M.Sc., PHYSICS

Course Structure and Syllabus

(For the candidates admitted from the academic year 2025-2026 onwards)

CHOICE BASED CREDIT SYSTEM – LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS-LOCF)

THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)

(Approved by NAAC, Affiliated to Bharathidasan University)

ELAMBALUR, PERAMBALUR – 621 220

THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)

(Affiliated to Bharathidasan University, Tiruchirappalli)

(Accredited with 'A' Grade by NAAC (3rd Cycle) with CGPA 3.23 out of 4)

Elambalur, Perambalur – 621 220

Vision

To build a base for pre-eminence and strengthen the augmentation of the institutions as a prime Institution by igniting and promoting impetuosity, interest in the study of Physics.

Mission

- To establish a platform for the dissemination and creation of knowledge through teaching and research in Physics at various levels.
- The study of physics promotes understanding of the basic workings of nature. It also extends that understanding beyond the realms of our everyday lives, from the scales of atomic nuclei to those of galaxies.
- It is essential for understanding the role of technology in society as well as important policy issues.

Program Outcomes (POs)

- **PO 1 – Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study

- **PO 2 – Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

- **PO 3 – 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.

- **PO 4 – 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 learning to real life situations

- **PO 5 – Fostering Social Responsibility**: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.

- **PO 6 – Analytical & Research 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 perspective.

- **PO 7 – Ethics:** Ability to ethical values and social concern will be able to understand and appreciate social harmony, cultural diversity ensure sustainable environment.

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- **PO 8 – Self learning and Leadership:** Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. Leadership involves mapping tasks, setting vision, building teams, motivating members, and guiding them efficiently towards a common goal.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- **PSO 1 – Placement**

  To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors and beliefs and apply diverse frames of reference to decisions and actions.

- **PSO 2 – Entrepreneur**

  To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations

- **PSO 3 – Research and Development**

  Design and implement HR systems and practices grounded in researches that comply with employment laws, leading the organization towards growth and development.

- **PSO 4 – Contribution to Business World**

  To produce employable, ethical and innovative professionals to sustain in the dynamic business world

- **PSO 5 – Contribution to the Society**

  To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Thanthai Hans Roever College (Autonomous), Elambalur, Perambalur – 621 220.

M.Sc. Physics

Choice-Based Credit System – Learning Outcome-Based Curriculum Framework

(For the candidate admitted from the academic year 2025 -2026)

Semester	Course Code	Title of the Course	Int. Hrs /Week	Credits	End Sem. Exam Hrs	Max. Marks		
						CIA	ESE	Total
I	25PPH1CC1	Mathematical Physics	5	4	3	25	75	100
	25PPH1CC2	Classical Mechanics and Relativity	5	4	3	25	75	100
	25PPH1CC3	Linear and Digital IC's and Applications	5	4	3	25	75	100
	25PPH1CP1	Physics Practical – I	6	4	6	40	60	100
	25PPH1EC11 25PPH1EC12	Physics of Nano Science and Technology Bio- Physics	5	3	3	25	75	100
	25PPH1EC21 25PPH1EC22	Crystal Growth and Thin Films Medical Physics	4	3	3	25	75	100
	25PPHVA1	Forensic Physics	-	2*	2	50	50	100*
		Total	**30**	**22**	**-**	**-**	**-**	**600**
II	25PPH2CC4	Statistical Mechanics	6	5	3	25	75	100
	25PPH2CC5	Quantum Mechanics	6	5	3	25	75	100
	25PPH2CP2	Physics Practical – II	6	4	6	40	60	100
	25PPH2EC31 25PPH2EC32	Advanced Optics Non Linear Dynamics	5	3	3	25	75	100
	25PPH2EC41 25PPH2EC42	Microprocessor 8085 and Microcontroller 8051 Microcontroller Based Physics Instrumentation	5	3	3	25	75	100
	25PPH2NME1	Solid Waste Management	2	2	3	25	75	100
	25PPH2OC	SWAYAM/NPTEL Online Course		2**				
		Total	**30**	**22**	**-**	**-**	**-**	**600**
III	25PPH3CC6	Electromagnetic Theory	6	4	3	25	75	100
	25PPH3CC7	Numerical Methods and Computer Programming	5	4	3	25	75	100
	25PPH3CC8	Condensed Matter Physics	6	4	3	25	75	100
	25PPH3CP3	Physics Practical – III	6	4	6	40	60	100
	25PPH3EC51 25PPH3EC52	Biomedical Instrumentation Physics of Disaster Management	5	3	3	25	75	100
	25PH3NME2	Physics of Medical Instruments	2	2	3	25	75	100
		Internship/Industrial Activity***	-	2	-	-	-	100
	25PPHVA2	Materials Characterization Techniques	-	2*	2	50	50	100*
			30	**23**	**-**	**-**	**-**	**700**

Semest er	Course Code	Title of the Course	Int. Hrs /Week	Credits	End Sem. Exam Hrs	Max. Marks		
						CI A	ESE	Tota l
IV	25PPH4CC9	Nuclear and Particle Physics	5	4	3	25	75	100
	25PPH4CC10	Spectroscopy	5	4	3	25	75	100
	25PPH4CP4	Physics Practical – IV	5	4	6	40	60	100
	25PPHA4PW	Project with Viva-Voce	5	4	-	-	-	100
	25PPH4EC6	Elective- VI (Industry Entrepreneurship) Non-conventional Energy Sources	4	3	3	25	75	100
	25PPH4SE1	Skill Enhancement Course/ Professional Competency Skill Research Publications and Ethics	3	2	3	25	75	100
	25PPH4SE2	Soft Skill (Discipline oriented) Framework for Physics Innovation and Entrepreneurship	3	2	3	25	75	100
		Total	**30**	**23**	**-**	**-**	**-**	**700**
		Total	**120**	**90**	**-**	**-**	**-**	**2600**

*Internship/Industrial Activity – Internship after 2nd semester during summer vacation – 30 Hours and 2 credits will be in the 3rd semester

*The value-added course credit will not be included in the total CGPA. These courses are extra credit courses. Instruction hours for these courses is 30 hours

** SWAYAM / NPTEL online course – Extra course not considered for grand total & CGPA

List of Core Course:

S. No.	Course	Title of the Course
1	CC1	Mathematical Physics
2	CC2	Classical Mechanics and Relativity
3	CC3	Linear and Digital ICs and Applications
4	CP1	Physics Practical – I
5	CC4	Quantum Mechanics
6	CC5	Statistical Mechanics
7	CP2	Physics Practical – II
8	CC6	Electro Magnetic Theory
9	CC7	Numerical Methods and Programming
10	CC8	Condensed Matter Physics
11	CP3	Physics Practical – III
12	CC9	Nuclear and Particle Physics
13	CC10	Spectroscopy
14	CP4	Physics Practical – IV
15	PW	Project with Viva-Voce

Elective Course

List 1

1. Physics of Nano Science and Technology
2. Crystal Growth and Thin Films
3. Advanced Optics
4. Microprocessor 8086 and Microcontroller 8051
5. Biomedical Instrumentation

List 2

1. Bio Physics
2. Medical Physics
3. Non Linear Dynamics
4. Microcontroller Based Physics Instrumentation
5. Physics of Disaster Management

Non Major Elective

1. Solid Waste Management
2. Physics of Medical Instruments

Value Added Course

1. Forensic Physics
2. Materials Characterization Techniques

Industry Entrepreneurship

1. Non-Conventional Energy Sources

Skill Enhancement Course / Professional Competency Skill

1. Research Publications and Ethics

Soft Skill

1. Framework for Physics Innovation and Entrepreneurship

Question Paper Pattern

<table>
<tr><th colspan="3">PG Programme</th></tr>
<tr><td colspan="2">Maximum Marks : 75</td><td>Duration: 3 Hours</td></tr>
<tr><td rowspan="3">Section - A</td><td>i) a- (5 Questions for Multiple Choice)
One question from each unit</td><td>5 x 1 = 5 Marks</td></tr>
<tr><td>b- (5 Questions for Fill in the Blanks)
One question from each unit</td><td>5 x 1 = 5 Marks</td></tr>
<tr><td>ii) (5 short answer questions)
One question from each unit</td><td>5 x 2 = 10 Marks</td></tr>
<tr><td>Section - B</td><td>5 Questions (Internal Choice: Either or)
One set of questions from each unit</td><td>5 x 5 = 25 Marks</td></tr>
<tr><td>Section - C</td><td>3 Questions (Answer any 3 out of 5 Questions)
One question from each unit</td><td>3 x10 = 30 Marks</td></tr>
</table>

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
			MATHEMATICAL PHYSICS		Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25PPH1CC1	4			5	1	0	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The main objectives of this course are:

1. To examine linear vector spaces, independence, orthogonality, Gram-Schmidt process, linear transformations.
2. To extend their manipulative skills to apply mathematical techniques in their fields .
3. To know about the evaluation of Matrix.
4. To help students apply probability Mathematics in solving problems .
5. Explore the properties, generation, and orthogonality of Legendre, Bessel, Hermite, and Laguerre polynomials and their associated Rodrigues formulas.

Course Outcomes: After successfully completing the course, the student will learn the:

CO1: Understand use of bra-ket vector notation, the meaning of complete orthonormal set of basis vectors, and transformations and be able to apply them important integral theorems.

CO2: Grasp the basic elements of complex, analysis, including the Complex analysis.

CO3: Solved problems involving matrix diagonalization, eigenvalues, eigenvectors, and advanced decomposition methods, and analyze quadratic forms and matrix representations Complex analysis, residues and singularities.

CO4: Solve equations using the Fourier transformations and probability solving the problem that acquire in various branches of physics .

CO5: Explained the properties, generation, and orthogonality of special functions like Legendre, Bessel, and Hermite polynomials, along with their recurrence relations.

Unit-I	LINEAR VECTOR SPACE	15 Hrs.

Basic concepts – Definitions- examples of vector space – Linear independence – Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure – linear operators – Dual space – ket and bra notation – orthogonal basis – change of basis – Isomorphism of vector space – projection operator – Eigen values and Eigen functions – Direct sum and invariant subspace – orthogonal transformations androtation.

Unit-II	COMPLEX ANALYSIS	15Hrs.

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 and an annular region.

Unit-III	MATRICES	15 Hrs.

Types of Matrices and their properties, Rank of a Matrix – Conjugate of a matrix – Adjoint of a matrix –Inverse of a matrix – Hermitian and Unitary Matrices –Trace of a matrix – Transformation of matrices – Characteristic equation – Eigen values and Eigen vectors – Cayley–Hamilton theorem – Diagonalization.

Unit-IV	FOURIER TRANSFORMS & PROBABILITY	15Hrs.

Definitions – Fourier transform and its inverse – Transform of Gaussian function and Dirac delta 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 – Wave equation Vibration of an infinite string and of a semi – infinite string. **Basic concept of probability distribution – Exclusive events and addition – Compound event and products – Binomial – Poisson and Guassian distribution – Normal Distribution.**

Unit-V	ORTHOGONAL POLYNOMIALS	15 Hrs.

General theory of orthogonal polynomials – Legendre, Bessel, Hermite, Laguerre and Associated Laguerre differential equations – Power series solution – Polynomials – Generating functions – Rodrigue's formula – Recursion relations – Orthogonality relations.

Text Book(s):

1. H. K. Dass and Dr. Rama Verma, 2014, Mathematical Physics, Seventh Revised Edition, S. Chand & Company Pvt. Ltd., New Delhi.
2. Satya Prakash, 2004, Mathematical Physics, 4 th Edition, Sultan Chand & Sons, New Delhi.
3. B. D. Gupta, 2009, *Mathematical Physics* (4th edition), Vikas Publishing House, New Delhi.
4. George Arfken and Hans J Weber, 2012, Mathematical Methods for Physicists – A Comprehensive Guide (7th edition), Academic press.
5. P.K. Chattopadhyay, 2013, *Mathematical Physics* (2nd edition), New Age, New Delhi
6. A W Joshi, 2017, Matrices and Tensors in Physics, 4th Edition (Paperback), New Age International Pvt.Ltd., India.

Reference Book(s):

1. E. Kreyszig, 1983, Advanced Engineering Mathematics, Wiley Eastern, New Delhi,
2. D. G. Zill and M. R. Cullen, 2006, Advanced Engineering Mathematics, 3rd Ed. Narosa, New Delhi.
3. S. Lipschutz, 1987, Linear Algebra, Schaum's Series, McGraw – Hill, New York 3. E. Butkov,1968, Mathematical Physics Addison – Wesley, Reading, Massachusetts.
4. P. R. Halmos, 1965, Finite Dimensional Vector Spaces, 2nd Edition, Affiliated EastWest, NewDelhi.
5. C. R. Wylie and L. C. Barrett, 1995, Advanced Engineering Mathematics, 6 th Edition,
6. International Edition, McGraw-Hill, New York.

Web Resources:

1. www.khanacademy.org
2. https//youtu.be/LznRlO A1_2I
3. http//hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath
4. https//www.youtube.com/watch?v=_2jymuM7OUU&list=PlhkiT_RYTEU27vS_SlED56gNj VJGO2qaZ

Course Outcomes (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	3	3	1	3	2	2	2	2	3	2	1
CO2	3	1	2	2	1	2	1	1	1	1	2	1	1
CO3	3	1	3	3	1	3	2	2	2	2	3	2	1
CO4	3	2	3	3	2	2	2	2	2	3	2	2	2
CO5	3	1	3	2	2	2	2	1	2	2	3	2	2
	Overall CO – PO Mapping index = 2.125								**Overall CO – PSO Mapping index = 1.92**				

1 – Low Correlation 2 – Medium Correlation 3 – High Correlation

Prepared by Checked by HoD

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25PPH1CC2	4	**CLASSICAL MECHANICS**		5	1	0	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The main objectives of this course are:

1. To make the students to understand fundamentals of classical mechanics
2. To gain knowledge about Lagrangian and Hamiltonian formulations
3. To discuss the theory of small oscillations of a system
4. To introduce the concepts of kinematics of rigid body
5. To learn the relativistic formulation of mechanics of a system.

Course Outcomes: After successfully completing the course, the student will learn the:

CO1:understand relativistic mechanics, D' Alemberts concept and Lagrangian

CO2:Solve problems involving Hamiltonian formulations.

CO3:Get better understanding on small oscillations.

CO4:Analyse the cyclic coordinates and apply them for rigid body dynamics.

CO5:Evaluate the concepts of inertial, non-inertial frames of references and rotating coordinate system in relativistic mechanics.

Unit-I	Principles of Classical Mechanics and Lagrangian Formulation	15 Hrs.

Mechanics of a single particle – mechanics of a system of particles – conservation laws for a systemof particles – constraints – holonomic & non- holonomic constraints – generalized coordinates – configuration space – transformation equations – principle of virtual work. D‟Alembert‟s principle – Lagrangian equations of motion for conservative systems – Applications: Atwood's machine, Simple pendulum, One dimensional harmonic oscillator and Projectile motion.

Unit-II	Hamiltonian Formulation	15 Hrs

Phase space – cyclic coordinates – conjugate momentum – Hamiltonian function – Hamilton's canonical equations of motion – applications: (i) simple pendulum (ii) one dimensional simple harmonic oscillator (iii) compound pendulum – linear harmonic oscillator **(iv) motion of particle in a central force field. – Δ-variation – principle of least action- statement and its proof – other forms of the action principle (Jacobi's form).**

Unit-III	Small Oscillations	15 Hrs

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**.

Unit-IV	Kinematics of Rigid body	15 Hrs

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.

Unit-V	Relativity	15 Hrs.

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

Text Book(s):

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).

Reference Book(s):

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 Nath Publishers, Meerut, 2020).
4. Classical Mechanics of Particles and Rigid Bodies – K.C. Gupta, (New Age International Publishers, New Delhi, 2018).
5. 5. Introduction to Classical Mechanics - R.G. Takwale and P.S. Puranik, (Tata McGrawHill, New Delhi, 2017).

Web Resources:

1. http//poincare.matf.bg.ac.rs/~zarkom/Book_Mechanics_Goldstein_Classical_Mechanics_optimized.pdf
2. https//pdfcoffee.com/classical- mechanics-j-c-upadhyay-2014-editionpdf-pdf- free.html
   3. https//nptel.ac.in/courses/122/106/122106027/
3. https//ocw.mit.edu/courses/physics/8-09-classical- mechanics- iii- fall-2014/lecture-notes/
4. https//www.britannica.com/science/relativistic- mechanics

Course Outcomes (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	1	2	2	0	2	1	2	2	2	3	2	1
CO2	3	1	3	3	0	3	1	2	2	3	3	3	1
CO3	3	1	2	3	0	3	1	2	2	2	3	2	1
CO4	3	1	3	3	0	3	1	3	2	3	3	3	1
CO5	3	1	3	2	0	2	1	2	2	2	2	2	1
	Overall CO – PO Mapping index = 1.875								**Overall CO – PSO Mapping index = 2.12**				

1 – Low Correlation 2 – Medium Correlation 3 – High Correlation

Prepared by Checked by HoD

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25PPH1CC3	4	Linear and Digital IC's and Applications		5	1	0	3 Hrs.	25	75	100

Pre-Requisite:

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.
5. Exposure to digital IC's

Course Outcomes: After successfully completing the course, the student will learn the:

CO1:Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems.

CO2:Develop skills to design linear and non-linear applications circuits using Op-Amp and designthe active filters circuits.

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.

CO4:Learn about various techniques to develop A/D and D/A converters.

CO5:Acquire the knowledge about the CMOS logic, combinational and sequential circuits.

Unit-I	**INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER**	15 Hrs.

Introduction – Classification of IC's – **Fabrication of Integrated Circuits – types of Integrated Circuits: Linear and Digital – IC Packages and Characteristics – IC Numbering and Manufacturer Designations – Introduction to Operational Amplifier – Block Diagram and Symbol of an Op-Amp – Construction and Internal Structure of Op-Amps basic information of Op-Amp 741 and its features** – the ideal Operational amplifier – Op-Amp internal circuit and Op-Amp. Characteristics.

Unit-II	**APPLICATIONS OF OP-AMP**	15 Hrs.

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, Adder and subtractor, multiplier and divider, Comparators, Schmitttrigger, Multivibrators, Triangular and Square waveform generators.

Unit-III	**ACTIVE FILTERS &TIMER AND PHASE LOCKED LOOPS**	15 Hrs.

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 a stable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage controlled oscillator (IC 566), low pass filter, monolithic PLL and applications of PLL

Unit-IV	**VOLTAGE REGULATOR &D to A AND A to D CONVERTERS**	15 Hrs.

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, DAC and ADC Specifications.

Unit-V	CMOS LOGIC,COMBINATIONAL CIRCUITS USING TTL 74XX ICs & SEQUENTIAL CIRCUITS USING TTL 74XX ICs	15 Hrs.
CMOS LOGICCMOS 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), Decoder (IC 74138, IC 74154), BCDto 7-segment decoder (IC7447), Encoder (IC74147), Multiplexer (IC74151), Demultiplexer (IC 74154). SEQUENTIAL CIRCUITS USING TTL 74XX ICs Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), **synchronous** and asynchronous binary counter (IC 7493).		

Text Book(s):

1. Classical mechanics - H. Goldstein, C. P. Poole and J. Safko, (Pearson, New Delhi,2011).
2. V.K. Mehta and Rohit Mehta, 2008, Principles of Electronics, S. Chand & Co, 12th Edition.
3. B.L. Theraja and A.K. Theraja, 2004, A Textbook of Electrical technology, S. Chand & Co.
4. Malvino and Leach (2005), Digital Principles and Applications 5th Edition, Tata McGraw Hill,New Delhi
5. D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt.Ltd., NewDelhi,India
6. 5. Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, PrenticeHall / Pearson Education, NewDelhi.

Reference Book(s):

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. Floyd, Jain (2009), Digital Fundamentals, 8th edition, Pearson Education, New Delhi.
4. Integrated Electronics, Millman & Halkias, Tata McGraw Hill, 17th Reprint (2000)
5. V. Vijayendran, 2008, Introduction to Integrated electronics (Digital & Analog), S.Viswanathan Printers & Publishers Private Ltd, Reprint. V.

Web Resources:

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/

Course Outcomes (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	1	2	3	0	3	1	2	2	2	3	3	1
CO2	3	1	3	3	0	3	1	2	2	3	3	3	1
CO3	3	1	3	3	0	2	1	2	2	3	3	2	1
CO4	3	1	3	3	0	3	1	3	2	2	3	2	1
CO5	3	1	3	3	0	3	1	3	3	3	3	3	1
	Overall CO – PO Mapping index = 2								**Overall CO – PSO Mapping index = 2.28**				

1 – Low Correlation 2 – Medium Correlation 3 – High Correlation

Prepared by Checked by HoD

Sem.	Course Code	Credits	Title of the Course	CP	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25PPH1CP1	4	**Physics Practical-I**		0	1	6	3 Hrs.	40	60	100

Pre-Requisite:

Course Outcomes: After successfully completing the course, the student will learn the:

CO1:Understand various technique and concepts in electronics experiments.

Co2:Develop the skill in handling instruments.

CO3:Various techniques and concepts in electronics.

CO4:Study the characteristics of FET, UJT and SCR.

CO%:Design and study the Multivibrator.

Unit-I	Any **TWELVE** Experiments	36 Hrs.

1. Determination of Young"s modulus and Poisson"s ratio by Hyperbolic fringes - Cornu"s Method.
2. Measurement of Conductivity - Four probe method.
3. Arc spectrum – Iron.
4. Molecular spectra – AlO band.
5. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.
6. Determination of Diffraction pattern of light with circular aperture using Diode/He-Ne laser.
7. Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser.
8. Measurements of Standing wave and standing wave co-efficient, Law of Inverse square, Receiver end transmitter behaviour, Radiation Pattern - Microwave test bench
9. UV-Visible spectroscopy – Verification of Beer-Lambert's law and identification of wavelength maxima – Extinction coefficient
10. Construction of relaxation oscillator using UJT
11. FET CS amplifier- Frequency response, input impedance, output impedance
12. Study of important electrical characteristics of IC741.
13. Constructions of Schmidt trigger circuit using IC 741 for a given hysteresis- application as squarer.
14. Construction of square wave Triangular wave generator using IC 741
15. Construction of a quadrature wave using IC 324
16. Construction of pulse generator using the IC 741 – application as frequency divider
17. Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
18. Study of Binary to Gray and Gray to Binary code conversion.
19. Study of R-S, clocked R-S and D-Flip flop using NAND gates
20. Study of J-K, D and T flip flops using IC 7476/7473
21. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.
22. Study of Arithmetic logic unit using IC 74181.
23. Construction of Encoder and Decoder circuits using ICs.

Text Book(s):

1. Practical Physics, Gupta and Kumar, PragatiPrakasan.
2. Kit Developed for doing experiments in Physics-Instruction manual,R.Srinivasan K.R Priolkar, Indian Academy of Sciences.
3. Electronic Laboratory Primer a design approach, S.Poornachandra, B.Sasikala, Wheeler Publishing, New Delhi.
4. Electronic lab manual Vol I, K ANavas, Rajath Publishing.
5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition.

Reference Book(s):

1. Advanced Practical Physics, S.P Singh, PragatiPrakasan.
2. An advanced course in Practical Physics, Chattopadhyay, C.R Rakshit, New Central Book Agency Pvt. Ltd
3. Op-Amp and linear integrated circuit, Ramakanth A Gaikwad, Eastern Economy Edition.
4. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd.
5. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing.

Course Outcomes (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	1	3	3	1	3	1	2	3	2	3	2	2
CO2	3	1	2	3	1	3	1	3	3	3	3	3	2
CO3	3	1	3	3	1	3	1	3	3	3	3	3	2
CO4	3	1	2	3	1	2	1	2	2	2	3	2	2
CO5	3	1	3	3	1	3	1	3	3	3	3	3	2
	Overall CO – PO Mapping index = 2.125								**Overall CO – PSO Mapping index = 2.6**				

1 – Low Correlation　　2 – Medium Correlation　　3 – High Correlation

Prepared by　　Checked by　　HoD

<table>
<tr><th rowspan="2">Sem.</th><th rowspan="2">Course Code</th><th rowspan="2">Credits</th><th>Title of the Course</th><th rowspan="2">CC</th><th colspan="3">Category</th><th rowspan="2">Sem. Exam</th><th colspan="3">Max. Marks</th></tr>
<tr><th rowspan="2">PHYSICS OF NANOSCIENCE AND TECHNOLOGY</th><th>Lect. Hrs.</th><th>Tutorial Hrs.</th><th>Lab. Hrs.</th><th>CIA</th><th>ESE</th><th>Total.</th></tr>
<tr><td>I</td><td>25PPH1EC11</td><td>3</td><td></td><td>5</td><td>1</td><td>0</td><td>3 Hrs.</td><td>25</td><td>75</td><td>100</td></tr>
</table>

Pre-Requisite:

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.
5. Physics of Nanoscience and Technology is concerned with the study, creation, manipulation and applications at nanometer scale.

Course Outcomes: After successfully completing the course, the student will learn the:

CO1:Understand the basic of nanoscience and explore the different types of nanomaterials and should comprehend the surface effects of the nanomaterials.

CO2:Explore various physical, mechanical, optical, electrical and magnetic properties nanomaterials.

CO3:Understand the process and mechanism of synthesis and fabrication of nanomaterials.

CO4:Analyze the various characterizations of Nano-products through diffraction, spectroscopic, microscopic and other techniques.

CO5:Apply the concepts of nanoscience and technology in medical field

Unit-I	**BACKGROUND AND EMERGENCE OF NANOTECHNOLOGY**	12 Hrs.

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.

Unit-II	**QUANTUM DOTS AND CARBON NANOTUBES**	12 Hrs.

Quantum dots (QDs) – Quantum confinement –Production and applications of QDs –Quantum wires – Quantum wells – Carbon allotropes – Discovery of C60 – Fullerenes – Types of fullerenes – Bucky balls – Carbon nanotubes (CNTs) – Single walled CNTs – Multiwalled CNTs – Properties of CNTs – Potential applications of CNTs.

Unit-III	**PREPARATION OF NANOMATERIALS**	12 Hrs.

Nanomaterials – Preparation– Top-down method – Ball milling– Photolithography– Electron beam lithography – Molecular beam epitaxy – Bottom-up technique – Soft-chemical method – Sol-gel synthesis – Electro chemical deposition – Atomic layer deposition- Molecular self-assembly.Synthesis of CNTs – Plasma-arc discharge method – Laser ablation technique – Chemical vapour deposition method

Unit-IV	ANALYTICAL TECHNIQUES FOR NANOMATERIALS CHARACTERIZATION	12 Hrs.
	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 tunneling microscope (STM) – Transmission Electron Microscope (TEM) – Photoluminescence spectroscopy –X-ray photoelectron spectroscopy (XPS).	
Unit-V	**APPLICATIONS OF NANOMATERIALS**	00 Hrs.
	Nanoelectronics – Molecular diodes and transistors – Quantum electronic devices – Nanophotonics –Photonic crystals – Nano electromechanical 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.	

Text Book(s):

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 Book(s):

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.

Course Outcomes (COs)	Program Outcomes (**POs**)								Programme Specific Outcomes (**PSOs**)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	1	3	2	1	2	1	2	3	2	3	2	2
CO2	3	1	3	3	1	3	1	2	3	2	3	3	2
CO3	3	1	3	3	1	3	1	3	3	3	3	3	2
CO4	3	1	3	3	1	3	1	3	3	3	3	3	2
CO5	3	2	3	2	3	2	2	3	3	2	3	3	3
	Overall CO – PO Mapping index = 2.2								**Overall CO – PSO Mapping index = 2.62**				

1 – Low Correlation 2 – Medium Correlation 3 – High Correlation

Prepared by Checked by HoD

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
			BIO-PHYSICS		Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25PPH1EC12	3			5	1	0	3 Hrs.	25	75	100

Pre-Requisite:

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.

Course Outcomes: After successfully completing the course, the student will learn the:

CO1:Understand the structural organization and function of living cells and should able to apply the cell signaling mechanism and its electrical activities.

Co2:Comprehension of the role of biomolecular conformation to function.

CO3:Conceptual understanding of the function of biological membranes and also to

CO4:understand the functioning of nervous system.

CO5:To know the effects of various radiations on living systems and how to prevent ill effects of radiations.

Unit-I	CELLLULAR BIOPHYSICS	12 Hrs.

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.

Unit-II	MOLECULAR BIOPHYSICS	12 Hrs.

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.

Unit-III	MEMBRANE AND NEURO BIOPHYSICS	12 Hrs.

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.

Unit-IV	RADIATION BIOPHYSICS	12 Hrs.

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.

Unit-V	PHYSICAL METHODS IN BIOLOGY	12 Hrs.
	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.	

Text Book(s):

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.
5. Bioinstrumentation, L. Veerakumari, MJP Publishers, 2006.

Reference Book(s):

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 (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	3	2	2	2	1	2	3	2	3	2	2
CO2	3	1	3	2	1	2	1	1	3	2	3	2	1
CO3	3	1	3	3	1	3	1	2	3	2	3	3	2
CO4	3	1	3	2	2	2	1	2	3	2	3	2	2
CO5	3	2	3	3	3	2	3	2	3	2	3	3	3
	Overall CO – PO Mapping index = 2.125								**Overall CO – PSO Mapping index = 2.48**				

1 – Low Correlation 2 – Medium Correlation 3 – High Correlation

Prepared by Checked by HoD

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25PPH1EC21	3	**CRYSTAL GROWTH AND THIN FILMS**		4	1	0	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The main objectives of this course are:

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

Course Outcomes: After successfully completing the course, the student will learn the:

CO1:Apply the idea about the growth of crystals by suitable methods

CO2:Realize the necessity growth of thin films and their growth stages

CO3:Design physical deposition method and their process to coating thin films

CO4:Design chemical deposition method and their steps to coating thin films

CO5:Analysis the properties of materials present in the thin film and grown crystals.

Unit-I	**CRYSTAL GROWTH METHODS**	12 Hrs.

Nucleation – types of nucleation – Classical theory of nucleation – Low temperature solution growth: solubility – Saturation – Super saturation Expression for super saturation – Miers T-C diagram – Slow cooling method – Slow evaporation method – Gel method – Chemical reaction method – single and double diffusion method – Advantages of gel method .Melt growth method: Bridgman technique – Czochralski technique – Verneuil method – Merits and demerits.

Unit-II	**FUNDAMENTALS AND APPLICATIONS OF THIN FILMS**	12 Hrs.

Introduction–Advantagesofthinfilmdevicesovertheirbulkcounterparts – Thin film growth stages: Nucleation stage – Island stage – Coalescence stage – 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–dye sensitized solar cells – Thin films in electronic devices – Thin films in disinfectant technologies –Optical coatings–Chemical and mechanical applications.

Unit-III	**PHYSICAL DEPOSITION METHODS**	12 Hrs.

Basics of vacuum – Physical Vapour Deposition (PVD) – Thermal evaporation – 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– Atomic layer Deposition.

Unit-IV	**CHEMICAL DEPOSITION METHODS**	12 Hrs.

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–Metalorganic type, plasma assisted, laser assisted – Applications.

Unit-V	**MATERIALS PROPERTIES MEASUREMENT**	12 Hrs.

Thickness of coatings, structural, micro structural, compositional, electrical and optical characterizations: Surface Profilometry – Multiple beam interferometry (Fizeau method) Energy dispersive analysis of X-ray (EDAX) – Atomic force microscopy (AFM) – Four-point probe technique for sheet resistance measurement. Mechanical properties: adhesion, micro and nano hardness, wear, roughness –Vickers hardness test Determination of hardness coefficient – Thermo gravimetric analysis (TGA) – Differential thermal analysis (DTA).

Text Book(s):

1.J.C.Brice, Crystal Growth Processes, John Wiley and Sons, New York (1986).
2. K.Ravichandran, K.Swaminathan, B.Sakthivel, Introduction to Thin Films, Research India Publications, New Delhi (2013)- ISBN:978-93-841444-05-0.
3. R.F.Bunshah, "Hand book of deposition technologies for films and coatings, science, technology and applications", NewYork Noyes publications,1994

Reference Book(s):

1. P. Santhana Ragavan 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,"Surface Modification Technologies", 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

Course Outcomes (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	1	3	2	1	2	1	2	3	2	3	2	2
CO2	3	1	3	3	1	3	1	2	3	3	3	3	2
CO3	3	1	3	3	1	3	1	2	3	3	3	3	2
CO4	3	1	3	3	1	3	1	3	3	3	3	3	2
CO5	3	2	3	3	2	3	2	3	3	2	3	3	3
	Overall CO – PO Mapping index = 2.2								**Overall CO – PSO Mapping index = 2.72**				

1 – Low Correlation   2 – Medium Correlation   3 – High Correlation

Prepared by   Checked by   HoD

<table>
<tr><td rowspan="2">Sem.</td><td rowspan="2">Course Code</td><td rowspan="2">Credits</td><td>Title of the Course</td><td rowspan="2">CC</td><td colspan="3">Category</td><td rowspan="2">Sem. Exam</td><td colspan="3">Max. Marks</td></tr>
<tr><td rowspan="2">MEDICAL PHYSICS</td><td>Lect. Hrs.</td><td>Tutorial Hrs.</td><td>Lab. Hrs.</td><td>CIA</td><td>ESE</td><td>Total.</td></tr>
<tr><td>I</td><td>25PPH1EC22</td><td>3</td><td></td><td>4</td><td>1</td><td>0</td><td>3 Hrs.</td><td>25</td><td>75</td><td>100</td></tr>
</table>

Pre-Requisite:

Course Objectives: The main objectives of this course are:

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.
5. To understand the Electrocardiogram and uses of computers in medicine

Course Outcomes: On completion of this course, students will

CO1:Be aware on the applications electricity and magnetism in medicine.

CO2:Gain knowledge on the role of lasers in medicine.

CO3:Acquire knowledge on the role of radioactivity in medicine.

CO4:Be equipped to tackle radiation accidents.

CO5:Equip themselves to use computers in medicine.

Unit-I	**TERMINOLOGY, MODELING AND MEASUREMENT**	12 Hrs.

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.

Unit-II	**LIGHT IN MEDICINE**	12 Hrs.

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.

Unit-III	**RADIO ISOTOPES IN MEDICINE (NUCLEAR MEDICINE)**	12 Hrs.

Sources of Radioactivity for Nuclear Medicine – Basic Instrumentation and its clinical applications – Nuclear Medicine imaging devices – Therapy with radioactivity – Radiation doses in Nuclear Medicines.

Unit-IV	**RADIATION PROTECTION IN MEDICINE**	12 Hrs.

Biological effects of ionizing radiation – Radiation protection in Diagnostic Radiology – Radiation protection in Radiation therapy – Radiation protection in Nuclear Medicine – Radiation Accidents.

Unit-V	**COMPUTERS IN MEDICINE**	12 Hrs.

History taking – Laboratory Automation – Electrocardiogram interpretation – Patient monitoring– Drug-test interactions – prescribing drug dosage – Pulmonary function testing – Medical record systems – Hospitals book keeping – Other uses of computers in medicine.

Text Book(s):

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 Book(s):

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.as

Course Outcomes (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	1	2	2	2	2	2	2	3	2	2	2	3
CO2	3	1	2	3	1	2	1	2	3	2	2	2	2
CO3	3	1	3	3	1	3	2	2	3	2	3	2	2
CO4	3	1	3	3	3	3	3	3	3	2	3	3	3
CO5	3	1	3	2	2	3	2	3	3	2	3	3	3
	Overall CO – PO Mapping index = 2.25								**Overall CO – PSO Mapping index = 2.52**				

1 – Low Correlation 2 – Medium Correlation 3 – High Correlation

Prepared by Checked by HOD

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25PPH1EC22	3	**Forensic physics**		4	1	0	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The main objectives of this course are:

1. To study the basic definitions and concepts involved in trace evidences.
2. To handle the evidences left out at the crime scene.
3. To Identify the Composition and Manufacture of Glass and Paint.
4. To Interpret of Physical aspects of Glass evidences.
5. To analyze the evidences with the help of various spectroscopic methods.

Course Outcomes: On completion of this course, students will

CO1:On successful completion of this course, students will be able to

CO2:Acquire knowledge about the concept and scope of forensic evidences.

CO3:Understand the composition and manufacturing of different types of evidences.

CO4:Identify and apply physical aspects of various evidences.

CO5:Distinguish the different evidences with the help of spectroscopic analysis.

Unit-I | TRACE EVIDENCES | 12 Hrs.

Preliminary definitions - Concepts and the production of physical evidence - Uses of trace evidence - The history of trace evidence - The scope of trace evidence - Associations based on physical pattern evidence - Associations based on material comparisons - The role of trace evidence databases - Complementary nature of trace evidence and DNA typing - Recognition and interpretation of trace evidence - Hair and fibre evidence - Glass evidence - Paint evidence - Miscellaneous types of trace evidence - Future Technology and trace evidence - Summary and conclusions.

Unit-II | COMPOSITION AND MANUFACTURE OF GLASS | 12 Hrs.

Introduction - Definition of a glass - Commercial glass types - Glass-manufacturing process - Glass - forming processes - Secondary glass processing - Principal glass types and applications.

Unit-III | INTERPRETATION OF PHYSICAL ASPECTS OF GLASS EVIDENCE | 12 Hrs.

Glass as physical evidence - Recovery of evidence glass fragments - Physical matches of fractured glass - Fractures in flat glass - Fractures in other items - Glass fractures produced by fragments - Backward propagation of glass fragments - Glass in fires - Retention and persistence of glass fragments in clothing - Future directions for the physical examination of glass evidence.

Unit-IV | INTERPRETATION OF PAINT EVIDENCE | 12 Hrs.

Introduction - Paint transfer mechanisms - Household paints - Vehicle paint - A Bayesian approach - Conclusion.

Unit-V | ELEMENTAL ANALYSIS OF GLASS AND PAINT | 12 Hrs.

Introduction - Forensic and analytical implications of the composition of glass - Atomic spectroscopy - X-ray methods - Introduction of Infrared spectroscopy - Infrared spectroscopy - Infrared instrumentation - Preparation of samples for analysis - Infrared analysis of paint - Interpretation of IR spectra of non-automotive (domestic) paints - Identification of automotive paints by interpretation of their infrared spectra. EDAX

Text Book(s):

1. Caddy, B. -Taylor & Francis Forensic science series (2001). *Forensic examination of Glass and Paint Analysis and interpretation*, Publication, London, United Kingdom.

Reference Book(s):

1. Richard, S., & Tiffany, R. (2020). *Criminalistics -An Introduction to Forensic Science.* Pearson - Education.
2. Hunter, H. (2014). *Solving Crimes with Physics.* Mason Crest publication.

Web Resources:

1. https://www.nist.gov/forensic-science#:~:text=Forensic%20science%20is%20the%20use,to%20anthropology%20and%20wildlife%20forensics.
2. https://www.merriam-webster.com/dictionary/forensic
3. https://nij.ojp.gov/topics/forensics

Course Outcomes (COs)	Program Outcomes (POs)								Programme Specific Outcomes (PSOs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	3	2	3	2	3	2	3	2	2	2	3
CO2	3	2	3	2	2	2	2	2	3	2	2	2	2
CO3	3	1	2	3	1	3	2	2	3	2	3	2	2
CO4	3	1	3	3	2	3	2	3	3	2	3	2	3
CO5	3	2	3	3	2	3	2	3	3	3	3	3	3
	Overall CO – PO Mapping index = 2.4								**Overall CO – PSO Mapping index = 2.52**				

1 – Low Correlation　　2 – Medium Correlation　　3 – High Correlation

Prepared by　　Checked by　　HOD

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25PPH2CC4	5	**STATISTICAL MECHANICS**		5	1	-	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The main objectives of this course are:

1. To review the fundamental concepts of thermodynamics in order to understand Statistical mechanics
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 understand the fundamental principles of Statistical mechanics
5. To get in depth knowledge about Real gas, Ising model and fluctuation of thermodynamic properties that vary with time

Course Outcomes: On completion of this course, students will

CO1:Understand the ways to calculate the thermo dynamical quantities theoretically

CO2: Describe the Liouville theorem and detailed description on different ensembles

CO3: Analyse the Phase Transitions and scale transformations of gas particles.

CO4: To recall and apply the different statistical concepts to analyse the behaviour of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics.

CO5: Examine the thermodynamical behaviour of gases under fluctuation and also using Ising model.

Unit-I	**STATISTICAL MECHANICS AND THERMODYNAMICS**	12 Hrs.

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.

Unit-II	**Canonical and grand canonical ensembles**	12 Hrs.

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.

Unit-III	**Phase transitions**	12 Hrs.

Phase transitions – First and Second order Phase transitions – Order parameters – Ehrenfest's classification – Phase equilibrium – Gibb's phase rule – Landau's theory of phase transition – critical indices – scale transformation and dimensional analysis.

Unit-IV	**Classical and Quantum statistics**	12 Hrs.

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 – comparison of three statistics – Bose-Einstein condensation.

Unit-V	**REAL GAS, ISING MODEL AND FLUCTUATIONS**	12 Hrs.

Cluster expansion for a classical gas – Virial equation of state – Calculation of the first Virial coefficient in thecluster expansion – vander wall's equation – Ising model – Mean-field theories of the Ising model in three, two and one dimensions – Exact solutions in one dimension. Correlation of space-time dependent fluctuations – Fluctuations and transportphenomena – Brownian motion – Langevin‟s theory – Fluctuation-dissipation theorem – The Fokker-Planck equation.

Text Book(s):

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, NewDelhi.
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.

M. K. Zemansky, 1968, *Heat and Thermodynamics*, 5th edition, McGraw-Hill New York.

Reference Book(s):

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. Neise and H. Stoecker, *Thermodynamics and Statistical Mechanics,* Springer Verlang, NewYork.
5. A. B. Gupta, H. Roy, 2002, *Thermal Physics*, Books and Allied, Kolkata

Web Resources:

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

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25PPH2CC5	5	QUANTUM MECHANICS		5	1	-	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The main objectives of this course are:

1. To develop the physical principles and the mathematical background important to quantum mechanic 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 three-dimensional potential.
4. To explain the mathematical formalism and the significance of constants of motion, and see their relatio to fundamental symmetries in nature
5. To discuss the Approximation methods like perturbation theory, Variational and WKB methods fo solving the Schrödinger equation.

Course Outcomes: On completion of this course, students will

CO1: Explaining the postulates of quantum mechanics.

CO2: Identify the features of certain exactly solvable systems.

CO3: Describing the time- independent and time-dependent perturbation theories.

CO4: Describe the method of angular momentum and commutation relation.

CO5: Application of the Born approximation and partial wave analysis to simple systems. Determine the solution of a relativistic free Dirac particle.

Unit-I **BASIC FORMALISM** 12 Hrs.

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 – adjoint and self adjoint operators – Eigen functions and eigenvalues – Hermitian operator – Postulates of quantum mechanics – measurability of observables – Uncertainty relation.

Unit-II **ONE DIMENSIONAL AND THREE-DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS** 12 Hrs.

Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – well periodic potential – Linear harmonic oscillator; Operator method – Particle moving in a spherically symmetric potential – System of two interacting particles – Hydrogen atom – Tunnel effect – Rigid rotator.

Unit-III **PERTURBATION THEORY** 12 Hrs.

Time dependent perturbation theory – First and Second order transition- Transition to continuum of states – Fermi Golden rule – Constant and Harmonic perturbation – Transition probability – Selection rules for dipole radiation.

Unit-IV **APPROXIMATION METHODS** 12 Hrs.

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.

Unit-V **ANGULAR MOMENTUM** 12 Hrs.

Orbital angular momentum – Spin angular momentum – Total angular momentum operators – commutation relations of total angular momentum with components – Ladder operators – Commutation relation of J_z with J_+ and J_- – Eigen values of J^2,J_Z-Matrix representation of J^2,J_Z, J_+ and J_- – Addition of angular momenta – CG Coefficients – properties.

Text Book(s):

1. Gupta, Kumar & Sharma, Quantum Mechanics, 34rd Edition, 2017.
2. G. Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009.
3. V. K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi, 1985.
4. P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, 2^{nd}edition(37th Reprint),Tata McGraw-Hill, New Delhi, 2010.
5. David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011.
6. SL Gupta and ID Gupta, Advanced Quantum Theory and Fields, 1^{st} Edition, S.Chand& Co., New Delhi, 1982.
7. A. Ghatak and S. Lokanathan, Quantum Mechanics Theory and Applications, 4^{th}Edition, Macmillan,India, 1984.

Reference Book(s):

1. E. Merzbacher, Quantum Mechanics, 2nd Edition, John Wiley and Sons, New York, 1970.
2. L. D. Landau and E. M. Lifshitz, Quantum Mechanics, 1st edition, Pergomon Press, Oxford, 1976.
3. S. N. Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata,1999.
4. V. Devanathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford , 2011.

Web Resources:

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
5. https//theory.physics.manchester.ac.uk/~xian/qm/chapter3.pdf

<table>
<tr><th rowspan="2">Sem.</th><th rowspan="2">Course Code</th><th rowspan="2">Credits</th><th>Title of the Course</th><th rowspan="2">CP</th><th colspan="3">Category</th><th rowspan="2">Sem. Exam</th><th colspan="3">Max. Marks</th></tr>
<tr><th rowspan="2">Physics Practical-II</th><th>Lect. Hrs.</th><th>Tutorial Hrs.</th><th>Lab. Hrs.</th><th>CIA</th><th>ESE</th><th>Total.</th></tr>
<tr><td>II</td><td>25PPH2CP2</td><td>4</td><td></td><td>0</td><td>0</td><td>6</td><td>3 Hrs.</td><td>40</td><td>60</td><td>100</td></tr>
</table>

Pre-Requisite:

Course Outcomes: After successfully completing the course, the student will learn the:

CO1: To understand the concept of mechanical behaviour of materials and calculation of same usingappropriate equations.

Co2: To analyse the electrical properties of materials.

CO3: To observe the applications of FET and UJT.

CO4: To study the different applications of operational amplifier circuits.

CO5: To learn about Combinational Logic Circuits and Sequential Logic Circuits.

Unit-I	Any **TWELVE** Experiments	36 Hrs.

1. Logic gates – Universality of NAND / NOR gates Using IC‟s
2. Verification of Demorgan‟s theorems and Boolean Expressions
3. Astable and monostable multivibrator using IC 555
4. FET amplifier (CD and CS configuration)
5. Phase shift network and Oscillator using IC 741
6. Construction of dual regulated power supply
7. Half and Full wave precision rectifier using IC 741
8. Characteristics of LDR
9. Digital to analog converter - R-2R method and Weighted method
10. Study the function of multiplexer and demultiplexer
11. Study the function of decoder and encoder
12. Flip flops
13. Half adder and Full adder (using only NAND & NOR gates)
14. Half subtractor and Full Subtractor (using only NAND & NOR gates)
15. Digital comparator using XOR and NAND gates
16. BCD to seven segment display
17. Study of counter using IC 7490 (0-9 and 00-99)
18. Determination of I-V Characteristics and efficiency of solar cell.
19. IC 7490 as scalar and seven segment display using IC7447
20. Solving simultaneous equations – IC 741 / IC LM324
21. Op-Amp –Active filters Low pass, High pass and Band pass filters (Second Order) Batterworth filter
22. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
23. Construction of second order Butterworth multiple feedback narrow band pass filter
24. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counterIC74193
25. Construction of square wave generator using IC 555 – Study of VCO

Text Book(s):

1. Practical Physics, Gupta and Kumar, PragatiPrakasan
2. Kit Developed for doing experiments in Physics- Instruction manual, R.Srinivasan K.R Priolkar, Indian Academy of Sciences
3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. Electronic lab manual Vol I, K ANavas, Rajath Publishing
5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition

Reference Book(s):

1. An advanced course in Practical Physics, D.Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd
2. Advanced Practical Physics, S.P Singh, PragatiPrakasan
3. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt.ltd
4. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing
5. Electronic Laboratory Primer a design approach, S. Poornachandra,B.Sasikala, Wheeler Publishing, New Delhi

<table>
<tr><th rowspan="2">Sem.</th><th rowspan="2">Course Code</th><th rowspan="2">Credits</th><th>Title of the Course</th><th rowspan="2">CC</th><th colspan="3">Category</th><th rowspan="2">Sem. Exam</th><th colspan="3">Max. Marks</th></tr>
<tr><th rowspan="2">ADVANCED OPTICS</th><th>Lect. Hrs.</th><th>Tutorial Hrs.</th><th>Lab. Hrs.</th><th>CIA</th><th>ESE</th><th>Total.</th></tr>
<tr><td>II</td><td>25PPH2EC31</td><td>5</td><td></td><td>5</td><td>1</td><td>-</td><td>3 Hrs.</td><td>25</td><td>75</td><td>100</td></tr>
</table>

Pre-Requisite:

Course Objectives: The main objectives of this course are:

1. To know the concepts behind polarization and could pursue research work on applicationaspects 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
5. Learn the principles of magneto-optic and electro-optic effects and its applications

Course Outcomes: On completion of this course, students will

CO1: Discuss the transverse character of light waves and different polarization phenomenon.

CO2: Discriminate all the fundamental processes involved in laser devices and to analyze the design and operation of the devices.

CO3: Demonstrate the basic configuration of a fiber optic – communication system and advantages.

CO4: Identify the properties of nonlinear interactions of light and matter.

CO5: Interpret the group of experiments which depend for their action on an applied magnetics and electric field.

Unit-I **POLARIZATION AND DOUBLE REFRACTION** 12 Hrs.

Classification of polarization – Transverse character of light waves – Polarizer and analyzer – Malu‟s law – Production of polarized light – Wire grid polarizer and the polaroid – Polarization by reflection – 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.

Unit-II **LASERS** 12 Hrs.

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 – Liquid lasers – Dye lasers – Chemical lasers – HCl laser – Semiconductor laser.

Unit-III **FIBER OPTICS** 12 Hrs.

Introduction – Total internal reflection – The optical fiber – Glass fibers – The coherent bundle – The numerical aperture – Attenuation in optical fibers – Single and multi- mode fibers – Pulse dispersion in multimode optical fibers – Ray dispersion in multimode step index fibers – Parabolic-index fibers – Fiber-optic sensors precision displacement sensor – Precision vibration sensor.

Unit-IV **NON-LINEAR OPTICS** 12 Hrs.

Basic principles – Harmonic generation – Second harmonic generation – Phase matching – Third harmonic generation – Optical mixing – Parametric generation of light – Self- focusing of light.

Unit-V **MAGNETO-OPTICS AND ELECTRO-OPTICS** 12 Hrs.

Magneto-optical effects – Zeeman effect – Inverse Zeeman effect – Faraday effect – Voigt effect – Cotton-mouton effect – Kerr magneto-optic effect – Electro-optical effects – Stark effect – Inverse stark effect – Electric double refraction – Kerr electro-optic effect – Pockels electro-optic effect.

Text Book(s):

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

Reference Book(s):

1. F. S. Jenkins and H. E. White, 1981, Fundamentals of Optics, (4th Edition), McGraw – HillInternational 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 UniversityPress, New Delhi, 2011.
4. Y. B. Band, Light and Matter, Wiley and Sons (2006)
5. R. Guenther, Modern Optics, Wiley and Sons (1990)

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
5. http//optics.byu.edu/textbook.aspx

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25PPH2EC31	5	NON - LINEAR DYNAMICS		5	-	-	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The main objectives of this course are:

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.
3. To train the students on bifurcations and onset of chaos.
4. To educate the students about the theory of chaos and its characterization.
5. To make the students aware of the applications of solitons, chaos and fractals.

Course Outcomes: On completion of this course, students will

CO1: Gain knowledge about the available analytical and numerical methods to solve various nonlinear systems.

CO2: Understand the concepts of different types of coherent structures and their importance in science and technology.

CO3: Learn about simple and complex bifurcations and the routes to chaos.

CO4: Acquire knowledge about various oscillators, characterization of chaos and fractals.

CO5: Analyse and evaluate the applications of solutions in telecommunication, applications of chaos in cryptography, computations and that of fractals.

Unit-I	**GENERAL**	10 Hrs.

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.

Unit-II	**COHERENT STRUCTURES**	11 Hrs.

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.

Unit-III	**BIFURCATIONS AND ONSET OF CHAOS**	7 Hrs.

One dimensional flows – Two dimensional flows – Phase plane – Limit cycles – Simple bifurcations – Discrete Dinamical system – Strange attractors – Routes to chaos.

Unit-IV	**CHAOS IN NONLINEAR ELECTRONIC CIRCUITS**	7 Hrs.

Linear and Nonlinear circuit elements – Resonant RLC circuit – Chua's diode – Practical implementation of Chua's diode – Bifurcations and chaos.

Unit-V	**APPLICATIONS**	10 Hrs.

Soliton based communication systems – Solition based computation – Synchronization of chaos – Chaos based communication – Cryptography – Image processing – Stochastic – Resonance – Chaos based computation – Time Series analysis.

Text Book(s):

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.

Reference Book(s):

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. 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

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25PPH2EC41	3	**MICROPROCESSOR 8085 and MICROCONTROLLER 8051**		5	-	-	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The main objectives of this course are:

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.

Course Outcomes: On successful completion of this course, students will be able to

CO1: Grasp the fundamentals of the Intel 8085 Microprocessor Architecture, memory mapping and data transfer schemes, know the addressing modes and perform arithmetic operation and sorting of a given data.

CO2: Know the architecture and memory organization of the Intel 8051 Microcontroller and the design of timers, counters and registers using it as well as understand the modes of operation and control.

CO3: Learn the architecture, operating mode and addressing modes of Intel 8086.

CO4: Learn the instruction set and assembly language programming for implementing arithmetic operations and sorting of a given data set using Intel 8051.

CO5: Know the various peripheral devices of Intel 8051and interfacing them.

Unit-I	8085 PROGRAMMING, PERIPHERAL DEVICES AND THEIR INTERFACIN	12 Hrs.

Instruction set - Addressing modes - Programming techniques - Memory mapped I/O scheme- I/O mapped I/O scheme - Memory and I/O interfacing- 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.

Unit-II	8085 INTERFACING APPLICATIONS	12 Hrs.

Seven segment display interface - Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities –Voltage and current) Measurement of physical quantities (Temperature an strain).

Unit-III	8051 MICROCONTROLLER HARDWARE	12 Hrs.

Introduction – Features of 8051 – 8051 Microcontroller Hardware Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input/ Output pins, Ports and Circuits – External data memory and program memory External program memory, External data memory.

Unit-IV	8051 INSTRUCTIONS SET AND ASSEMBLY LANGUAGE PROGRAMMING	12 Hrs.

Addressing modes – Data moving (Data transfer) 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, Addition, Subtraction, Multiplication and division, Decimal arithmetic – Jump and CALL instructions Jump and Call program range, Jump, Call and subroutines – Programming.

Unit-V	**INTERRUPT PROGRAMMING AND INTERFACING TO EXTERNAL WORLD**	12 Hrs.
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 Nested interrupts, Software triggering of interrupt. LED Interface Seven segment display interface- Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities – Voltage and current) Measurement of physical quantities (Te mperature and strain).computation – Time Series analysis.		

Text Book(s):

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 Book(s):

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 Resources:

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/

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25PPH2EC42	3	**MICROCONTROLLER BASED PHYSICS INSTRUMENTATION**		5	-	-	3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The main objectives of this course are:

1. To describe the fundamentals of microcontroller, Arduino, IoT.
2. To provide the knowledge on the features of Arduino and understand its functions.
3. To discover Arduino and IoT circuits for physics applications.
4. To experiment the interfacing between microcontroller and sensors/actuator for Roll-to-Roll system.
5. To recommend microcontroller circuit for domestic and industrial applications and design the Arduino based physics instruments.

Course Outcomes: On successful completion of this course, students will be able to

CO1: Describe the architecture of Microcontroller, Arduino and IoT.

CO2: Outline the features of Arduino IDE, syntax and algorithm and understand the use of this to solve the problems.

CO3: Outline the features of Arduino IDE, syntax and algorithm and understand the use of this to solve the problems.

CO4: Examine the problems encountered in interfacing the Arduino with the accessories to analyse the problems.

CO5: Recommend Arduino circuits for the applications and use professional ethics on using sensors to rate modern society.

Unit-I **MICROCONTROLLER AND ARCHITECTURE OF ARDUINO** 12 Hrs.

Microprocessor and Microcontroller - ATmega328/P: Introduction - Feature - Description - Block Diagram - Pin Configurations - Pin Descriptions. **Arduino:** Block diagram - Architecture - Pin functions - features - I/O Ports - Timers - interrupts - serial port - variants - Introduction to Arduino IDE - writing, saving, compiling and uploading sketches.

Unit-II **ARDUINO LANGUAGE REFERENCE AND PROGRAMMING** 12 Hrs.

Language Reference: Variables - Operators - Control structures - Time and math functions Libraries and library management - Board management - digital I/O: blinking LED - interfacing Switch and 4x4 matrix keyboard - Interfacing LCD - simple programs.

Unit-III **8051 MICROCONTROLLER HARDWARE** 12 Hrs.

ADC – Analog Read – Analog Reference - Pulse Width Modulation PWM - control of DC motor - Serial Communication - Inter Integrated Circuit I2C- Serial Peripheral Interface SPI- Ethernet shield.

Unit-IV **MICROCONTROLLER INSTRUMENT DESIGN** 12 Hrs.

Pressure meter - thermometer - lux meter - Ultrasonic range finder - humidity meter - density meter - viscometer - dielectric meter - LCR meter.

Unit-V **INTERNET OF THINGS (IoT)** 12 Hrs.

Introduction - Block diagram - Networking with ESP8266 Wi-Fi module - MQTT Protocol - IoT service platform - IoT weather monitoring - IoT Physics Applications - IoT based air pollution meter.

Reference Book(s):

1. Atmega328/P Data sheet.
2. Evans, B. (2011). *Beginning Arduino Programing*. A press.
3. Waher, P. (2015). *Learning Internet of Things*. Packt Publishing.

Text Book(s):

1. Simon Monk. (2016). *Programming Arduino, Getting Started with Sketches,* (2nd Ed.). McGraw-Hill Education.

Web Resources:

1. https://www.arduino.cc/
2. https://www.arduino.cc/en/Tutorial/HomePage
3. https://opensource.com/resources/what-arduino

Sem.	Course Code	Credits	Title of the Course	CC	Category			Sem. Exam	Max. Marks		
					Lect. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25PPH2NME1	3	**SOLID WASTE MANAGEMENT**		2	-	-	2 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The main objectives of this course are:

1. To gain basic knowledge in solid waste management procedures
2. To gain industry exposure and be equipped to take up a job.
3. To harness entrepreneurial skills.
4. To analyze the status of solid waste management in the nearby areas.
5. To sensitize the importance of healthy practices in waste managements.

Course Outcomes: On successful completion of this course, students will be able to

CO1: Explain the fundamentals of solid waste management, including types, sources, and hazardous waste regulations such as the Resource Conservation and Recovery Act (RCRA).

CO2: Analyze the physical and chemical characteristics of solid waste and apply the solid waste management hierarchy to minimize waste generation.

CO3: Describe and evaluate the tools, equipment, transportation, and disposal techniques such as composting and landfilling used in solid waste management.

CO4: Assess the role of solid waste management in promoting economic development, environmental protection, and mitigating impacts of climate change and marine litter.

CO5: Collect, analyze, and present data from an industrial visit to a solid waste management facility to understand real-world practices and operational efficiency.

Unit-I	**SOLID WASTE MANAGEMENT**	12 Hrs.

Introduction - Definition of solid waste - Types – Hazardous Waste: Resource conservation and Renewal act – Hazardous Waste: Municipal Solid waste and non-municipal solid waste.

Unit-II	**SOLID WASTE CHARACTERISTICS**	12 Hrs.

Solid Waste Characteristics: Physical and chemical characteristics - SWM hierarchy - factors affecting SW generation.

Unit-III	**TOOLS AND EQUIPMENT**	12 Hrs.

Tools and equipment - Transportation - Disposal techniques - Composting and land filling technique

Unit-IV	**ECONOMIC DEVELOPMENT**	12 Hrs.

SWM for economic development and environmental protection Linking SWM and climate change and marine litter.

Unit-V	**INDUSTRIAL VISIT**	12 Hrs.

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

Reference Book(s):

1. Municipal Solid Waste Management, Christian Ludwig, Samuel Stucki, Stefanie Hellweg, Springer Berlin Heisenberg, 2012
2. Solid Waste Management Bhide A. D Indian National Scientific Documentation Centre, New Delhi Edition 1983 ASIN: B0018MZ0C2
3. Solid Waste Techobanoglous George; Kreith, Frank McGraw Hill Publication, New Delhi 2002, ISBN 9780071356237
4. Environmental Studies Manjunath D. L. Pearson Education Publication, New Delhi, 20061SBN-I3: 978-8131709122

Solid Waste Management Sasikumar K. PHI learning, New Delhi, 2009 ISBN 8120338693

Text Book(s):

1. Handbook of Solid Waste Management /Second Edition, George Tchobanoglous, McGraw Hill (2002).
2. Prospects and Perspectives of Solid Waste Management, Prof. B BHosett, New Age International (P) Ltd (2006).
3. Solid and Hazardous Waste Management, Second Edition, M.N Rao, BS Publications / BSP Books (.(2020
4. Integrated Solid Waste Management Engineering Principles and Management, Tchobanoglous, McGraw Hill (2014).
   Solid Waste Management (SWM), Vasudevan Rajaram, PHI learning private limited, 2016

Web Resources:

1. 1https://www.meripustak.com/Integrated-Solid-Waste-Management-Engineering-Principles-And-Management-Issues-125648
2. https://testbook.com/learn/environmental-engineering-solid-waste-management/
3. https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsA-gM0iVpismAJN93CHA1sX6NuNeOKLXfQJ_jxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB
4. https://images.app.goo.gl/tYiW2gUPfS2cxdD28
5. https://amzn.eu/d/5VUSTDI