instructions – Logical instructions: byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions: Flags, Incrementing and decrementing,– Jump and CALL instructions: Jump and Call program range, Jump, Call and subroutines – Programming- Addition, Subtraction, Multiplication and division.	12
V	**INTERRUPT PROGRAMMING AND INTERFACING TO EXTERNAL WORLD** 8051 Interrupts – Interrupt vector table – Enabling and disabling an interrupt – Timer interrupts and programming – Programming external hardware interrupts – Serial communication interrupts and programming – Interrupt priority in the 8051. LED Interface –Keyboard interface- traffic light interface - Stepper motor interface	12

TEXT BOOKS

1. A. NagoorKani, Microprocessors & Microcontrollers, RBA Publications (2009).
2. A. P. Godse and D. A. Godse, Microprocessors, Technical Publications, Pune (2009).
3. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishing (2013).
4. B. Ram, Fundamentals of Microprocessors & Microcontrollers, DhanpatRai publications New Delhi (2016).
5. V. Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S.Visvanathan Pvt, Ltd.

REFERENCE BOOKS

1. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008)
2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008).
3. Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi.
4. J. Uffrenbeck, "The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.
5. W. A. Tribel, Avtar Singh, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.

WEB SOURCES

1. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.html
2. http://www.electronicsengineering.nbcafe.in/peripheral-mapped-io-interfacing/
3. https://www.geeksforgeeks.org/programmable-peripheral-interface-8255/
4. http://www.circuitstoday.com/8051-microcontroller
5. https://www.elprocus.com/8051-assembly-language-programming/
6. https://onlinecourses.nptel.ac.in/noc23_ee47/preview
7. https://www.vssut.ac.in/lecture_notes/lecture1423813120.pdf

8. https://kanchiuniv.ac.in/coursematerials/VIJAYARAGHAVAN_mp%20_mc%20notes.pdf
9. Nptel Web course on Microcontrollers and Applications by Dr. S. P. Das, IITKanpur. https://nptel.ac.in/courses/117/104/117104072/

Pedagogy: Teaching / Learning methods

• Lecture	• Tutorial	• Assignment	• Quiz
• PPT Presentation	• Group Discussion	• e-content seminar	

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Understand the concept of 8085 microprocessor instruction set, addressing mode and interfacing devices.	K1
CO2	Apply and analyze the interfacing concept of different programmable interfacing modules with microprocessor for real time applications	**K3,K5**
CO3	Understand the concept of 8051 microcontroller, embedded system components and their interactions.	**K1, K2**
CO4	Get idea with Assembly language programming to develop embedded solutions and use the instructionto writetheprogramming in ALP.	**K3**
CO5	Identify the types of interrupts in 8051 microcontroller. Apply and analyze the interfacing concept of different programmable interfacing modules with mc for real time applications	**K2,** **K 5**

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1	3	3	3	3	2	2	2
CO2	3	3	3	3	2	2	2
CO3	3	3	3	3	1	1	1
CO4	3	3	3	3	1	1	1
CO5	3	3	3	3	1	1	1

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2PHEL4B**	**Major Elective – IV Biomedical Instrumentation**	**4**	**3**

Nature of the course

EmployabilityOriented	✓	Relevant to Local need	✓
Entrepreneurship Oriented	✓	Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

Themainobjectives ofthis coursearеto:

1. To introduce the knowledge in Biomedical Instrumentation.
2. To know about human physiological systems.
3. To be aware of operational theatre equipment's.
4. To be aware of specialized medical equipment's

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Human Physiological Systems and Biopotential electrodes** Human physiological systems: Cells and their structure – Nature of Cancer cells – Transport of ions through the cell membrane – Resting and action potentials – Bio-electric potentials – Nerve tissues and sense organs – Different systems of human body (outline only). Design of Medical instruments – components of the biomedical instrument system – Half cell potential –Types of electrodes –Micro electrodes – Depth and needle electrodes – Surface electrodes – Transducers – Active transducers – magnetic induction type transducers (only).	12
II	**Biosignal Acquisition and Physiological Assist Devices** Required conditions for physiological signal amplifiers – Isolation amplifiers – ECG Isolation Amplifier Circuit – Medical preamplifier design – Bio-signal analysis – Analog and digital methods. Physiological Assist Devices:Pacemakers – Typical ranges of pacemaker parameters - External and implanted pacemakers(comparison) –Ventricular asynchronous pacemakers - Defibrillators – DC Defibrillator – Oxygenators – Bubble oxygenators–Dialysis – Hemodialysis – Peritonial dialysis .	12
III	**Biopotential Recorders** Biosignal Recorders: Characteristics of the recording system – Electrocardiography (ECG) – Physiological nature of ECG waveform – ECG Recording setup - Echocardiography – Electroencephalography	12

	(EEG) – Origin of EEG – Simple block diagram of EEG recording setup – Electromyography (EMG) recording setup – Electroretinogrphy (ERG) and Electroculography (EOG).	
IV	**Operation Theatre Equipment** Surgical diathermy- Shortwave diathermy – Microwave diathermy – Ultrasonic diathermy – Range and area of irritation of different techniques – Ventilators – Pressure limited ventilators – Anesthesia machine – Blood flow meters – Electromagnetic blood flowmeter – Cardiac Output measurements – Fick's method – Spirometer – Gas analyzers –Infrared CO_2 analyzer – Blood gas analyzers – pH meter – Oxymeters – Vivo oximetry.	12
V	**Specialized Medical Equipments** Blood Cell counters – Automatic blood cell counter – Laser based blood cell counting –Radiation detectors – G-M counter – Photometers – Filter photometer (colorimeter) –Digital thermometer – Audiometers – X-rays tube – X-ray machine – Radiography and Fluoroscopy –Image intensifiers – Angiography – Bio-telemetry – Elements of Bio-telemetry system – Design of Bio-telemetry system– Single channel radio telemetry system – Effects of ionizing radiation on human beings – Physiological effects of 50Hz current passage – Micro shock and macro shock – Magnetic Resonance Imaging – principle – MRI Instrumentation.	12

Textbooks:

1. Dr. M. Arumugan – Biomedical instrumentation, Anurada Agencies Publishers,1992.
2. R.S Khandpur, "Handbook on Biomedical Instrumentation", Tata McGraw Hill Company, New Delhi, 1989
3. Ohn G Webster, Ed., "Medical Instrumentation Application and Design", Third edition, John Wiley & Sons, Singapore, 1999

References:

1. L. Cromwell,F. J. Weibell, E. A. Pfeiffer – Biomedical instrumentation and Measurements, PHI second edition, 1993.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education Asia, New Delhi, 4th Edition, 2001.

Pedagogy: Teaching / Learning methods

• Lecture	• Tutorial	• Assignment	• Quiz
• PPT Presentation	• Group Discussion	• e-content seminar	

Course Outcomes
At the end of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	acquire knowledge on the fundamentals of biomedical instrumentation.	K1, K2
CO2	aware of different biochemical measurement techniques.	K2
CO3	learn about Physiological Assist Devices	K1, K2
CO4	get knowledge on biopotential recorders	K2
CO5	acquire knowledge on operation theatre equipments and specialized medical equipments.	K1, K2

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	1	1	1	1
CO2	3	2	2	1	1	1	1
CO3	3	2	2	1	1	1	1
CO4	3	2	2	1	1	1	1
CO5	3	2	2	1	1	1	1

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2PHSEC2**	**Skill Enhancement Course – Astrophysics**	**2**	**2**

Nature of the course

Employability Oriented		Relevant to Local need	✓
Entrepreneurship Oriented		Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

The main objectives of this course are to:

1. To understand the fundamentals concept of Astrophysics.
2. To gain knowledge about solar system,
3. To get knowledge in Activities of Astrophysics.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Telescopes, solar system, Eclipses, The sun** Optical telescopes - magnifying power, brightness-types of reflecting and refracting telescopes-radio telescope-Hubble space telescope- Bode,s law of planetary distances- meteors, meteorites, comets, asteroids - kuiper belt-Oort cloud-recent advances in astrophysics-types of eclipses-solar eclipse-lunar eclipse-total and partial lunar eclipse-solar atmosphere-photosphere-chromosphere-solar corona sunsports-11 year solar cycle.	15
II	**Stellar evolution, galaxies and Activities in Astrophysics** H-R diagram-birth and death of low mass,intermediate mass and massive star-neutron stars-pulsars-black holes-supernovae-classification of galaxies-galaxy clusterd-interaction of galaxies, dark matter and super clusters-(i)Basic construction of telescope-(ii) Develop models to demonstrate eclipse/planetary motion (iii) Night sky observation-(iv) Visit to any one of the National Observatories.	15

Textbooks:

1. BaidyanathBasu,(2001).An instruction to Astrophysics,second printing,prentice-Hall of India(p)Ltd,New Delhi
2. K.S. Krishnaswamy, (2002), Astrophysics-a modern perspective, New Age International (P) Ltd, New Delhi

Web resources:

1. **https://youtube.com/watch?v=MqrcuWOKeno&feature=share**
2. **https://youtu.be/e-P5IFTqB98**

Pedagogy: Teaching / Learning methods

- Lecture
- PPT presentation
- e-content Seminar
- Tutorial
- Quiz
- Assignment
- Group Discussion

CourseOutcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	understand the Optical telescopes, meteors,meteorites, Comets,asteroids-kuiper belt, lunar eclipse-solar atmosphere, solar corona	K1, K2,K4
CO2	grasp knowledge aboutgalaxies and activities in Astrophysics	K2, K3,K4

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	3	3	2	3
CO2	2	1	3	3	3	1	2

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2PHAECC2**	**Ability Enhancement Compulsory Course - Language Lab**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need	√	Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need	√	Addresses Human Values	√
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

- To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
- To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize their mother tongue influence
- To train students to use language appropriately for public speaking and Interviews

Unit – I LSRW

Listening Skills: Introduction to Phonetics – Speech Sounds – Vowels and Consonants, Listen to News, poem, songs, Motivational speech, stories, movies, interesting facts, sign of zodiac, dialogues, idioms, dictation – Common errors

Speaking Skills: Stress, Intonation, Homophone, Silent Letters, Greetings, Small Talk, Telephone English, Role Play, Tongue Twisters, Welcome Speech & Vote of Thanks, Compering, Declamation, Sing Along, Brain Storming, JAM (Just A Minute)

Reading Skills: Reading test, Skit, Proof Reading, Oral Reading Fluency, Reading Stories,

Writing Skills: learn English Grammar through Tamil Translation, Reading Comprehension-short stories, informational passages, Advanced Critical reading – Intelligence Augmentation, Dialogues, Sentence Completion, Word Definition, Classic Analogy Bridges, Sentence Analogies, Same Sound, Divided Syllables, Finish the Story, Answering the questions, Practical Writing, Making a formal Argument, Free Writing, Using Precise Language

Unit – II Career and Soft Skills

Career Skills: Body Language (BL) : BL Interview, BL Model, BL Tips, Business English, Communication skills, GD, Interview Skills

Soft Skills: Assertiveness, Creativity, Critical Thinking and Problem Solving, Empathy, Enthusiasm and attitude, Goal Setting, Great interviews, Negotiation Skills, Personality Development, Professionalism, Self Esteem, Stress Management, Team Building, Time Management, Motivation and Attitude, Interpersonal relationship and skills, Networking,

Reference:

1. Materials prepared by the Department of English for Writing skills
2. Soft Skills – Know Yourself and know the world, Dr.K.Alex, Chand Publications, 3rd revised edition 2014
3. Software : Express Pro Lite

The Language Lab focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Learning Outcomes: Students will be able to attain

- Better understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills

Minimum Requirement of infrastructural facilities for Language Lab:

1. Computer Assisted Language Learning (CALL) Lab:

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration
ii)High Fidelity Headphones

2. Interactive Communication Skills (ICS) Lab:

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public-Address System, a LCD and a projector etc

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3PHC5**	**Quantum Mechanics**	**6**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	✓
Entrepreneurship Oriented	✓	Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

The main objectives of this course are to:

1. To develop the physical principles and the mathematical background important to quantum mechanical descriptions.
2. To describe the propagation of a particle in a simple, one-dimensional potential.
3. To formulate and solve the Schrodinger's equation to obtain eigenvectors and energies for particle in a three-dimensional potential.
4. To explain the mathematical formalism and the significance of constants of motion, and see their relation to fundamental symmetries in nature
5. To discuss the Approximation methods like perturbation theory, Variational and WKB methods for solving the Schrödinger equation.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**BASIC FORMALISM** Time dependent and Time independent Schrodinger equation – Interpretation of the wave function - normalised and orthogonal wave functions – Ehrenfest's theorem – Time independent Schrodinger equation – Stationary states – Admissible condition on the wave function. Linear vector space – Linear operator – Eigen functions and eigenvalues – Hermitian operator – Postulates of quantum mechanics – measurability of observables – Uncertainty relation –	18
II	**ONE DIMENSIONAL AND THREE-DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS** Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – Bloch waves in a periodic potential – Kronig-penny square – well periodic potential – Linear harmonic oscillator: Operator method – Particle moving in a spherically symmetric potential – System of two interacting particles – Hydrogen atom – Rigid rotator.	18

III	**ANGULAR MOMENTUM** Dirac's notation – Equations of motion – Momentum representation.– Angular momentum operators – Angular momentum commutation relations – Eigenvalues and eigenfunctions of L^2 and L_z – General angular momentum – Eigenvalues of J^2 and J_z – Angular momentum matrices – Spin angular momentum – Spin vectors for spin (½) system. Addition of angular momenta: Clebsh - Gordan coefficients – Selection rules – recursion relations –Computation of Clebsh - Gordon coefficients.	18
IV	**APPROXIMATION METHODS** Time independent perturbation theory for non-degenerate energy levels – Degenerate energy levels – Stark effect in Hydrogen atom – Ground and excited state – Variation method – Helium atom – WKB approximation – Connection formulae (no derivation) – WKB quantization – Application to simple harmonic oscillator.	18
V	**RELATISTIC QUANTUM MECHANICS** Klein – Gordon Equation – Charge and Current Densities – Dirac Matrices – Dirac Equation – Plane Wave Solutions – Interpretation Of Negative Energy States – Antiparticles – Spin of Electron – Magnetic Moment Of An Electron Due To Spin Dirac Equation – Properties of the gamma matrices – Traces – Relativistic invariance of Dirac equation – Probability Density	18

TEXT BOOKS

1. P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, 2nd edition(37th Reprint),Tata McGraw-Hill, New Delhi, 2010.
2. G. Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009.
3. David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011.
4. SL Gupta and ID Gupta, Advanced Quantum Theory and Fields, 1st Edition, S.Chand& Co., New Delhi, 1982.

REFERENCE BOOKS

1. E. Merzbacher, Quantum Mechanics, 2nd Edition, John Wiley and Sons, New York, 1970.
2. V. K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi, 1985.
3. L. D. Landau and E. M. Lifshitz, Quantum Mechanics, 1st edition, Pergomon Press, Oxford, 1976.
4. S. N. Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata, 1999.

WEB SOURCES

1. http://research.chem.psu.edu/lxjgroup/download_files/chem565-c7.pdf
2. http://www.feynmanlectures.caltech.edu/III_20.html
3. http://web.mit.edu/8.05/handouts/jaffe1.pdf
4. https://hepwww.pp.rl.ac.uk/users/haywood/Group_Theory_Lectures/Lecture_ 1.pdf

Pedagogy: Teaching / Learning methods

• Lecture	• Tutorial	• Assignment	• Quiz
• PPT Presentation	• Group Discussion	• e-content seminar	

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics	**K1, K5**
CO2	Is able to apply and analyze the Schrodinger equation to solve one dimensional problems and three dimensional problems	**K3, K4**
CO3	To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.	**K3, K4**
CO4	Can formulate and analyze the approximation methods for various quantum mechanical problems	**K4, K5**
CO5	Discuss the relativistic quantum mechanical equations namely, Klein-Gordon and Dirac equations and the phenomena accounted by them like electron spin and magnetic moment	**K1, K4**

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	1	1	1	1
CO2	3	2	2	1	1	1	1
CO3	3	2	2	1	1	1	1
CO4	3	2	2	1	1	1	1
CO5	3	2	2	1	1	1	1

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3PHC6**	**Statistical Mechanics**	**5**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	✓
Entrepreneurship Oriented		Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

The main objectives of this course are to:

1. To acquire the knowledge of thermodynamic potentials and to understand the mixing of gases.
2. To comprehend the concept of partition function, canonical and grand canonical ensembles.
3. To acquire the knowledge of Phase transitions and critical indices.
4. To grasp the fundamental knowledge about the three types of statistics
5. To get in depth knowledge about Real gas, Ising model and fluctuation of thermodynamic properties that vary with time

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Statistical mechanics and Thermoydynamics** Introduction to statistical mechanics –-Thermodynamic potentials – Third law of thermodynamics – connection between statistics and thermodynamics - Entropy- Phase space – Ensemble – Micro canonical ensemble – Entropy of an ideal gas using the micro canonical ensemble – Entropy of mixing and Gibb's paradox.	15
II	**Canonical and grand canonical ensembles** Density distribution in Phase space-Liouville's theorem-canonical and grand canonical ensembles – comparision of ensembles - partition function- Ideal mono-atomic gas - calculation of statistical quantities - energy and density fluctuations.	15
III	**Phase transitions** Phase transitions –First and Second order Phase transitions – Order parameters - Ehrenfest's classification - Phase equilibrium - Gibb's phase	15

	rule- Landau's theory of phase transition - critical indices - scale transformation and dimensional analysis.	
IV	**Classical and Quantum statistics** Identical particles and symmetry requirements – Maxwell-Boltzmann Statistics - Quantum distribution functions for partition function - Fermi-Dirac statistics - Ideal fermi gas – Degeneracy – Bose-Einstein statistics - Planck radiation formula – Ideal Bose gas -comparision of three statistics – Bose-Einstein condensation.	15
V	**Real gas, Ising model and Fluctuations** Theory of imperfect gas – Partition function – Equation of state and virial coefficients – vander wall's equation – Ising model – Exact solutions in one dimension – Brownian motion – Langevin' theory -Fluctuation dissipation theorem – The Fokker-Planck equation.	15
	SELF STUDY Fundamentals of statistics and thermodynamics- laws of thermodynamics - micro and macro state - Specification of states of a system – correlation of space- time dependent fluctuations.	

TEXT BOOKS

1. S. K. Sinha, 1990, Statistical *Mechanics*, Tata McGraw Hill, New Delhi.
2. B. K. Agarwal and M. Eisner, 1998, *Statistical Mechanics,* Second Edition New Age International, New Delhi.
3. J. K. Bhattacharjee, 1996, *Statistical Mechanics*: An Introductory Text, Allied Publication, New Delhi.
4. F. Reif, 1965, *Fundamentals of Statistical and Thermal Physics,* McGraw -Hill, New York.
5. M. K. Zemansky, 1968, *Heat and Thermodynamics,* 5th edition, McGraw-Hill New York.

REFERENCE BOOKS

1. R. K. Pathria, 1996, *Statistical Mechanics,* 2nd edition, Butter WorthHeinemann, New Delhi.
2. L. D. Landau and E. M. Lifshitz, 1969, *Statistical Physics,* Pergamon Press, Oxford.
3. K. Huang, 2002, *Statistical Mechanics,* Taylor and Francis, London
4. W. Greiner, L. Neiseand H.Stoecker, *Thermodynamics and Statistical Mechanics,* Springer Verlang, New York.
5. A. B. Gupta, H. Roy, 2002, *Thermal Physics*, Books and Allied, Kolkata.

WEB SOURCES

1. https://byjus.com/chemistry/third-law-of-thermodynamics/
2. https://web.stanford.edu/~peastman/statmech/thermodynamics.html
3. https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics
4. https://en.wikipedia.org/wiki/Grand_canonical_ensemble
5. https://en.wikipedia.org/wiki/Ising_model.

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition	K5
CO2	Understand the canonical and grand canonical ensembles and to interpret the relation between thermodynamical quantities and partition function. Describe the peculiar behaviour of the entropy by mixing two gases	**K2**
CO3	Analyze the Phase Transistions and scale transformations of gas particles	**K4**
CO4	To recall and apply the different statistical concepts to analyze the behaviour of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics.	**K4, K5**
CO5	examine the thermodynamical behaviour of gases under fluctuation and also using Ising model	**K3**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1	3	2	3	3	3	2	3
CO2	2	1	3	3	3	2	2
CO3	3	3	3	3	3	2	2
CO4	3	2	3	3	3	2	2
CO5	3	3	3	3	3	3	1

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3PHCP3**	**Practical - III**	**6**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	✓
Entrepreneurship Oriented		Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

The main objectives of this course are to:

1. To gainpracticalskills on experiments related with Op-amp.
2. To gainpractical skills in doing advanced experiments

List of Experiments – Any 10 Experiments

1. Op. Amp- Solving linear equations.
2. Op. Amp- Waveform generation- sine, square and ramp.
3. Solving Boolean expressions using gate circuits.
4. Counters construction and 99
5. Op. Amp - Wien's Bridge Oscillator.
6. 555timer –Astablemultivibrator and VCO
7. Determination of Thickness of transparent sheet using Michelson interferometer.
8. Determinationof wavelength of monochromatic source using Michelson interferometer.
9. Determination of Magnetic Susceptibility of a liquid by Guoy method.
10. Determination of Magnetic Susceptibility of a liquid by Quincke's method.
11. Spectrograph - ALO band/ Iodine absorption spectrum.
12. Design of arithmetic and logic unit.
13. Construction -1x1 RAMS.
14. Construction of A/D converter.
15. Construction of D/A converter.
16. Op Amp – low pass and high pass filters.

17. Hall effect- Determination of Hall coefficient and carrier concentration.
18. Determination of g- factor using Electron spin Resonance spectrometer
19. Magneto- resistance of power samples.
20. Laser- Grating- Determination of wavelength.
21. Fiber optics experiments.
22. Determination of wavelength and thickness using Biprism
23. Resistivity of semiconductor.
24. Study of Transducers.
25. Multiplexer and Demultiplexer using gates.

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	acquire skills in doing advanced experiments.	K5
CO2	effectively handle op-amps for the applications needed.	**K2**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Mapping of Course Outcomes with Programme Specific Outcomes

PSO CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO 6**	**PSO7**
CO1	3	2	3	3	3	2	3
CO2	2	1	3	3	3	2	2

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3PHCIM**	**Industry Module - Non-Conventional Energy Sources**	**5**	**3**

Nature of the course

EmployabilityOriented	✓	Relevant to Local need	✓
Entrepreneurship Oriented	✓	Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values			

Course Objectives

The main objectives of this course are to:

1. To impart fundamental aspects of solar energy utilization.
2. To give adequate exposure ocean energy.
3. To harness entrepreneurship skills
4. To understand the different types of energy and channelizing them to the different sectors of society
5. To develop an industrialist mindset by utilizing renewable source of energy

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**INTRODUCTION TO ENERGY SOURCES:** Conventional and non-conventional energy sources and their availability–prospects of Renewable energy sources– Energy from other sources–chemical energy–Nuclear energy– Energy storage and distribution.	15
II	**SOLAR COLLECTORSAND SOLAR HEATERS:** Physical principles of conversion of solar radiation into heat flat plate collectors - General characteristics – Focusing collector systems – Thermal performance evaluation of optical loss - Types of solar water heater - Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling systems.	15
III	**SOLAR ENERGY CONVERSION:** Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo - electric conversion - process flow of silicon solar cells- different approaches on the process- texturization, diffusion, Antireflective coatings, metallization.	15
IV	**ENERGY FROM THE OCEANS AND WIND ENERGY:** Energy	15

	utilization–Energy from tides–Basic principle of tidal power–utilization of tidal energy – Principle of ocean thermal energy conversion systems. Basic principles of wind energy conversion–power in the wind–forces in the Blades– Wind energy conversion–Advantages and disadvantages of wind energy conversion systems (WECS) - Energy storage–Applications of wind energy.	
V	**ENERGY FROM BIOMASS:** Biomass conversion Technologies– wet and dry process– Photosynthesis -Biogas Generation: Introduction–basic process: Aerobic and anaerobic digestion – Advantages of anaerobic digestion–factors affecting bio digestion and generation of gas- bio gas from waste fuel– properties of biogas-utilization of biogas.	15

Textbooks:

1. G.D. Rai, 1996, Non – convention sources of, 4th edition, Khanna publishers, New Delhi.
2. S. Rao and Dr. ParuLekar, Energy technology.
3. M.P. Agarwal, Solar Energy, S. Chand and Co., New Delhi (1983).
4. Solar energy, principles of thermal collection and storage by S. P. Sukhatme, 2nd edition, Tata McGraw-Hill Publishing Co. Lt., New Delhi (1997).
5. Energy Technology by S. Rao and Dr. Parulekar.

References:

1. Renewable energy resources, John Twidell and Tonyweir, Taylor and Francis group, London and New York.
2. Applied solar energy, A. B. Meinel and A. P. Meinal
3. John Twidell and Tony Weir, Renewable energy resources, Taylor and Francis group, London and New York.
4. Renewal Energy Technologies: A Practical Guide for Beginners C.S. Solanki-PHI Learning.

Web Resources

1. https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=2411&printable=1
2. https://www.nationalgeographic.org/encyclopedia/tidal-energy/
3. https://www.ge.com/renewableenergy/wind-energy/what-is-wind-energy
4. https://www.reenergyholdings.com/renewable-energy/what-is-biomass/
5. https://www.acciona.com/renewable-energy/solar-energy/

Pedagogy: Teaching / Learning methods

• Lecture	• Tutorial	• Assignment	• Quiz
• PPT Presentation	• Group Discussion	• e-content seminar	

Course Outcomes
At the end of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	To identify various forms of renewable and non-renewable energy sources	**K1**
CO2	Understand the principle of utilizing the oceanic energy and apply it for practical applications.	**K2**
CO3	Discuss the working of a windmill and analyze the advantages of wind energy.	**K3**
CO4	Distinguish aerobic digestion process from anaerobic digestion.	**K3,K4**
CO5	Understand the components of solar radiation, their measurement and apply them to utilize solar energy.	**K2,K5**

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO CO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1	3	2	1	2	1	3	2
CO2	3	2	1	2	1	3	2
CO3	3	2	1	2	1	3	2
CO4	3	2	1	2	1	3	2
CO5	3	2	1	2	1	3	2

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3PHEDC**	**Extra Disciplinary Course – Fundamentals of Nanotechnology**	**4**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	√
Entrepreneurship Oriented		Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability	√		
Addresses Human Values			
Addresses Professional Ethics			

Course Objectives

Themainobjectives ofthis courseare:

- To impart knowledge on nanomaterials and their peculiar properties
- To describe various techniques for the preparation of nanomaterials
- To inculcate knowledge on various analytical techniques for characterization of nanomaterials and their applications

SYLLABUS

Unit	Content	No. of Hours
I	**Fundamentals of Nanomaterials** Need and origin of Nanotechnology – Nanomaterials – Classification of nanomaterials based on dimension: 1D – 2D – 3D nanostructured materials - classification based on composition – Surface area to volume ratio – Its effects on the properties of nanomaterials – Nanocomposites – Nanohybrids - Quantum dots (QDs) – Excitons confinement in quantum dots – Production and applications of QDs –Quantum wires – Quantum wells.	12
II	**Fullerenes** Carbon allotropes – super conductivity of C60 – Fullerenes –Types of fullerenes – Bucky balls – Carbon nanotubes (CNTs) – Single walled CNTs – Multi-walled CNTs – Mechanical and Electrical Properties of CNTs – Synthesis of CNTs – Plasma-arc discharge method –Laser ablation technique – Chemical vapour deposition method – CNT emitters-Potential applications of CNTs.	12
III	**Preparation Methods** Nanomaterials – Preparation – Top-down approach – Working principles, merits and demerits of Ball milling – Photolithography–Electron beam lithography – Molecular beam epitaxy – Bottom-up approach – Soft-chemical method – Sol-gel synthesis – Electro chemical deposition – Atomic layer deposition - Molecular self assembly – Langmuir - Blodgett film (2D	12

	nanostructure) preparation – green synthesis.	
IV	**Analytical techniques for nanomaterials characterization** Structural characterization: Principle of X-ray powder diffraction – Determination of structural parameters – Optical studies: UV-Vis-NIR spectrometry – Band gap determination by Tauc'splot method – Photoluminescence spectroscopy –FTIR spectroscopy – Surface morphological analysis:– Scanning electron microscopy (SEM) – Transmission Electron Microscope (TEM) –X-rayphotoelectron spectroscopy (XPS)-Magnetic properties of nanomaterials – SQUID – Vibrating sample magnetometer.	12
V	**Applications of nanomaterials** Nanoelectronics – Molecular electronics – Nanorobots - Nanophotonics – Nano electromechanical systems (NEMS) –Nanomaterials in energy conversion and storage – Nanomaterials as photocatalysts – Nanomaterial in industrial applications – Bio-medical applications: Targeted drug delivery – Nanomaterial based radiation therapy – Photodynamic therapy (PDT) – Tissue engineering – Bio imaging.	12

Books for Study

1. K. Ravichandran, K. Swaminathan, P. K. Praseetha, P. Kavitha *Introduction tonanotechnology*,
Jazym Publications, Tiruchirappalli (2019), ISBN: 978-93-87360-40-2
2. Rishabh Anand, *Essentials of Nanotechnology*, Medtech; 1st Edition, 2014
3. Guozhang Cao, *Nanostructures and Nanomaterials, synthesis, properties and applications*, Imperial College Press (distributed by World Scientific): London, 2004.
4. K.P. Mathur, *Nanoscience and nanotechnology,* 1st Edition 2009, Rajat Publications, NewDelhi

Books for Reference

1. M. Ratner, *Nanotechnology: A Gentle introduction*, Prentice – Hall ISBN 0-13-101400-5, 2003.
2. Michael Wilson, KamaliKannagara, Geoff Smith, Michelle Simmons and Burkhard Raguse, *Nanotechnology: Basic Science and Emerging Technologies*, CRC Press, 2002
3. Charles P.Poole Jr and Frank J. Owens, *Introduction to Nanoscience and Nanotechnology, An Indian adaptation* Wiley,ISBN: 978-9354240201, 2020.
4. A.S.Edelstein and R.C. Cornmarata, Nanomaterials; synthesis, Properties andApplications, Ed, Iop (U.K), 1996.

Web resources

1. Dr. R. B. BHISE, Dr. A. B. BHISE, Dr. V. D. Kulkarni, Dr. H. R. Kulkarni, Dr. A. P. Zambare, *Physics of nanomaterials,* NiraliPrakashan, 2019

Pedagogy: Teaching / Learning methods

- Lecture
- e-content Seminar
- Assignment
- PPT presentation
- Quiz
- ○

Course Outcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	Explain how the nanosized materials differ from bulk materials. Assess the effect of nanosize on various properties of nanomaterials	K2, K4
CO2	Classify the synthesizing techniques suitable for different nano structured materials.	K3
CO3	Make use of the available instruments to study the properties of nanomaterials .	K5
CO4	Frame hypotheses for using new nanomaterials for different applications .	K2, K3
CO5	Design, prepare, analyse and apply nanosized materials for suitable applications. writing.	K3, K6

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	3	3	2	2	2
CO2	3	2	3	3	3	2	1
CO3	3	3	3	3	2	2	2
CO4	3	2	3	3	3	2	2
CO5	3	3	3	3	3	2	2

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3PHSEC3**	**Skill Enhancement Course – Physics of Medical Instruments**	**2**	**2**

Nature of the course

Employability Oriented	✓	Relevant to Local need	✓
Entrepreneurship Oriented		Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values	✓		

Course Objectives

The main objectives of this course are to:

1. To understand the fundamentals of Medical Instruments.
2. To gain knowledge about medical imaging, Diagnostics.
3. To get knowledge of LASER in Medicine.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Bio Potentials and Potential based Instruments** Transport of ions through cell membrane-resting and action potential-Characteristics of resting potential-bio-electric potential-Design of medical instruments-Electrocardiography (ECG)-Origin of cardiac action potential – ECG lead configuration – block diagram of ECG recording set up(qualitative)-Electroencephalography (EEG)-origin of EEG-brain waves-block diagram of modern EEG setup-electromyography (EMG)-block diagram of EMG recording set up	15
II	**Radiationsafety, Medical imaging, Dignostics, Laser in Medicine** Units ofRadiation - pocket dosimeter - thermo-luminescence dosimeter-nuclear imaging technique - computer tomography (CT)-block diagram of CT scanner - Ultrasonic imaging system - MRI principle and instrumentation-X-rays in radiography – fluoroscopy – comparison - image intensifiers-angiography - laser interactions with biomolecules - advantages of laser surgery – endoscopy-type of endoscopes with their operation (qualitative)	15

Textbooks:

1. Biomedical Instruments and measurement, Leslie Cromwell, PH, 2015.
2. Medical Instruments, M. Arumugam, Anuradha agencies,1992.
3. Electronic Instruments and Instrumentation Technology, M.M. Anand, PH, 2015

Web resources:

1. https://youtu.be/Pm9L1vv8hVA

2. https://youtu.be/nFkBhUYynUw

Pedagogy: Teaching / Learning methods

- Lecture
- PPT presentation
- e-content Seminar
- Tutorial
- Quiz
- Assignment
- Group Discussion

Course Outcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	Students will understand the application of biomedical instruments.	K1, K2, K3
CO2	Have a good grasp of the radiation safety, medical, imaging, dignostics, Laser in Medicine and also practiced formulating good question to others	K2,K4,, K5

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	3	3	2	3
CO2	2	1	3	3	3	1	2

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3PHAECC3**	**Ability Enhancement Compulsory Course - Research Methodology**	**2**	**2**

Nature of the course

Employability Oriented	✓	Relevant to Local need	✓
Entrepreneurship Oriented		Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values	✓		

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Research Methodology** Definitions of research - Types of research- Qualities of a good research - Scientific methods of research - Research methodology -Steps involved in a typical experimental research work – data analysis – primary data- secondary data - data organization – graphical representation- measures of central tendency- types of errors– precision and accuracy – mean – median – mode – statistical tools used in research- SPSS- SAS – stata.	15
II	**Scientific writing** Scientific writing - Types of scientific literature - Writing scientific articles in journals - Writing style - Common errors of word usage - Scientific convention and nomenclature–Thesis writing - structure of a thesis- presentation of research findings - Necessary factors for impressive presentation - Oral vs Poster presentation–indexing and journal metrices- indexing services- impact factor- h-index - i10-Index- publication ethics- plagiarism- predatory publications.	15

Book for References:

[1] K. Ravichandran, A. T. Ravichandran, M. Ayyanar, P. Kavitha, (2022) Research Methodolgy and Publication Ethics – A Researcher's Handbook, Jazym Publications Trichy – 620 023, India.

[2] C. R. Kothari, (2004) Research Methodology – Methods and Techniques, New Age International (P) Limited, Publishers, New delhi – 110002.

[3] Shanti Bhushan Mishra, Shashi Alok, (2017), Handbook of research Methodology, Educreation Publishing, New Delhi – 110075.

Web resources:

3. https://youtu.be/Pm9L1vv8hVA
4. https://youtu.be/nFkBhUYynUw

Pedagogy: Teaching / Learning methods

- Lecture
- PPT presentation
- e-content Seminar
- Tutorial
- Quiz
- Assignment
- Group Discussion

Course Outcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	Students will understand the application of biomedical instruments.	K1, K2, K3
CO2	Have a good grasp of the radiation safety, medical, imaging, dignostics, Laser in Medicine and also practiced formulating good question to others	K2,K4,, K5

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	3	3	2	3
CO2	2	1	3	3	3	1	2

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	**23P4PHC7**	**Nuclear and Particle Physics**	**6**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need	
Entrepreneurship Oriented		Relevant to regional need	
Skill development Oriented	√	Relevant to national need	
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability			
Addresses Human Values			
Addresses Professional Ethics	√		

Course Objectives

Themainobjectives ofthis courseare:

1. To impart the fundamental concepts of nucleus and its models
2. To understand the nature of nuclear forces, structure and their technological applications
3. To get the knowledge of elementary particles and quarks.

SYLLABUS

Unit	Content	No. of Hours
I	**NUCLEAR MODELS** Liquid drop model – Weizacker mass formula – Isobaric mass parabola – Mirror Pair – shell model – spin-orbit coupling – magic numbers – angular momenta and parity of ground states – magnetic moment – Nilsson model – electric Quadrapole moment - Bohr and Mottelson collective model – rotational and vibrational bands.	18
II	**NUCLEAR FORCES** Nucleon – nucleon interaction – Tensor forces – properties of nuclear forces – ground state of deuteron – Exchange Forces - Meson theory of nuclear forces – Yukawa potential – nucleon-nucleon scattering – effective range theory – spin dependence of nuclear forces - charge independence and charge symmetry – isospin formalism.	18
III	**NUCLEAR REACTIONS** Kinds of nuclear reactions – Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nuclear reactions – Reciprocity theorem – Resonances – Breit Wigner one level formula – Direct reactions - Nuclear Chain reaction – four factor formula.	18

IV	**NUCLEAR DECAY** Beta decay – Continuous Beta spectrum – Fermi theory of beta decay - Comparative Half-life –Fermi Kurie Plot – mass of neutrino – allowed and forbidden decay — neutrino physics – Helicity - Parity violation - Gamma decay – multipole radiations – Angular Correlation - internal conversion – nuclear isomerism – angular momentum and parity selection rules.	18
V	**ELEMENTARY PARTICLES** Classification of Elementary Particles – Types of Interaction and conservation laws – Families of elementary particles – Isospin – Quantum Numbers – Strangeness – Hypercharge and Quarks – SU (3) groups-Gell Mann matrices– Gell Man Nishijima Mass formula-Quark Model. Standard model of particle physics.	18

Textbook:

1. Nuclear Physics- D.C. Tayal, Himalaya Publishing house-2009
2. Nuclear Physics – S.N.Ghoshal, S.Chand& Co., New Delhi-2008
3. Introduction To Nuclear And Particle Physics (2nd Edition)- A. Das and T. Ferbel, World scientific Publishing .Co. Ltd-2003
4. Radioactivity Radionuclides Radiation- Joseph Magill and jean galy-Springer-2004
5. Nuclear Reactions -An Introduction-Hans Paetz gen, Schieck- Springer Berlin Heidelberg-2014.

References:

1. Basic Nuclear Physics - D.N. Srivatsava, Pragati Prakashan publishers, Meerut.-2011
2. Nuclear Physics - Roy & Nigam, Wiley Eastern Publishers-1996
3. Nuclear Physics – V.Devanathan.Narosa Publishing house, New Delhi-2011
4. Concepts of Nuclear Physics – B.L.Cohen. Tata –McGraw Hill, New Delhi-1984
5. Nuclear Physics An Introduction –Wiley - S. B. Patel · 1991

Web resources

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

2.https://www.google.co.in/books/edition/Nuclear_Reactions/Ep65BQAAQBAJ?hl=en&gbpv=1&dq=nuclear+reactions&printsec=frontcover

3. https://www.youtube.com/watch?v=cD-ZlLA2UgI

Pedagogy: Teaching / Learning methods

*Lecture *PPT presentation * Assignment *Quiz *e-content

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	acquire knowledge and skills in the structures of nucleus.	K2,k6
CO2	acquire the knowledge on nuclear forces	K2
CO3	analyze nuclear reactions and their implications	K4
CO4	Understand the decay process of nucleus and their potency	K2,k5
CO5	Know the fundamental concepts of elementary particle physics	K1,k2

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**2**	**2**	**3**	**2**	**3**	**3**
CO2	**3**	**3**	**1**	**3**	**2**	**2**	**3**
CO3	**3**	**2**	**3**	**3**	**1**	**3**	**1**
CO4	**2**	**3**	**3**	**1**	**1**	**2**	**1**
CO5	**1**	**2**	**2**	**3**	**3**	**2**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated;
0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	**23P4PHC8**	**Condensed Matter Physics**	**5**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need	
Entrepreneurship Oriented		Relevant to regional need	
Skill development Oriented	√	Relevant to national need	
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability			
Addresses Human Values			
Addresses Professional Ethics	√		

Course Objectives

The main objectives of this course are:

1. To describe various crystal structures, symmetry and to differentiate different types of bonding.
2. To construct reciprocal space, understand the lattice dynamics and apply it to concept of specific heat.
3. To critically assess various theories of electrons in solids and their impact in distinguishing solids.
4. Outline different types of magnetic materials and explain the underlying phenomena.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**CRYSTAL PHYSICS** Types of lattices - Miller indices – Symmetry elements and allowed rotations - Simple crystal structures – Atomic Packing Factor- Crystal diffraction - Bragg's law - Reciprocal Lattice (sc, bcc, fcc). X-Ray Diffraction - Laue equations - Brillouin zone - Structure factor - Atomic scattering factor –Geometrical structure factor-Classification of imperfections.	15
II	**LATTICE DYNAMICS** Wave motion of one dimensional atomic lattice -wave motion of linear diatomic lattice-optical and acoustical branches-phase velocity and group velocity – Infrared absorption -Phonon momentum- inelastic scattering of neutrons by phonons- inelastic scattering of X-rays by phonons.	15
III	**THEORY OF METALS AND SEMICONDUCTORS** Solidstate- Types of solids- properties of metalic solids- Theories of bonding in metals- Classification of solids and band theory- Bloch theorem- Kronig-Penny model- Semiconductor–Types of semiconductors – applications of semiconductor - Superconductors- application of superconductors.	15

IV	**MAGNETISM** Diamagnetism - Quantum theory of paramagnetism - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Exchange integral - Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall - Spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism - Neel temperature.	15
V	**SUPERCONDUCTIVITY** **Experimental facts:** Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical temperature - Entropy and heat capacity - Energy gap - Type I and II Superconductors. **Theoretical Explanation:** Thermodynamics of super conducting transition - London equation - Coherence length – Isotope effect - Cooper pairs – Bardeen Cooper Schrieffer (BCS) Theory – Single particle tunneling - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors – SQUIDS.	15

Text Books

1. C. Kittel, 1996, *Introduction to Solid State Physics,* 7th Edition, Wiley, New York.
2. Rita John, Solid State Physics, Tata Mc-Graw Hill Publication.
3. A. J. Dekker, *Solid State Physics*, Macmillan India, New Delhi.
4. M. Ali Omar, 1974, *Elementary Solid State Physics – Principles and Applications,* Addison - Wesley
5. H. P. Myers, 1998, *Introductory Solid State Physics,* 2nd Edition, Viva Book, New Delhi.

Reference Books

1. J. S. Blakemore, 1974, *Solid state Physics,* 2nd Edition, W.B. Saunder, Philadelphia
2. H. M. Rosenburg, 1993, *The Solid State,* 3rd Edition, Oxford University Press, Oxford.
3. J. M. Ziman, 1971, Principles *of the Theory of Solids*, Cambridge University Press, London.
4. C. Ross-Innes and E. H. Rhoderick, 1976, *Introduction to Superconductivity,* Pergamon, Oxford.

Web Sources

1. http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html
2. http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html
3. https://www.britannica.com/science/crystal
4. https://www.nationalgeographic.org/encyclopedia/magnetism/

Pedagogy: Teaching / Learning methods

*Lecture *PPT presentation * Assignment *Quiz *e-content

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Student will be able to list out the crystal systems, symmetries allowed in a system and also the diffraction techniques to find the crystal structure	**K1**
CO2	Students will be able to visualize the idea of reciprocal spaces, Brillouin Zone and their extension to band theory of solids.	**K1, K2**
CO3	Student will be able to comprehend the heat conduction in solids	**K3**
CO4	Student will be able to generalize the electronic nature of solids from band theories.	**K3, K4**
CO5	Student can compare and contrast the various types of magnetism and conceptualize the idea of superconductivity.	**K5**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

PSO / CO	PSO 1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**2**	**2**	**3**	**2**	**3**	**3**
CO2	**3**	**3**	**1**	**3**	**2**	**2**	**3**
CO3	**3**	**2**	**3**	**3**	**1**	**3**	**1**
CO4	**2**	**3**	**3**	**1**	**1**	**2**	**1**
CO5	**1**	**2**	**2**	**3**	**3**	**2**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	**23P4PHCP4**	**Practical – IV**	**6**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need	
Entrepreneurship Oriented	√	Relevant to regional need	
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	
Addresses Gender Sensitization		Addresses Professional Ethics	
Addresses Environment and Sustainability			
Addresses Human Values	√		

Course Objectives:

1. To expose students to the operation of typical microcontroller- 8051 trainer kit and C/C++ programming.
2. To study programming based application.
3. To study 8051 microcontroller based ALP using arithmetic, logical, data transfer and jump operations.
4. To Learn the design aspects of I/O and Memory Interfacing circuits.
5. To study and solve the programming based numerical application.
6. To develop, assessing and analyzing the obtained data by programming.

List of Experiments – Any 12 Experiments

1. Microcontroller- Addition, subtraction (8 bit)
2. Microcontroller- Addition, subtraction (array)
3. Microcontroller- Multiplication 8 bit by 8 bit & 16 bit by 8 bit.
4. Microcontroller- Division 8 bit by 8 bit & 16 bit by 8 bit.
5. Microcontroller- To find the largest and smallest number in an array
6. Microcontroller- Pattern comparison
7. Microcontroller- wave form generation
8. Microcontroller – Interfacing – Stepper Motor
9. Microcontroller – Interfacing – Traffic light Control
10. Program for arranging in ascending and descending order
11. Program to find the sum and difference of two matrices
12. Program to find the product of two matrices
13. Program to find the solution using Newton -Raphson method.
14. Program for Numerical Integration – Simpson Rule

15. Program for Lagrange's interpolation.

16. Program for R-K fourth order method.

Books for Reference

1. Introduction to microprocessor – Aditya P. Mathur.
2. Programming and customizing the 8051 micro controller- Myke predco, Tata McGraw Hill Publishing company ltd, New Delhi.
3. Hardware reference manual for, micro controller Intel Corporation- San Francisco

Course Outcomes

On the successful completion of the course, students will be able to

CO No.	CO Statement	Cognitive Level
CO1	Students acquire skills in writing and executing assembly language programs (microcontroller)	K1,K2
CO2	Understand and apply the fundamentals of assembly level programming of microcontroller.	K2,K3
CO3	Develop testing and experimental procedures on Microcontroller analyze their operation under different cases.	K3
CO4	Analyze the problems and apply a suitable hardware and software to address the problem	K4
CO5	Use standard interface kit and to evaluate digital interfaces.	K5

Cognitive Level: K1 - Remember; K2 - Understanding; K3 - Apply; K4 - Analyze;
K5 – Evaluate;

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	3	3	2	2	2
CO2	3	3	3	3	2	2	2
CO3	3	3	3	3	1	1	1
CO4	3	3	3	3	1	1	1
CO5	3	3	3	3	1	1	1

3 - Strongly Correlated; 2 - Moderately Correlated;

1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	**23P4PHEL5A**	**Major Elective – V Spectroscopy**	**4**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	√
Entrepreneurship Oriented		Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability			
Addresses Human Values			
Addresses Professional Ethics	√		

Course Objectives

The main objectives of this course are:

1. To comprehend the theory behind different spectroscopic methods
2. To know the working principles along with an overview of construction of different types of spectrometers involved
3. To explore various applications of these techniques in R &D.
4. Apply spectroscopic techniques for the qualitative and quantitative analysis of various chemical compounds.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**MICROWAVE SPECTROSCOPY** Central field approximation-coupling schemes:L-S coupling and J-J coupling-Spin-orbit interaction-Hyrogenatom:Heitler London theory. Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)-reduced mass – rotational constant - - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric asymmetric top molecules - Hyperfine structure and quadrupole moment of linear molecules - Instrumentation techniques – block diagram -Information Derived from Rotational Spectra - Stark effect- Problems.	12
II	**INFRA-RED SPECTROSCOPY** Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations- Diatomic Vibrating Rotator- - Fundamental modes of vibration of H_2O and CO_2 –analysis of poly atomic molecule(vibrating rotation spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy - Interpretation of vibrational spectra– remote analysis of atmospheric gases like N_2O using FTIR.	12
III	**RAMAN SPECTROSCOPY** Theory of Raman Scattering - Classical theory – molecular polarizability –	12

	polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line- SR branch -Raman activity of H_2O and CO_2 .Mutual exclusion principle- determination of N_2O structure -Instrumentation technique and block diagram -structure determination of planar and non-planar molecules using IR and Raman techniques - FT Raman spectroscopy-SERS	
IV	**RESONANCE SPECTROSCOPY** Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Double resonance-Chemical shift and its measurement - NMR of Hydrogen nuclei - Indirect Spin -Spin Interaction – interpretation of simple organic molecules - Instrumentation techniques of NMR spectroscopy-single coil and double coil method. Electron Spin Resonance: Basic principle –theory of esr- Hyperfine Structure (Hydrogen atom) –g-factors –Determination of g factor, Instrumentation – Biological applications of ESR. Nuclear Quadrupole Resonance: Basic principle –theory of NQR-axial and non axial symmetry - Instrumentation techniques –Application-nature of chemical bond.	12
V	**MOSSBAUER SPECTROSCOPY ANDUV SPECTROSCOPY** Mossbauer spectroscopy –Basic principle –Instrumentation-necessary condition-application-chemical shift hyper fine spilliting and quadrupole splitting-Origin of UV spectra - Laws of absorption – Lambert Bouguer law – Lambert Beer law - molar absorptivity – transmittance and absorbance - Choice of Solvent and Solvent effect - Absorption by inorganic systems - Instrumentation - double beam UV-Spectrophotometer.	12

Textbook:

1. C N Banwell and E M McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi.
2. G Aruldhas, 1994, Molecular Structure and Molecular Spectroscopy, Prentice–Hall of India, New Delhi.
3. D.N. Satyanarayana, 2001, *Vibrational Spectroscopy and Applications*, New Age International Publication.
4. B.K. Sharma, 2015, *Spectroscopy*, Goel Publishing House Meerut.
5. Kalsi.P.S, 2016, Spectroscopy of Organic Compounds (7^{th} Edition), New Age International Publisher.

References:

1. J L McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi.
2. J M Hollas, 2002, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge.
3. B. P. Straughan and S. Walker, 1976, Spectroscopy Vol. I, Chapman and Hall, New York.
4. K. Chandra, 1989, Introductory Quantum Chemistry, Tata McGraw Hill, New Delhi.

Web resources:

1. https://www.youtube.com/watch?v=0iQhirTf2PI
2. https://www.coursera.org/lecture/spectroscopy/introduction-3N5D5
3. https://www.coursera.org/lecture/spectroscopy/infrared-spectroscopy-8jEee

4. https://onlinecourses.nptel.ac.in/noc20_cy08/preview

Pedagogy: Teaching / Learning methods

- Lecture
- Tutorial
- Assignment
- PPT presentation
- Quiz
- Group Discussion
- e-content Seminar

Course Outcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	Understand fundamentals of rotational spectroscopy, view molecules as elastic rotors and interpret their behaviour. Able to quantify their nature and correlate them with their characteristic properties.	**K2**
CO2	Understand the working principles of spectroscopic instruments and theoretical background of IR spectroscopy. Able to correlate mathematical process of Fourier transformations with instrumentation. Able to interpret vibrational spectrum of small molecules.	**K2, K3**
CO3	Interpret structures and composition of molecules and use their knowledge of Raman Spectroscopy as an important analytical tool	**K5**
CO4	Use these resonance spectroscopic techniques for quantitative and qualitative estimation of a substances	**K4**
CO5	Learn the electronic transitions caused by absorption of radiation in the UV/Vis region of the electromagnetic spectrum and be able to analyze a simple UV spectrum.	**K1, K5**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO 6	PSO7
CO1	2	3	2	2	3	3	2
CO2	3	2	3	3	3	2	2
CO3	3	3	3	2	3	2	2
CO4	2	2	3	3	3	2	2
CO5	2	3	3	3	3	2	2

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	**23P4PHEL5B**	**Major Elective – V Plasma Physics**	**4**	**3**

Nature of the course

Employability Oriented		Relevant to Local need	√
Entrepreneurship Oriented		Relevant to regional need	√
Skill development Oriented	√	Relevant to national need	√
		Relevant to Global development need	√
Addresses Gender Sensitization			
Addresses Environment and Sustainability	√		
Addresses Human Values			
Addresses Professional Ethics			

Course Objectives

The main objectives of this course are:

6. To explore the plasma universe by means of in-site and ground-based observations.
7. To understand the model plasma phenomena in the universe.
- To explore the physical processes which occur in the space environment.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**FUNDAMENTAL CONCEPT OF PLASMA** 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.	12
II	**MOTION OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELD** 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 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 behaviour.	12
III	**PLASMA OSCILLATIONS AND WAVES** 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.	12
IV	**PLASMA DIAGNOSTICS TECHNIQUES** Single probe method - Double probe method - Use of probe technique for	12

	measurement of plasma parameters in magnetic field - microwave method - spectroscopic method - -laser as a tool for plasma diagnostics-X-raydiagnostics of plasma - acoustic method - conclusion.	
V	**APPLICATIONS** Magneto hydrodynamic Generator - Basic theory - Principle of Working-Fuel in MHD Generator - Generation of Microwaves Utilizing High Density Plasma - Plasma Diode.	12

Text Book

1. Plasma Physics- Plasma State of Matter - S. N. Sen, Pragati Prakashan, Meerut.
2. Introduction to Plasma Physics-M. Uman
3. Krall, N. A., and A. W. Trivelpiece. Principles of Plasma Physics. Berkeley, CA: San Francisco Press, 1986. ISBN: 9780911302585.Tanenbaum, B. S. Plasma Physics. New York, NY: McGraw-Hill, 1967. ISBN: 9780070628120.
4. Goldston, R. J., and P. H. Rutherford. Introduction to Plasma Physics. Philadelphia, PA: IOP Publishing, 1995. ISBN: 9780750301831.

Reference Book:

1. Chen, F. F. Introduction to Plasma Physics. 2nd ed. New York, NY: Springer, 1984. ISBN: 9780306413322.
2. Introduction to Plasma Theory-D.R. Nicholson
3. Shohet, J. L. The Plasma State. San Diego, CA: Academic Press Inc., 1971. ISBN: 9780126405507.
4. Hazeltine, R. D., and F. L. Waelbroeck. The Framework of Plasma Physics. Boulder, CO: Westview Press, 2004. ISBN: 9780813342139.

Web Resources :

1. https://fusedweb.llnl.gov/Glossary/glossary.html
2. http://farside.ph.utexas.edu/teaching/plasma/lectures1/index.html
3. http://www.plasmas.org/
4. http://www.phy6.org/Education/whplasma.html
5. http://www.plasmas.org/resources.html

COURSE OUTCOMES

At the end of the course, the student will be able to:

CO1	Understand the collision, cross section of charged particles and to able to correlate the magnetic effect of ion and electrons in plasma state.	**K1, K2**
CO2	Understand the plasma and learn the magneto-hydrodynamics concepts applied to plasma.	**K2**
CO3	Explore the oscillations and waves of charged particles and thereby apply the Maxwell's equation to quantitative analysis of plasma.	**K1, K3**
CO4	Analyze the different principle and techniques to diagnostics of plasma.	**K2, K5**
CO5	Learn the possible applications of plasma by incorporating various electrical and electronic instruments.	**K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	3	3	2	3
CO2	2	1	3	3	3	1	2
CO3	3	3	3	3	3	1	2
CO4	3	2	3	3	3	1	2
CO5	3	3	3	3	3	1	1

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated; 0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	**23P4PHSEC4**	**Skill Enhancement Course – Advanced Optics**	**2**	**2**

Nature of the course

Employability Oriented		Relevant to Local need	✓
Entrepreneurship Oriented		Relevant to regional need	✓
Skill development Oriented	✓	Relevant to national need	✓
Addresses Gender Sensitization		Relevant to Global development need	✓
Addresses Environment and Sustainability		Addresses Professional Ethics	
Addresses Human Values	✓		

Course Objectives

The main objectives of this course are to:

1. To know the concepts behind polarization and could pursue research work on application aspects of laser
2. To impart an extensive understanding of fiber and non-linear optics
3. To study the working of different types of LASERS
4. To differentiate first and second harmonic generation

SYLLABUS

Unit	Content	No. of Hours
I	**POLARIZATION AND DOUBLE REFRACTION AND NON LINEAR OPTICS** Classification of polarization – Transverse nature of light waves – Polarizer and analyzer – Malu's law – Production of polarized light – – Polarization by double refraction – Polarization by scattering – The phenomenon of double refraction – Normal and oblique incidence – Interference of polarized light: Quarter and half wave plates – Analysis of polarized light – Optical activity. Harmonic generation- basic principle – Second harmonic generation – Kurtz-Perry technique- Phase matching – Third harmonic generation – Optical mixing – Parametric generation of light – Self-focusing of light – Organic, inorganic and semiorganic NLO materials-Magneto optic Stark effect- Electro optic Kerr effect and Pokels effect.	15
II	**LASERS AND FIBER OPTICS** Basic principles – Spontaneous and stimulated emissions – Components of the laser – Resonator and lasing action – Types of lasers and its applications – Solid state lasers – Ruby laser – Nd:YAG laser – gas lasers – He-Ne laser – CO_2 laser – Semiconductor laser. Total internal reflection – The optical fiber –Classification-– Guiding mechanism-The numerical aperture – Attenuation in optical fibers – Single and multi-mode fibers – Pulse dispersion in multimode optical	15

	fibers – Ray dispersion in multimode step index fibers – Parabolic-index fibers – Fiber-optic sensors: precision displacement sensor – Precision vibration sensor-Advantages and disadvantages of optical fiber- Block diagram of optical fiber communication system	

Textbooks:

1. B. B. Laud, 2017, Lasers and Non – Linear Optics, 3rd Edition, New Age International (P) Ltd.
2. AjoyGhatak, 2017, Optics, 6th Edition, McGraw – Hill Education Pvt. Ltd.
3. William T. Silfvast, 1996, Laser Fundamentals Cambridge University Press, New York
4. J. Peatros, Physics of Light and Optics, a good (and free!) electronic book.

Reference Books:

1. F. S. Jenkins and H. E. White, 1981, Fundamentals of Optics, (4th Edition), McGraw – Hill International Edition.
2. Dieter Meschede, 2004, Optics, Light and Lasers, Wiley – VCH, Varley GmbH.
3. Lipson, S. G. Lipson and H. Lipson, 2011, Optical Physics, 4th Edition, Cambridge University Press, New Delhi, 2011.
4. Y. B. Band, Light and Matter, Wiley and Sons (2006)

Web resources:

1. https://www.youtube.com/watch?v=WgzynezPiyc
2. https://www.youtube.com/watch?v=ShQWwobpW60
3. https://www.ukessays.com/essays/physics/fiber–optics–and–it-applications.php
4. https://www.youtube.com/watch?v=0kEvr4DKGRI

Pedagogy: Teaching / Learning methods

- Lecture
- Tutorial
- Assignment
- PPT presentation
- Quiz
- Group Discussion
- e-content Seminar

Course Outcomes

On the successful completion of the course, students will be able to

CO	CO Statement	Cognitive Level
CO1	Discuss the transverse character of light waves and different polarization phenomenon. Identify the properties of nonlinear interactions of light and matter.	K1,K3
CO2	Discriminate all the fundamental processes involved in laser devices and to analyze the design and operation of the devices. Demonstrate the basic configuration of a fiber optic – communication system and advantages.	**K2,K4**

Cognitive Level : K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

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