PG & RESEARCH DEPARTMENT OF PHYSICS

M.Sc. PHYSICS SYLLABUS

(Affiliated to Annamalai University)

(For the Candidates to be admitted from the academic year 2023-2024 onwards)

POOMPUHAR COLLEGE (AUTONOMOUS)

(of the Tamil Nadu H.R.& C.E Admn. Dept)

MELAIYUR - 609 107

2023- 24

POOMPUHAR COLLEGE (AUTONMOUS)

M.Sc. PHYSICS

(Affiliated to Annamalai University)
Programme Structure and Scheme of Examination (under CBCS)
(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

Part	Course Code	Study Components & Course Title	Credit	Hours/ Week	Maximum Marks		
					CIA	ESE	Total
		SEMESTER – I					
Part A		Core I: Mathematical Physics	5	7	25	75	100
		Core II: Classical Mechanics and Relativity	5	7	25	75	100
		Core III: Linear and Digital ICs and Applications	4	6	25	75	100
		Practical I	3	5	25	75	100
		Elective – I: (Generic / Discipline Specific) (One from List I) Energy Physics Crystal Growth and Thin films	3	5	25	75	100
		Total	**20**	**30**			**500**
SEMESTER – II							
Part A		Statistical Mechanics	5	6	25	75	100
		Quantum Mechanics –I	5	6	25	75	100
		Practical – II	4	6	25	75	100
		Elective – II: (Generic / Discipline Specific) (One from List II) Plasma Physics Bio Physics	3	4	25	75	100
		Elective – III: (INDUSTRY ORIENTED ELECTIVE (IOE)) (One from List- III) Advanced Spectroscopy Microprocessor and Microcontroller	3	4	25	75	100
Part B		Skill Enhancement Course – I	2	4	25	75	100
		Total	**22**	**30**			**600**

Head of the Department Principal

ELECTIVE PAPERS

List 1

1. Energy Physics
2. Crystal Growth and Thin films

LIST 2

1. Plasma Physics
2. Bio Physics

LIST 3
INDUSTRY ORIENTED ELECTIVE (IOE)

1. Advanced Spectroscopy
2. Microprocessor and Microcontroller

SKILL ENHANCEMENT COURSE – I

1. Research Methodology & IPR

SEMESTER: I PART: A CORE – I	MATHEMATICAL PHYSICS	Credit:5 Hours:7

LEARNING OBJECTIVES

- To equip students with the mathematical techniques needed for understanding theoretical treatment in different courses taught in their program
- To extend their manipulative skills to apply mathematical techniques in their fields
- To help students apply Mathematics in solving problems of Physics

UNIT – I INTRODUCTION TO VECTOR ALGEBRA

Concept of gradient-Gradient of scalar field-Lines surface and volume integrals-Divergence of a vector fuctions-Curl of a vector functions-Physical significance-Vector identities-Guass divergence theorem-Green therem.

UNIT – 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.

UNIT – III MATRICES:

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 & LAPLACE TRANSFORMS

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.

Laplace transform and its inverse - Transforms of derivatives and integrals – Differentiation and integration of transforms - Dirac delta functions - Application - Laplace equation: Potential problem in a semi infinite strip.

UNIT – V DIFFERENTIAL EQUATIONS:

Second order differential equation- Sturm-Liouville's theory - Series solution with simple examples - Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations – Legendre polynomials - Generating function - Rodrigue formula – Orthogonality properties.

UNITS – VI PROFESSIONAL COMPONENTS:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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, New Delhi.
5. C. R. Wylie and L. C. Barrett, 1995, Advanced Engineering Mathematics, 6 th Edition, International Edition, McGraw-Hill, New York.

WEB SOURCES

1. www.khanacademy.org
2. https://youtu.be/LZnRlOA1_2I
3. http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath
4. https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SlED56gNjVJGO2qaZ
5. https://archive.nptel.ac.in/courses/115/106/115106086/

COURSE OUTCOMES:

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

CO1	Able to know about basic ideas of grad,div,curl	K1, K2
CO2	Able to understand analytic functions, do complex integration, by applying Cauchy Integral Formula. Able to compute many real integrals and infinite sums via complex integration.	K2, K3
CO3	Analyze characteristics of matrices and its different types, and the process of diagonalization.	K4
CO4	Solve equations using Laplace transform and analyze the Fourier transformations of different function, grasp how these transformations can speed up analysis and correlate their importance in technology	K4, K5
CO5	To find the solutions for physical problems using linear differential equations and to solve boundary value problems using Green's function. Apply special functions in computation of solutions to real world problems	K2, K5

K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	3	3	3	2	2	2
CO3	3	3	3	2	2	3	3	2	3	2
CO4	3	3	3	3	2	3	3	2	2	2
CO5	3	2	3	3	2	3	3	2	2	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	3	3	3	2	2	2
CO3	3	3	3	2	2	3	3	2	3	2
CO4	3	3	3	3	2	3	3	2	2	2
CO5	3	2	3	3	2	3	3	2	2	3

SEMESTER: I PART: A CORE – II	CLASSICAL MECHANICS AND RELATIVITY	Credit:5 Hours:7

LEARNING OBJECTIVES:

- To understand fundamentals of classical mechanics.
- To understand Lagrangian formulation of mechanics and apply it to solve equation of motion.
- To understand Hamiltonian formulation of mechanics and apply it to solve equation of motion.
- To discuss the theory of small oscillations of a system.
- To learn the relativistic formulation of mechanics of a system.

UNIT – I PRINCIPLES OF CLASSICAL MECHANICS:

Mechanics of a single particle – mechanics of a system of particles – conservation laws for a system of particles – constraints – holonomic & non-holonomic constraints – generalized coordinates – configuration space – transformation equations – principle of virtual work.

UNIT – II LAGRANGIAN FORMULATION:

D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.

UNIT – III HAMILTONIAN FORMULATION:

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) motion of particle in a central force field.

UNIT – IV SMALL OSCILLATIONS:

Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.

UNIT – 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's space – four vectors – position, velocity, momentum, acceleration and force in for vector notation and their transformations.

UNIT – VI PROFESSIONAL COMPONENTS:

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

TEXT BOOKS:

1. H. Goldstein, 2002, *Classical Mechanics*, 3rd Edition, Pearson Edu.
2. J. C. Upadhyaya, *Classical Mechanics*, HimalayaPublshing. Co.New Delhi.
3. R. Resnick, 1968, *Introduction to Special Theory of Relativity*, Wiley Eastern, New Delhi.
4. R. G. Takwala and P.S. Puranik, Introduction to Classical Mechanics –Tata – McGraw Hill, New Delhi, 1980.
5. N. C. Rana and P.S. Joag, Classical Mechanics - Tata McGraw Hill, 2001

REFERENCE BOOKS:

1. K. R. Symon,1971, *Mechanics*, Addison Wesley, London.
2. S. N. Biswas, 1999, *Classical Mechanics*, Books & Allied, Kolkata.
3. Gupta and Kumar, *Classical Mechanics*, KedarNath.
4. T.W.B. Kibble, *Classical Mechanics*, ELBS.
5. Greenwood, *Classical Dynamics*, PHI, New Delhi.

WEB SOURCES:

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/
4. https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/
5. https://www.britannica.com/science/relativistic-mechanics

COURSE OUTCOMES:

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

CO1	Understand the fundamentals of classical mechanics.	K2
CO2	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.	K3
CO3	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.	K3, K5
CO4	Analyze the small oscillations in systems and determine their normal modes of oscillations.	K4, K5
CO5	Understand and apply the principles of relativistic kinematics to the mechanical systems.	K2, K3
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	3	3	3	2	2	2	3	2	2
CO2	2	3	3	3	2	2	2	3	2	2
CO3	2	3	3	3	2	2	2	3	2	2
CO4	2	3	3	3	2	2	2	3	2	2
CO5	2	3	3	3	2	2	2	3	2	2

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	3	3	3	2	2	2
CO3	3	3	3	2	2	3	3	2	3	2
CO4	3	3	3	3	2	3	3	2	2	2
CO5	3	2	3	3	2	3	3	2	2	2

SEMESTER: I PART: A CORE – III	LINEAR AND DIGITAL ICs AND APPLICATIONS	Credit: 4 Hours: 6

LEARNING OBJECTIVES:

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

UNIT – 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.

UNIT – II LINEAR & NON-LINEAR APPLICATIONS OF OP-AMP:

Solution to simultaneous equations and differential equations- Instrumentation amplifiers- V to I and I to V converters.

Sample and Hold circuit- Log and Antilog amplifier- multiplier and divider- Comparators- Schmitt trigger- Multivibrators- Triangular and Square waveform generators.

UNIT – III ACTIVE FILTERS, TIMER AND PHASE LOCKED LOOPS:

Introduction- Butterworth filters – 1st order- 2nd order low pass and high pass filters- band pass- band reject and all pass filters.

Introduction to IC 555 timer- description of functional diagram- monostable and astable 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/ A AND A / D CONVERTERS:

Introduction- Series Op-Amp regulator- IC Voltage Regulators- IC 723 general purpose regulators- Switching Regulator.

Introduction- basic DAC techniques -weighted resistor DAC- R-2R ladder DAC- inverted R-2R DAC- A/D converters -parallel comparator type ADC- counter type ADC- successive approximation ADC and dual slope ADC- DAC and ADC Specifications.

UNITS – V CMOS LOGIC & SEQUENTIAL CIRCUITS

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- Comparator - Decoder - BCD to 7-segment decoder - Encoder - Multiplexer - Demultiplexer .

UNIT – VI

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

TEXT BOOKS:

1. D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt.Ltd.,NewDelhi,India
2. Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, NewDelhi.
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. V.

REFERENCE BOOKS:

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.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/

COURSE OUTCOMES:

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

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
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	3	2	2	3	3	3	2
CO2	3	3	3	3	1	3	3	3	2	1
CO3	3	3	3	3	1	3	3	3	2	1
CO4	3	3	3	3	1	3	3	3	2	1
CO5	3	3	3	2	1	1	2	3	2	1

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	3	2	2	3	3	3	2
CO2	3	3	3	3	1	3	3	3	2	1
CO3	3	3	3	3	1	3	3	3	2	1
CO4	3	3	3	3	1	3	3	3	2	1
CO5	3	3	3	2	1	1	2	3	2	1

SEMESTER: I PART: A PRACTICAL – I	PRACTICAL I	Credit: 3 Hours: 5

LEARNING OBJECTIVES:

- To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations.
- To calculate the thermodynamic quantities and physical properties of materials.
- To analyze the optical and electrical properties of materials.

LIST OF EXPERIMENTS

(Minimum of Twelve Experiments from the list)

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method
2. Determination of Viscosity of the given liquid – Meyer's disc
3. Measurement of Coefficient of linear expansion- Air wedge Method
4. B-H loop using Anchor ring.
5. Determination of Thickness of the enamel coating on a wire by diffraction
6. Determination of Rydberg's Constant - Hydrogen Spectrum
7. Verification of Hartmann formula using spectrometer
8. Measurement of Band gap energy- Thermistor
9. Determination of Specific charge of an electron – Thomson's method(e/m).
10. Determination of Wavelength, Separation of wavelengths - Michelson Interferometer
11. GM counter – Characteristics and inverse square law.
12. Measurement of Conductivity - Four probe method.
13. Molecular spectra – AlO band.
14. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.
15. Measurements of Standing wave and standing wave co-efficient, Law of Inverse square, Receiver end transmitter behavior, Radiation Pattern - Microwave test bench
16. UV-Visible spectroscopy – Verification of Beer-Lambert's law and identification of wavelength maxima – Extinction coefficient
17. Construction of relaxation oscillator using UJT
18. FET CS amplifier- Frequency response, input impedance, output impedance
19. Mathematical operations of IC741.
20. V- I Characteristics of FET
21. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
22. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
23. Construction of Schmidt trigger circuit using IC 741 for a given hysteresis- application as squarer.
24. Construction of square wave Triangular wave generator using IC 741
25. Construction of a quadrature wave using IC 324
26. Construction of pulse generator using the IC 741 – application as frequency divider
27. Study of R-S, clocked R-S and D-Flip flop using NAND gates
28. Study of J-K, D and T flip flops using IC 7476/7473
29. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.
30. Study of Arithmetic logic unit using IC 74181.

TEXT BOOKS:

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 BOOKS:

1. Advanced Practical Physics, S.P Singh, PragatiPrakasan.
2. An advanced course in Practical Physics, D.Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd
3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, 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:

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

CO1	Understand the strength of material using Young's modulus.	K2
CO2	Acquire knowledge of thermal behaviour of the matetials.	**K1**
CO3	Understand theoretical principles of magnetism through the experiments.	**K2**
CO4	Acquire knowledge about arc spectrum and applications of laser	**K1, K3**
CO5	Improve the analytical and observation ability in Physics Experiments	**K3, K5**
CO6	Conduct experiments on applications of FET and UJT	**K4**
CO7	Analyze various parameters related to operational amplifiers.	**K4**
CO8	Understand the concepts involved in arithmatic and logical circuits using IC's	**K2**
CO9	Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits	**K1**
CO10	Analyze the applications of counters and registers	**K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	2	2	3	2	2	2	1	2	3
CO2	2	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	2	2
CO6	2	2	2	3	3	1	1	1	3	3
CO7	2	2	3	3	3	1	1	1	3	3
CO8	3	3	3	3	3	3	2	2	3	3
CO9	3	3	3	3	3	3	1	1	1	1
CO10	3	3	3	3	3	3	1	1	1	1

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	2	2	3	2	2	2	1	2	3
CO2	2	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	2	2
CO6	2	2	2	3	3	1	1	1	3	3
CO7	2	2	3	3	3	1	1	1	3	3
CO8	3	3	3	3	3	3	2	2	3	3
CO9	3	3	3	3	3	3	1	1	1	1
CO10	3	3	3	3	3	3	1	1	1	1

SEMESTER: I PART: A ELECTIVE – I	ENERGY PHYSICS	Credit: 3 Hours: 5

LEARNING OBJECTIVES:

- To learn about various renewable energy sources.
- To know the ways of effectively utilizing the oceanic energy.
- To study the method of harnessing wind energy and its advantages.
- To learn the techniques useful for the conversion of biomass into useful energy.
- To know about utilization of solar energy.

UNIT - 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.

UNIT – II ENERGY FROM THE OCEANS:

Energy utilization–Energy from tides–Basic principle of tidal power–utilization of tidal energy – Principle of ocean thermal energy conversion systems.

UNIT – III WIND ENERGY SOURCES:

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.

UNIT – IV ENERGY FROM BIOMASS:

Biomass conversion Technologies– wet and dry process– Photosynthesis -Biogas Generation: Introduction– 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.

UNIT – V SOLAR ENERGY SOURCES:

Solar radiation and its measurements–solar cells: Solar cells to electric powers–solar cell parameter–solar cell electrical characteristics– Efficiency–solar water Heater –solar distillation– solar cooking – Solar pond and its applications.

UNIT – VI PROFESSIONAL COMPONENTS:

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

TEXT BOOKS:

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.

REFERENCE BOOKS:

1. Renewable energy resources, John Twidell and Tonyweir, Taylor and Francis group, London and New York.
2. Applied solar energy, A.B.MeinelandA.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
5. Introduction to Non-Conventional Energy Resources -Raja et. al., Sci. Tech Publications.

WEB SOURCES:

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/

COURSE OUTCOMES:

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

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
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	3	3	3	2	2	2	3	3	3
CO2	2	3	3	3	2	2	2	3	3	3
CO3	2	3	3	3	2	2	2	3	3	3
CO4	2	3	3	3	2	2	2	3	3	3
CO5	2	3	3	3	2	2	2	3	3	3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	3	3	3	2	2	2	3	3	3
CO2	2	3	3	3	2	2	2	3	3	3
CO3	2	3	3	3	2	2	2	3	3	3
CO4	2	3	3	3	2	2	2	3	3	3
CO5	2	3	3	3	2	2	2	3	3	3

SEMESTER: I PART: A ELECTIVE – I	CRYSTAL GROWTH AND THIN FILMS	Credit: 3 Hours: 5

LEARNING OBJECTIVES:

- To acquire the knowledge on Nucleation and Kinetics of crystal growth
- To understand the Crystallization Principles and Growth techniques
- To study various methods of Crystal growth techniques
- To understand the thin film deposition methods
- To apply the techniques of Thin Film Formation and thickness Measurement

UNIT – I CRYSTAL GROWTH KINETICS:

Basic Concepts- Nucleation and Kinetics of growth Ambient phase equilibrium - super saturation - Types of Nucleation - Formation of critical Nucleus –Spherical and cylindrical nucleus- Classical theory of Nucleation - rate of Nucleation.

UNIT – II CRYSTALLIZATION PRINCIPLES:

Crystallization Principles and Growth techniques - Classes of Crystal system - Crystal symmetry - solutions - Solubility - Super solubility - expression for super saturation - Miers TC diagram - Solution growth - Low Temperature solution growth - Slow cooling and solvent evaporation methods - Constant temperature bath as a Crystallizer.

UNIT – III GEL, MELT AND VAPOUR GROWTH:

Gel, Melt and Vapour growth techniques Principle of Gel techniques - Various types of Gel - Structure and importance of Gel - Methods of Gel growth and advantages - Melt techniques - Czochralski growth - Bridgeman method- Physical vapour deposition - Chemical vapour deposition.

UNIT – IV THIN FILM DEPOSITION METHODS:

Thin film deposition methods of thin film preparation- Thermal evaporation- Electron beam evaporation- pulsed LASER deposition- Cathodic sputtering- RF Magnetron sputtering- MBE- chemical vapour deposition methods - Sol Gel spin coating- Spray pyrolysis- Chemical bath deposition.

UNIT – V THIN FILM FORMATION:

Thin Film Formation and thickness Measurement Nucleation- Film growth and structure - Various stages in Thin Film formation- Thermodynamics of Nucleation- Nucleation theories- Capillarity model and Atomistic model and their comparison- Structure of Thin Film- Roll of substrate- Roll of film thickness-Film thickness measurement – Interferometry.

UNIT – VI PROFESSIONAL COMPONENTS:

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

TEXT BOOKS:

1. V. Markov Crystal growth for beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy (2004) 2nd edition
2. A. Goswami, Thin Film Fundamentals (New Age, New Delhi, 2008)
3. M. Ohora and R. C. Reid, "Modeling of Crystal Growth Rates from Solution"
4. 4. D. Elwell and H. J. Scheel, "Crystal Growth from High Temperature Solution"
5. Heinz K. Henish, 1973, "Crystal Growth in Gels", Cambridge University Press. USA.

REFERENCE BOOKS:

1. J.C. Brice, Crystal Growth Process (John Wiley, New York, 1986)
2. P. Ramasamy and F. D. Gnanam, 1983, "UGC Summer School Notes".
3. P. SanthanaRaghavan and P. Ramasamy, "Crystal Growth Processes",KRU Publications.
4. H.E. Buckley, 1951, Crystal Growth, John Wiley and Sons, New York
5. B.R. Pamplin, 1980, Crystal Growth, Pergman Press, London.

WEB SOURCES:

1. https://www.youtube.com/playlist?list=PLbMVogVj5nJRjLrXp3kMtrIO8kZl1D1Jp
2. https://www.youtube.com/playlist?list=PLFW6lRTa1g83HGEihgwcy7KeTLUuBu3WF
3. https://www.youtube.com/playlist?list=PLADLRin7kNjG1Dlna9MDA53CMKFHPSi9m
4. https://www.youtube.com/playlist?list=PLXHedI-xbyr8xIl_KQFs_R_oky3Yd1Emw
5. https://www.electrical4u.com/thermal-conductivity-of-metals/

COURSE OUTCOMES:

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

CO1	Acquire the Basic Concepts, Nucleation and Kinetics of crystal growth	K1
CO2	Understand the Crystallization Principles and Growth techniques	K2, K4
CO3	Study various methods of Crystal growth techniques	K3
CO4	Understand the Thin film deposition methods	K2
CO5	Apply the techniques of Thin Film Formation and thickness Measurement	K3, K4
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	2	1	2	1	3	2	2	2	2
CO2	3	3	1	3	1	2	3	2	2	1
CO3	3	2	1	3	1	2	3	3	3	1
CO4	3	2	1	2	1	2	3	3	3	1
CO5	2	3	3	3	1	3	3	3	3	2

		Credit: 5

SEMESTER: II PART: A CORE- IV	STATISTICAL MECHANICS	Hours: 6

LEARNING OBJECTIVES:

- To acquire the knowledge of thermodynamic potentials and to understand phase transition in thermodynamics
- To identify the relationship between statistic and thermodynamic quantities
- To comprehend the concept of partition function, canonical and grand canonical ensembles
- To grasp the fundamental knowledge about the three types of statistics
- To get in depth knowledge about phase transitions and fluctuation of thermodynamic properties that vary with time

UNIT – I PHASE TRANSITIONS :

Thermodynamic potentials - Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications –Third law of Thermodynamics. Order parameters – Landau's theory of phase transition - Critical indices - Scale transformations and dimensional analysis.

UNIT – II STATISTICAL MECHANICS AND THERMODYNAMICS:

Foundations of statistical mechanics - Specification of states of a system - Micro canonical ensemble - Phase space – Entropy - Connection between statistics and thermodynamics – Entropy of an ideal gas using the micro canonical ensemble - Entropy of mixing and Gibb's paradox.

UNIT – III CANONICAL AND GRAND CANONICAL ENSEMBLES:

Trajectories and density of states - Liouville's theorem - Canonical and grand canonical - Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.

UNIT – IV CLASSICAL AND QUANTUM STATISTICS:

Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.

UNIT – V REAL GAS,ISING MODEL AND FLUCTUATIONS:

Fluctuations and transport phenomena - Ising model – one dimension random walk - Brownian motion - Langevin's theory - Fluctuation-dissipation theorem - .

UNIT – VI PROFESSIONAL COMPONENTS:

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

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

5. F. Reif, 1965, *Fundamentals of Statistical and Thermal Physics,* McGraw -Hill, New York.
6. Gupta kumar 2019 Elementary statistical mechanics pragathi publications

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. NeiseandH.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/Ising_model
5. https://en.wikipedia.org/wiki/Grand_canonical_ensemble

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	To analyze the macroscopic properties such as pressure, volume, temperature, specific heat, elastic moduli etc. using microscopic properties like intermolecular forces, chemical bonding, atomicity etc. Describe the peculiar behaviour of the entropy by mixing two gases Justify the connection between statistics and thermodynamic quantities	K4
CO3	Differentiate between canonical and grand canonical ensembles and to interpret the relation between thermodynamical quantities and partition function	K1
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	To discuss and 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 WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	1	1	2	3	1	1	3
CO2	3	3	3	1	1	2	3	1	1	3
CO3	3	3	3	1	1	2	3	2	1	3
CO4	3	3	3	1	1	2	3	2	1	3
CO5	3	3	3	1	1	2	3	1	1	3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO 10
CO1	3	3	3	1	1	2	3	1	1	3
CO2	3	3	3	1	1	2	3	1	1	3
CO3	3	3	3	1	1	2	3	2	1	3
CO4	3	3	3	1	1	2	3	2	1	3
CO5	3	3	3	1	1	2	3	1	1	3

SEMESTER: II PART: A CORE – V	QUANTUM MECHANICS – I	Credit: 5 Hours: 6

LEARNING OBJECTIVES:

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

UNIT – I BASIC FORMALISM:

Interpretation of the wave function – Time dependent Schrodinger equation –Time independent Schrodinger equation – Stationary states – Ehrenfest's theorem – Linear vector space – Linear operator – Eigen functions and Eigen Values – Hermitian Operator – Postulates of Quantum Mechanics – Simultaneous measurability of observables – General Uncertainty relation.

UNIT – 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.

UNIT – III GENERAL FORMALISM:

Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation – Coordinate representation – Momentum representation – Symmetries and conservation laws – Unitary transformation – Parity and time reversal.

UNIT – 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.

UNIT – V ANGULAR MOMENTUM:

Eigenvalue spectrum of general angular momentum – Ladder operators and their algebra – Matrix representation – Spin angular momentum – Addition of angular momenta – CG Coefficients – Symmetry and anti – symmetry of wave functions – Construction of wave-functions and Pauli's exclusion principle.

UNIT – VI PROFESSIONAL COMPONENTS:

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

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.
5. A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4thEdition, Macmillan, India, 1984.

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.
5. V. Devanathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford , 2011.

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

COURSE OUTCOMES:

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

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	Can discuss the various representations, space time symmetries and formulations of time evolution	K1
CO4	Can formulate and analyze the approximation methods for various quantum mechanical problems	K4, K5
CO5	To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.	K3, K4
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	2	3	2	2	3
CO3	2	3	3	2	3	2	3	2	2	3
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	3	2	3	2	3	3	2	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	2	3	2	2	3
CO3	2	3	3	2	3	2	3	2	2	3
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	3	2	3	2	3	3	2	3

SEMESTER: II PART: A PRACTICAL – II	PRACTICAL II	Credit: 4 Hours: 6

LEARNING OBJECTIVES:

- To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations.
- To calculate the thermodynamic quantities and physical properties of materials.
- To analyze the optical and electrical properties of materials.
- To observe the applications of FET and UJT.
- To study the different applications of operational amplifier circuits.
- To learn about Combinational Logic Circuits and Sequential Logic Circuits

LIST OF EXPERIMENTS
(Minimum of Twelve Experiments from the list)

1. Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes - Cornu's Method
2. Determination of thermal conductivity of a good conductor –Forbe's Method
3. Measurement of polarisability of the liquid - Spectrometer
4. B-H curve using CRO
5. Thickness of LG Plate
6. Arc spectrum: Copper
7. Determination of e/m - Millikan's method
8. Miscibility measurements using ultrasonic diffraction method
9. Determination of refractive index of the liquid using biprism
10. Iodine absorption spectra
11. Determination of specific rotatory power of a sugar solution using Lorentz half shade polarimeter
12. Measurement of Dielectricity - Microwave test bench
13. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility
14. Interpretation of vibrational spectra of a given material
15. Determination of Wavelength of monochromatic source using biprism
16. GM counter – Absorption coefficient – Maximum range of β rays
17. IC 7490 as scalar and seven segment display using IC7447
18. Solving simultaneous equations – IC 741 / IC LM324
19. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
20. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
21. Construction of second order butterworth multiple feedback narrow band pass filter
22. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
23. Construction of FET as CD amplifier
24. Construction of Decoder and Encoder and verify the truth table
25. BCD to Excess- 3 and Excess 3 to BCD code conversion

26. Study of D/A convertor using operational amplifier
27. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474

TEXT BOOKS:

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 BOOKS:

1. An advanced course in Practical Physics, D.Chattopadhayay, C.RRakshit, 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

COURSE OUTCOMES:

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

CO1	Understand the strength of material using Young's modulus	K2
CO2	Acquire knowledge of thermal behaviour of the materials	K1
CO3	Understand theoretical principles of magnetism through the experiments.	K2
CO4	Acquire knowledge about arc spectrum and applications of laser	K1
CO5	Improve the analytical and observation ability in Physics Experiments	K4
CO6	Conduct experiments on applications of FET and UJT	K5
CO7	Analyze various parameters related to operational amplifiers	K4
CO8	Understand the concepts involved in arithmetic and logical circuits using IC's	K2
CO9	Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits	K3
CO10	Analyze the applications of counters and registers	K4
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	2	2	S	S	2	2	2	3	3
CO2	2	2	S	S	S	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3
CO6	2	2	2	3	3	2	2	2	3	3
CO7	2	2	3	3	3	2	2	3	3	3
CO8	3	3	3	3	3	3	3	3	3	3
CO9	3	3	3	3	3	3	3	3	3	3
CO10	3	3	3	3	3	3	3	3	3	3

	PSO 1	**PSO2**	**PSO3**	**PSO4**	**PS O5**	**PSO6**	**PSO7**	**PSO8**	**PS O9**	**PSO 10**
CO1	2	2	2	3	3	2	2	2	3	3
CO2	2	2	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3
CO6	2	2	2	2	2	2	2	2	3	3
CO7	2	2	3	3	2	2	2	3	3	3
CO8	3	3	3	3	3	3	3	3	3	3
CO9	3	3	3	3	3	3	3	3	3	3
CO10	3	3	3	3	3	3	3	3	3	3

SEMESTER: II PART: A ELECTIVE – II	PLASMA PHYSICS	Credit: 3 Hours: 4

LEARNING OBJECTIVES:

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

UNIT –I FUNDAMENTAL CONCEPTS 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.

UNIT –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.

UNIT –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.

UNIT –IV PLASMA DIAGNOSTICS TECHNIQUES:

Single probe method - Double probe method - Use of probe technique for measurement of plasma parameters in magnetic field - microwave method - spectroscopic method - -laser as a tool for plasma diagnostics-X-ray diagnostics of plasma - acoustic method - conclusion.

UNIT –V APPLICATIONS OF PLASMA PHYSICS:

Magneto hydrodynamic Generator - Basic theory - Principle of Working-Fuel in MHD Generator - Generation of Microwaves Utilizing High Density Plasma - Plasma Diode.

UNIT –VI PROFESSIONAL COMPONENTS:

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

TEXT BOOKS:

1. Plasma Physics- Plasma State of Matter - S. N.Sen, PragatiPrakashan, 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
5. Hutchinson, I. H. Principles of Plasma Diagnostics. Cambridge, UK: Cambridge University Press, 2005. ISBN: 9780521675741.

REFERENCE BOOKS:

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.
5. Huddlestone, R. H., and S. L. Leonard. Plasma Diagnostic Techniques. San Diego, CA: Academic Press, 1965

WEB SOURCES:

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.htm

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 WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	1	1	2	1	2	3	3
CO2	3	3	2	1	1	2	1	2	3	3
CO3	3	3	2	2	1	2	1	3	3	3
CO4	3	3	3	2	1	2	1	3	3	3
CO5	3	3	3	2	1	2	1	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	2	1	1	2	1	2	3	3
CO2	3	3	2	1	1	2	1	2	3	3
CO3	3	3	2	2	1	2	1	3	3	3
CO4	3	3	3	2	1	2	1	3	3	3
CO5	3	3	3	2	1	2	1	3	3	3

SEMESTER: II PART: A ELECTIVE – II	BIO PHYSICS	Credit: 3 Hours: 4

LEARNING OBJECTIVES:

- To understand the physical principles involved in cell function maintenance.
- To understand the fundamentals of macromolecular structures involved in propagation of life.
- To understand the biophysical function of membrane and neuron.
- 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.
- To understand the physical principles behind the various techniques available for interrogating biological macromolecules.

UNIT – I CELLULAR 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.

UNIT – 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.

UNIT – III MEMBRANEAND NEURO BIOPHYISCS:

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 BIO PHYSICS:

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:

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-Electrophoresis: Gel electrophoresis.

UNIT – VI PROFESSIONAL COMPONENTS:

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

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

TEXT BOOKS:

1. The cell: A molecular approach, Geoffrey M. Cooper, ASM Press, 2013.
2. Biophysics, VasanthaPattabhi, 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 BOOKS:

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 Ashrafuzzaman, Jack A. Tuszynski, (Springer science & business media).
5. Biological spectroscopyby Iain D. Campbell, Raymond A. Dwek

WEB SOURCES:

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 WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	1	2	1	3	3	2
CO2	3	3	3	2	1	2	1	3	3	2
CO3	3	3	3	3	1	1	2	3	3	2
CO4	3	3	3	2	1	1	2	3	3	3
CO5	3	3	3	3	1	1	2	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	2	1	2	1	3	3	2
CO2	3	3	3	2	1	2	1	3	3	2
CO3	3	3	3	3	1	1	2	3	3	2
CO4	3	3	3	2	1	1	2	3	3	3
CO5	3	3	3	3	1	1	2	3	3	3

SEMESTER: II PART: A ELECTIVE – III	ADVANCED SPECTROSCOPY	Credit: 3 Hours: 4

LEARNING OBJECTIVES:

- Helps students understand and appreciate spectroscopy as a sufficiently broad field in which many sub disciplines exist.
- Make them appreciate each of these specific techniques with numerous implementations.
- To realize the progress in this field that is rapid, resulting in improved instrument capabilities and an ever-widening range of applications.
- To apply group theory in spectroscopy to shed light on molecular symmetry and determine important physical parameters.

UNIT – I MOLECULAR SPECTROSCOPY AND GROUP THEORY:

Group axioms –subgroup, simple group, Abelian group, cyclic group, order of a group, class- Lagrange's theorem statement and proof - Symmetry operations and symmetry elements - Application: construction of group multiplication table (not character table) for groups of order 2, 3, cyclic group of order 4, noncyclic group of order 4 – reducible and irreducible representations- Unitary representations – Schur's lemmas – Great orthogonality theorem - point group -Simple applications : Symmetry operations of water and ammonia- Construction of character table for C_{2v} (water) and C_{3v} (ammonia) molecules**.**

UNIT – II LASER SPECTROSCOPY:

Lasers as Spectroscopy Light sources – Special Characteristics of Laser emission- ultra short pulses- laser cooling -Single and multi-mode lasers- Laser tenability- Fluorescence spectroscopy with lasers- Laser Raman Spectroscopy – Non-linear Spectroscopy – Applications of Laser Spectroscopy in medical fields, materials science research.

UNIT – III MOSSBAUER SPECTROSCOPY:

Basic idea of Mossbauer spectroscopy - Principle- Mossbauer effect- Recoilless emission and absorption- Chemical shift -Effect of electric and magnetic fields – hyperfine interactions- instrumentation-Applications: understanding molecular and electronic structures.

UNIT – IV X RAY PHOTO ELECTRON SPECTROSCOPY:

Principle – XPS spectra and its interpretation- ECSA-EDAX- other forms of XPS – chemical shift - Applications : - stoichiometric analysis- electronic structure- XPES techniques used in astronomy, glass industries, paints and in biological research.

UNIT – V MOLECULAR MODELLING:

Determination of force constants- force field from spectroscopic data-normal coordinate analysis of a simple molecule (H_2O) – analyzing thermodynamic functions, partition functions, enthalpy, specific heat and related parameters from spectroscopic data- molecular modelling using data from various spectroscopic studies.

UNIT – VI PROFESSIONAL COMPONENTS:

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

TEXT BOOKS:

1. William Kemp, 2019, Organic Spectroscopy (2nd Edition) MacMillan, Indian Edition.
2. C N Banwell and McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, 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. J M Hollas, 2002, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge.

REFERENCE BOOKS:

1. Demtroder. W, Laser Spectroscopy: Basic concepts and Instrumentation, SpringerLink.
2. B. P. Straughan and S. Walker, 1976, Spectroscopy Vol.I., Chapman and Hall, New York.
3. J L McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi.
4. David. L. Andrews**,** Introduction to Laser Spectroscopy, Springer, 2020
5. Kalsi.P.S, 2016, Spectroscopy of Organic Compounds (7th Edition) New Age International Publishers.

WEB SOURCES:

1. Fundamentals of Spectroscopy - Course (nptel.ac.in)
2. http://mpbou.edu.in/slm/mscche1p4.pdf
3. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
4. https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu
5. https://serc.carleton.edu/research_education/geochemsheets/techniques/mossbauer.html

COURSE OUTCOMES:

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

CO1	Comprehend set of operations associated with symmetry elements of a molecule, apply mathematical theory while working with symmetry operations. Apply mathematical theory while working with symmetry operations. To use group theory as a tool to characterize molecules.	**K1, K2**
CO2	Align with the recent advances in semiconductor laser technology combined sensitive spectroscopic detection techniques.	**K3**
CO3	Understand principle behind Mossbauer spectroscopy and apply the concepts of isomer shift and quadrupole splitting to analyse molecules.	**K2, K3**
CO4	Assimilate this XPES quantitative technique and the instrumentation associated with this, as applied in understanding surface of materials.	**K3, K4**
CO5	Employ IR and Raman spectroscopic data along with other data for structural investigation of molecules. Analyze thermodynamic functions and other parameters to evolve molecular models.	**K5**

K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	2	3	3	3	3	3	2
CO2	2	2	2	3	3	3	2	3	3	2
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	2	3	3	2	3	3	3	3	2
CO5	3	2	3	3	3	3	3	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	2	2	3	3	3	3	3	2
CO2	2	2	2	3	3	3	2	3	3	2
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	2	3	3	2	3	3	3	3	2
CO5	3	2	3	3	3	3	3	3	3	3

SEMESTER: II PART: A ELECTIVE – III	MICROPROCESSOR AND MICROCONTROLLER	Credit: 3 Hours: 4

LEARNING OBJECTIVES:

- To provide an understanding of the architecture and functioning of microprocessor 8085A and to the methods of interfacing I/O devices and memory to microprocessor.
- To introduce 8085A programming and applications and the architecture and instruction sets of microcontroller 8051

UNIT – I MICROPROCESSOR ARCHITECTURE & INSTRUCTION SET (8085):

Introduction to 8085,8086 - 8085 Microprocessor architecture-Address Bus,Control Bus,Data Bus-Various registers- Timing and control unit –Instruction and Data flow.
Instruction set-Data Transfer group-Branch group –Stack and I/O control instructions –Addressing modes.

UNIT – II 8085 PROGRAMMING, PERIPHERAL DEVICES AND THEIR INTERFACING:

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 – III 8085 INTERFACING APPLICATIONS:

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 and strain) –Addition – Subtraction – Largest and smallest of n numbers

UNIT – IV 8051 MICROCONTROLLER HARDWARE:

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 – V 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 Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities – Voltage and current) Measurement of physical quantities(Temperature and strain) – Addition – Subtraction.

UNIT – VI PROFESSIONAL COMPONENTS:

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

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/

COURSE OUTCOMES:

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

CO1	Gain knowledge of architecture and working of 8085 microprocessor.	K1
CO2	Get knowledge of architecture and working of 8051 Microcontroller.	K1
CO3	Be able to write simple assembly language programs for 8085A microprocessor.	K2, K3
CO4	Able to write simple assembly language programs for 8051 Microcontroller.	K3, K4
CO5	Understand the different applications of microprocessor and microcontroller.	K3,K 5

K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	3	3	1	1	1	1	1
CO2	2	1	1	1	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1
CO4	3	3	3	3	3	1	1	1	1	1
CO5	3	3	3	3	3	1	1	1	1	1

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	3	3	3	3	1	1	1	1	1
CO2	2	1	1	1	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1
CO4	3	3	3	3	3	1	1	1	1	1
CO5	3	3	3	3	3	1	1	1	1	1

SEMESTER: II PART: B SEC : I	**SKILL ENHANCEMENT COURSE** **Research Methodology and IPR**	**Credit: 2** **Hours: 4**

UNIT-I: RESEARCH METHODOLOGY

Introduction – Meaning of research – Objectives of research – Types of research – Significance of research – Research approach – Research methods vs Methodologies – Research and Scientific methods.

UNIT-II: RESEARCH DESIGHN

Need for research design – features of a good design – important concept relating to research design – experimental and control groups – different types of research design – research design in case of exploratory research studies – research design in case of descriptive and diagnostic research studies.

UNIT-III: DATA PREPARATION

Introduction – questionnaire checking – editing – coding – classification – tabulation – graphical representation – data cleaning – data adjusting – types of analysis – statistics in research.

UNIT-IV: ICT SUPPORT AND CYBER SECURITY

Information and communication technology, tools and services: Search engines & research papers – shared datasets & codes – connect and communicate with experts and researchers – free digital library–simulation/lab & project management – write and publish research papers.

Cyber space – security challenges – evolution & threats – Indian cyber situation –cyber disruptions - challenges in cyber space domain – 10 steps to cyber security.

UNIT-V: INTELLECTUAL PROPERTY RIGHTS

Project concept–project design-Intellectual Property Law Basics-Types of Intellectual Property: Patents, Copyright Trademarks, Industrial Designs and Integrated Circuits, Geographical indications-Agencies Responsible for Intellectual Property Registration -International Organizations, Agencies, and Treaties - Search engines for IPR -The Indian patent act 1970.

BOOKS FOR REFERENCE:

1. C.R.Kothari, Research Methodology, 2nd ed.New Age International(P) Ltd.2004.
2. Deborah E. Bouchoux, Intellectual Property, 4thed. Cengage Learning, 2013
3. Vijay Upagade & Arvind Shende, 1st Edison 2010, S Chand & Co.
4. Suresh Chandra & Mohit Kr Sharma, Narosa Publications.

COURSE OUTCOMES:

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

CO-1	Know the basics of research methodology, information communication technologies, cyber security and the future of physics.	**K1**
CO-2	Understand the fundamentals of intellectual property rights and the role of incubators and public policies.	**K2**

CO-3	Identify and classify various types of reports, ICT tools, ICT services, intellectual properties, agencies, treaties and public policies.	**K3**
CO-4	Utilize search engines for finding research articles, patents, designs, incubator policies and current research topics in physics.	**K4**
CO-5	Evaluate and create new ideas in the situation in cyber security, intellectual property and innovation-incubator system in India.	**K5 &K6**

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO-1	3	3	3	2	2	1	3	3	2	3
CO-2	3	3	3	2	2	1	3	3	3	3
CO-3	3	3	3	2	2	1	3	3	3	3
CO-4	3	3	3	2	2	1	3	3	3	3
CO-5	3	3	3	2	2	1	3	3	3	3

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