GOVERNMENT ARTS COLLEGE (AUTONOMOUS)
KUMBAKONAM

DEPARTMENT OF PHYSICS

M.Sc.
Curriculam and Syllabus

Scheme for the *M.Sc., Physics*
Choice Based Credit System

From *2023 – 2024* onwards
APRIL -2024

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM
DEPARTMENT OF PHYSICS
Scheme for the M.*Sc.*, *Students*
Under Choice Based Credit System

From *2023 – 2024* Onwards – APRIL 2024

SEM	COURSE	PAPER	Credit	INST. Hrs/ week	Marks		Total
					Int	Ext	
I	Core Course – I	Mathematical Physics	5	6	25	75	100
	Core Course – II	Classical mechanics & Relativity	5	6	25	75	100
	Core Practical – I	Practical -I	4	6	40	60	100
	Elective – I	Crystal growth and Thin films	3	6	25	75	100
	Elective -II	Linear and digital ICs and applications	3	6	25	75	100
		TOTAL	**20**	**30**	Total Marks		500
II	Core Course – III	Statistical mechanics	5	6	25	75	100
	Core Course – IV	Quantum Mechanics	5	6	25	75	100
	Core Practical -II	Practical –II	4	6	40	60	100
	Elective – III	Microprocessor 8085 and Microcontroller 8051	3	4	25	75	100
	Elective -IV	Physics of Nanoscience and Technology	3	4	25	75	100
	SEC – I	Object oriented Programming using C++	2	4	25	75	100
		TOTAL	**22**	**30**	Total Marks		**600**
III	Core Course - V	Condensed matter Physics	5	6	25	75	100
	Core Course - VI	Electromagnetic theory	5	6	25	75	100
	Core Course - VII	Nuclear and particle physics	5	6	25	75	100
	Core practical - III	Practical – III	4	6	40	60	100
	Elective – V	Numerical methods and computer programming	4	3	25	75	100
	SEC –II	Solar Energy Utilisation	2	3	25	75	100
	Internship/Industrial activity		2	-	-	-	-
		TOTAL	**27**	**30**	Total Marks		**600**
IV	Core Course – VIII	Spectroscopy	5	6	25	75	100
	Core practical – IV	Practical – IV	5	6	40	60	100
	Elective – VI	Characterisation of materials	4	4	25	75	100
	SEC – III	Python Programming	2	4	25	75	100
		Project with Viva-voce	**7**	10	20	80	100
	Extension Activity		1				
		TOTAL	**24**	**30**	Total Marks		**500**
		GRAND TOTAL	**93**	**120**	**-**		**2000**

COURSE PATTERN - SUMMARY

Subject	TOTAL PAPERS	CREDITS
Core Course	8	40
Core Practical	4	17
Electives	6	20
Skill Enhancement Course SEC	3	6
Project with Viva – Voce	1	7
Internship/ Industrial Activity		2
Extension Activity		1
	22	**93**

COMMON SCHEME FOR THEORY PAPERS

Part – A [10 × 2 = 20]

Two short answer questions from each unit (5 units) 10 questions:

(1) & (2) – Unit I

(3) & (4) – Unit II

(5) & (6) – Unit III

(7) & (8) – Unit IV

(9) & (10) – Unit V

Part – B [5 × **5 = 25]**

Two questions from each unit (5 units) either or type:

(11) a (or) b – Unit I

(12) a (or) b – Unit II

(13) a (or) b – Unit III

(14) a (or) b – Unit IV

(15) a (or) b – Unit V

Part – C [3 × 10 = 30]

(Answer any three)

Five long answer questions one from each unit (5 units):

(16) Unit I

(17) Unit II

(18) Unit III

(19) Unit IV

(20) Unit V

Core Course – I	MATHEMATICAL PHYSICS	I YEAR - FIRST SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	MATHEMATICAL PHYSICS	Core				5	6	75

Pre-Requisites
Knowledge of Matrices, vectors, differentiation, integration, differential equations
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

UNITS	Course Details
UNIT I: **VECTOR ANALYSIS AND VECTOR SPACE**	**Vector Analysis:** Scalar and vector fields – Gradient –Divergence–Curl and Laplacian interms of orthogonal and curvilinear coordinates–line integral–surface integral–volume integral–Gauss divergence theorem–Stoke's theorem–Green's theorem. **Vector space:** Basic concepts – Definitions– examples of vector space – Linear independence – Scalar product– Orthogonality – Gram–Schmidt orthogonalization procedure –
UNIT II: **COMPLEX ANALYSIS**	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.
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. Laplace transform and its inverse – Transform of derivatives and integrals – Differentiation and integration of transforms – Dirac delta functions – Application – Laplace equation: Potential problem in a semi – infinite strip.

UNIT V: **SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS AND SPECIAL FUNCTIONS**	Second order linear differential equation–solution with simple examples – Bessel polynomials – generating function – orthogonality properties – Recurrence relations – Legendre polynomials – Generating function – Rodrigue formula – Orthogonality properties - Hermite polynomials – Generating function – Orthogonality properties – Recurrence relations.
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. B. D. Gupta, 2009, Mathematical Physics (4th edition), VikasPublishing House, New Delhi. 2. H. K. Dass and Dr. Rama Verma, 2014, Mathematical Physics, Seventh Revised Edition, S. Chand & Company Pvt. Ltd., New Delhi. 3. P.K. Chattopadhyay, 2013, Mathematical Physics (2nd edition), New Age, New Delhi 4. A W Joshi, 2017, Matrices and Tensors in Physics, 4th Edition (Paperback), New Age International Pvt.Ltd., India 5. George Arfken and Hans J Weber, 2012, Mathematical Methods for Physicists – A Comprehensive Guide (7th edition), Academic press.
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	Understand the vector analysis and vector space and explain the line integral, surface integral and volume integral.	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. 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 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	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

Core Course-II	CLASSICAL MECHANICS AND RELATIVITY	I YEAR - FIRST SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	CLASSICAL MECHANICS AND RELATIVITY	Core				5	6	75

Pre-Requisites
Knowledge of fundamentals of mechanics, Foundation in mathematical methods.
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.

UNITS	Course Details
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. – Hamilton's variational principle – Lagrange's equation of motion from Hamilton's principle – principle of least action.
UNIT III: HAMILTONIAN FORMULATION	Phase space – cyclic coordinates – conjugate momentum – Hamiltonian function – physical significance - 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	Euler angles – Moments and products of inertia – Euler's equations- Theory of small oscillations - Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear tri atomic 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

Core Practical - I	PRACTICAL I	I YEAR - FIRST SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	PRACTICAL I	Core				4	6	60

Pre-Requisites

Knowledge and hands on experience of basic general and electronics experiments of Physics

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.

Course Details

(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 Rydberg's Constant - Hydrogen Spectrum
3. Measurement of Band gap energy- Thermistor
4. Determination of Specific charge of an electron – Thomson's method.
5. Determination of Wavelength, Separation of wavelengths - Michelson Interferometer
6. Measurement of Conductivity - Four probe method.
7. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.
8. Construction of relaxation oscillator using UJT and verify its characteristics.
9. FET CS amplifier- Frequency response, input impedance, output impedance
10. Study of important electrical characteristics of IC741.
11. V- I Characteristics of different colours of LED.
12. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
13. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
14. Construction of Schmidt trigger circuit using IC 741 for a given hysteresis- application as squarer.
15. Construction of square wave Triangular wave generator using IC 741
16. Construction of pulse generator using the IC 741 – application as frequency divider
17. Study of R-S, clocked R-S and D-Flip flop using NAND gates
18. Study of J-K, D and T flip flops using IC 7476/7473
19. Tuned drain oscillator using FET
20. Specific charge of an electron – Helical coil method
21. Characteristics of LDR.

TEXT BOOKS	1. Practical Physics, Gupta and Kumar, Pragati Prakasan. 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, Pragati Prakasan. 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) and LOW (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

METHOD OF EVALUATION:

Continuous Internal Assessment	**End Semester Examination**	**Total**	**Grade**
40	60	**100**	

Elective – I	CRYSTAL GROWTH AND THIN FILMS	I YEAR – FIRST SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	CRYSTAL GROWTH AND THIN FILMS	ELECTIVE				3	6	75

Pre-Requisites
Fundamentals of Crystal Physics
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

UNITS	Course Details
UNIT I: INTRODUCTION TO CRYSTAL GROWTH	Basic Concepts, Nucleation and Kinetics of growth Ambient phase equilibrium - super saturation - equilibrium of finite phases equation of Thomson - Gibbs - Types of Nucleation - Formation of critical Nucleus - Classical theory of Nucleation - Homo and heterogeneous formation of 3D nuclei - rate of Nucleation - epitaxial growth - Growth mechanism and classification.
UNIT II: CRYSTALLIZATION PRINCIPLES	Crystallization Principles and Growth techniques Classes of Crystal system - Crystal symmetry - Solvents and solutions - Solubility diagram - Metastable zone and introduction period - Miers TC diagram - Solution growth - Low and high temperatures 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 - Floating zone - Bridgeman method - Horizontal gradient freeze - Flux growth - Hydrothermal growth - Vapour phase growth - 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, Micro balance.
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 the 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) and LOW (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

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
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

Elective – II	LINEAR AND DIGITAL ICs & APPLICATIONS	I YEAR – FIRST SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	LINEAR AND DIGITAL ICs AND APPLICATIONS	Core				3	6	75

Pre-Requisites
Knowledge of semiconductor devices, basic concepts of digital and analog electronics
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

UNITS	Course Details
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 – Logarithmic and antilogarithmic amplifier - Solution to simultaneous equations and differential equations, Instrumentation amplifiers, V to I and I to V converters.
UNIT II: APPLICATIONS OF OP-AMP & ACTIVE FILTERS	**NON-LINEAR APPLICATIONS OF OP-AMP**: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multi-vibrators, Triangular and Square waveform generators. ACTIVE FILTERS: Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters, band pass, band reject and all pass filters.
UNIT III: TIMER AND PHASE LOCKED LOOPS	**TIMER AND PHASE LOCKED LOOPS**: 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 to A AND A to D CONVERTERS	**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: COMBINATIONAL CIRCUITS USING TTL 74XX ICs & SEQUENTIAL CIRCUITS USING TTL 74XX ICs	**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), BCD to 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), 4- bit asynchronous binary counter (IC 7493).
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. 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. 5. Integrated Electronics, Millman &Halkias, Tata McGraw Hill, 17th Reprint (2000)
WEB SOURCES	1. https://nptel.ac.in/course.html/digital circuits/ 2. https://nptel.ac.in/course.html/electronics/operational amplifier/ 3. https://www.allaboutcircuits.com/textbook/semiconductors/chpt-7/field-effect-controlled-thyristors/ 4. https://www.electrical4u.com/applications-of-op-amp/ 5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

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 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) and LOW (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

CORE COURSE III - STATISTICAL MECHANICS	I YEAR - SECOND SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	STATISTICAL MECHANICS	Core				4	6	75

Pre-Requisites
Knowledge of Laws of thermodynamics, phase transition, entropy, ensembles, partition function, classical and quantum statistics, thermal equilibrium, Brownian motion
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

UNITS	Course Details
UNIT I: THERMODYNAMICS AND THEIR CONSEQUENCES	Energy and first law of thermodynamics – Heat content and heat capacity – Specific heat – Entropy and second law of thermodynamics – Thermodynamic potential and the reciprocity relations – Maxwell's relations – Deductions – Gibb's-Helmholtz relation – Thermodynamic equilibrium – Nernst heat theorem of third law – Consequences of third law – Phase – Gibb's phase rule – Chemical potential.
UNIT II: KINETIC THEORY	Distribution function and its evolution – Boltzmann transport equation and its validity – Boltzmann's H-theorem – Maxwell-Boltzmann distribution – Transport phenomena – Mean free path – Conservation laws- Hydrodynamics.
UNIT III: CLASSICAL STATISTICAL MECHANICS	Macro and micro states – Statistical equilibrium – Phase space and ensembles – Micro canonical ensemble and Grand canonical ensembles - Liouville's theorem – Maxwell-Boltzmann distribution law – Principles of equipartition of energy – partition function – Relation between partition function and thermodynamic quantities.
UNIT IV: QUANTUM STATISTICAL STATISTICS	Basic concepts – Identical particle and symmetry requirement – Bose-Einstein statistics - Fermi-Dirac statistics – Comparison of M-B, B-E and F-D statistics – Blackbody radiation and Plancks radiation – Thermodynamic properties of diatomic molecules.

UNIT V: APPLICATION OF QUANTUM STATISTICAL MECHANICS	Ideal Bose-Einstein gas: Energy and pressure of gas – Gas degeneracy – Bose-Einstein condensation – Thermal properties of Bose-Einstein gas – Liquid Helium – Ideal Fermi-Dirac gas: Fermi energy - Electron gas – Pauli paramagnetism - Ising and Heisenberg models.
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. R. K. Pathria, 1996, *Statistical Mechanics*, 2nd edition, Butter WorthHeinemann, New Delhi. 2. S. K. Sinha, 1990, Statistical *Mechanics*, Tata McGraw Hill, New Delhi. 3. B. K. Agarwal and M. Eisner, 1998, *Statistical Mechanics*, Second Edition New Age International, New Delhi. 4. J. K. Bhattacharjee, 1996, *Statistical Mechanics*: An Introductory Text, Allied Publication, New Delhi. 5. F. Reif, 1965, *Fundamentals of Statistical and Thermal Physics*, McGraw -Hill, New York. 6. M. K. Zemansky, 1968, *Heat and Thermodynamics*, 5th edition, McGraw-Hill New York.
REFERENCE BOOKS	7. L. D. Landau and E. M. Lifshitz, 1969, *Statistical Physics*, Pergamon Press, Oxford. 8. K. Huang, 2002, *Statistical Mechanics*, Taylor and Francis, London 9. W. Greiner, L. Neiseand H.Stoecker, *Thermodynamics and Statistical Mechanics*, Springer Verlang, New York. 10. A. B. Gupta, H. Roy, 2002, *Thermal Physics*, Books and Allied, Kolkata.
WEB SOURCES	1. https://byjus.com/chemistry/third-law-of-thermodynamics/ 2. https://web.stanford.edu/~peastman/statmech/thermodynamics.html 3. https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics 4. https://en.wikipedia.org/wiki/Grand_canonical_ensemble 5. https://en.wikipedia.org/wiki/Ising_model

COURSE OUTCOMES:

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

CO1	To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition	K5
CO2	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	**K4, K5**

	the three types of statistics.	
CO5	To discuss and examine the thermo dynamical behavior of gases under fluctuation.	**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**	**PSO10**
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

Core Course-IV	QUANTUM MECHANICS	I YEAR - SECOND SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	QUANTUM MECHANICS	Core				5	6	75

Pre-Requisites
Knowledge of Newton's laws of motion, Schrodinger's equation, integration, differentiation.
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 and Variational methods for solving the Schrödinger equation.

UNITS	Course Details
UNIT I: **BASIC FORMALISM**	Postulates of Quantum mechanics – Schrodinger's Time dependent and Time independent equations – Interpretation of wave function – Ehrenfest's theorem – Linear vector space –Dirac's Bra and Ket notation–properties – Hermitian Operator – Uncertainty reation for operators – Minimum uncertainty condition. Quantum dynamics: Schrodinger, Heisenberg and Interaction pictures – Comparison.
UNIT II: **ONE DIMENSIONAL AND THREE-DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS**	Square – well potential with rigid and finite walls – Square potential barrier – Linear harmonic oscillator: Operator method – Particle moving in a spherically symmetric potential – Hydrogen atom - Rigid rotator.
UNIT III **APPROXIMATION METHODS**	Time independent perturbation theory for non-degenerate and degenerate energy levels – Stark effect in Hydrogen atom – Ground and excited state – Variation method – Helium atom – Time dependent perturbation theory – Constant and harmonic perturbation – Fermi's Golden rule – Transition probability – Einstein's A and B coefficients.

UNIT IV: ANGULAR MOMENTUM	Orbital angular momentum – Commutation rules – spin angular momentum – Total angular momentum – Ladder operators and their properties – Eigen values of J^2 and J_Z – Addition of angular moemnta – Clebch Gordon coefficients – calculation of C.G. coefficients for $J_1 = ½$ and $J_2 = ½$.
UNIT V: RELATIVISTIC QUANTUM MECHANICS	Klein-Gordon equation – charge and current densities – Dirac equation – Dirac matrices – plane wave solution – Interpretation of negative energy states – Anti particles – spin of the electron – magnetic moment of an electron due to spin.
TEXT BOOKS	1. G. Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009. 2. P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, 2nd edition(37th Reprint),Tata McGraw-Hill, New Delhi, 2010. 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 formulate and analyze the approximation methods for various quantum mechanical problems	**K1**
CO4	To apply commutative algebra for topics such as angular and spin angular momentum and to add angular momenta	**K4, K5**
CO5	Understand the concept of relativistic quantum mechanics and understand the spin of the electron.	**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	S	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	S	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	S	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	S	3	3	2	3

Core Practical-II	PRACTICAL II	I YEAR - SECOND SEMESTER						
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
	PRACTICAL II	Core				4	6	60

Pre-Requisites

Knowledge and handling of basic general and electronics experiments of Physics

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 study the different applications of operational amplifier circuits.
- To learn about Combinational Logic Circuits and Sequential Logic Circuits

Course Details

(Minimum of Twelve Experiments from the list)

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method
2. Measurement of Susceptibility of liquid - Quincke's method
3. Miscibility measurements using ultrasonic diffraction method
4. Determination of Thickness of thin film. - Michelson Interferometer
5. IC 7490 as scalar and seven segment display using IC7447
6. Solving simultaneous equations – IC 741 / IC LM324
7. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
8. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
9. Construction of Schmidt trigger circuit using IC555
10. Study of binary up / down counters - IC 7476 / IC7473
11. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474
12. Planck's costant – Photo electric cell
13. Dual power supply using Zener diode.
14. Charge of an electron – Spectrometer.
15. Universal NAND and NOR gates (7400 and 7402)
16. Half adder and full adder using NAND gates.
17. Rydberg's constant – Hydrogen discharge tube.
18. Half subtractor and full subtractor using NAND gates.
19. Hartmann's constant – Spectrometer.
20. Simplification of Boolean expression using K-map
21. Adder, Subtractor, Differentiator and Integrator using OPAMP IC 741

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 Michelson interferometer and its applications	**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) and LOW (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

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
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	S	S	2	2	2	3	3
CO7	2	2	S	S	S	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

METHOD OF EVALUATION:

Continuous Internal Assessment	**End Semester Examination**	**Total**	**Grade**
40	60	**100**	

Elective – III MICROPROCESSOR 8085 AND MICROCONTROLLER 8051	I YEAR – SECOND SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	MICROPROCESSOR 8085 AND MICROCONTROLLER 8051	ELECTIVE				3	4	75

Pre-Requisites
Knowledge of number systems and binary operations
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

UNITS	Course Details
UNIT I: **8085 MICROPROCESSOR**	8085 Microprocessor Architecture –PIN configuration of 8085 -opcode and operands - Instruction word size – Instruction cycle- Fetch operation – Execute operation – Machine cycle and state - Instruction and data flow – Timing diagrams for opcode fetch cycle, Memory Read, Memory Write, I/O Read and I/O Write- Instruction set – Data transfer group- Arithmetic group- Logical group – Branch control group stack and I/O control instructions.
UNIT II: **PROGRAMMING WITH 8085**	Instruction and data formats – Addressing modes – Direct , register direct, indirect, immediate and implicit mode- Assembly language programming of 8085 microprocessor – Addition, subtraction, multiplication, division, biggest and smallest number of a set of numbers- Ascending and descending order- Address space partitioning – Memory mapped I/O scheme – I/O mapped I/O scheme.
UNIT III: PERIPHERAL DEVICES, INTERFACING AND APPLICATIONS	Memory and I/O interfacing – Memory interfacing (74LS5138) – I/O interfacing (74LS5138) – data transfer schemes - Interrupts of 8085- Programmable peripheral interfaces (PPI) (8055A) - Control group and control word - Programmable DMA controller (8257) – Programmable Interrupt controller (8259).
UNIT IV: 8051 MICROCONTROLLER	Introduction – Features of 8051 – 8051 microcontroller hardware – 8051 PIN configuration – memory architecture – special functions registers – I/O ports – timers/counters – interrupts of µc 8051 – programming timer interrupts- programming serial communication port interrupts – programming internal hardware interrupts – Interrupts priority in µc 8051.
UNIT V: INSTRUCTION SET AND PROGRAMMING OF MICROCONTROLLER 8051	Program memory and the program counter – Instructions of µc 8051- Data transfer instructions – Arithmetic instructions –Logical instructions- Boolean instructions and Branching instructions - Loop, Jump and CALL instructions - Addressing modes – Immediate, Register, register direct and indirect , indexed addressing mode – Programming for addition, subtraction, multiplication and division .

TEXT BOOKS	1. B. Ram, Fundamentals of Microprocessors & Microcontrollers, Dhanpat Rai publications New Delhi (2016). 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. A. NagoorKani, Microprocessors & Microcontrollers, RBA Publications (2009). 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	Be able to write simple assembly language programs for 8085A microprocessor	**K2,K3**
CO3	Get knowledge of peripheral devices	**K2, K3**
CO4	Get knowledge Architecture and working 8051 Microcontroller.	**K3, K4**
CO5	Able to write simple assembly language program for 8051 microcontrollor..	**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) **and** LOW (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

Elective - IV **PHYSICS OF NANOSCIENCE AND TECHNOLOGY**	**I YEAR – SECOND SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	PHYSICS OF NANOSCIENCE AND TECHNOLOGY	ELECTIVE				3	4	75

Pre-Requisites
Basic knowledge in Solid State Physics
Learning Objectives
➢ Physics of Nanoscience and Technology is concerned with the study, creation, manipulation and applications at nanometer scale. ➢ To provide the basic knowledge about nanoscience and technology. ➢ To learn the structures and properties of nanomaterials. ➢ To acquire the knowledge about synthesis methods and characterization techniques and its applications.

UNITS	Course Details
UNIT I: FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY	Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology -– Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells - Surface effects of nanomaterials.
UNIT II: PROPERTIES OF NANOMATERIALS	Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant - Mechanical behavior :Elastic properties – strength - ductility - Optical properties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS).
UNIT III: SYNTHESIS AND FABRICATION	Synthesis of metallic and semi conductor nanoparticle - Physical and Chemical techniques – Ball milling – Laser ablation – Photo , e-beam , X-Ray lithography – Molecular Beam Epitaxy (MBE) – Plasma arching – Sol Gel technique – Electro chemical etching technique.
UNIT IV: CHARACTERIZATION TECHNIQUES	Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer.
UNIT V: APPLICATIONS OF NANOMATERIALS	Sensors: Nanosensors based on optical and physical properties - Electrochemical sensors. Nano Electronics: Nanobots - display screens - GMR read/write heads - Photocatalytic application: water purification -Medicine: Imaging of cancer cells – biological tags -

	drug delivery - Energy: fuel cells- supercapacitors - photovoltaics.
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 textbook of Nanoscience and Nanotechnology, Pradeep T., Tata McGraw-Hill Publishing Co. (2012). 2. Principles of Nanoscience and Nanotechnology, M.A. Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., (2010). 3. Introduction to Nanoscience and Nanotechnology, K. K. Chattopadhyay and A.N. Banerjee, PHI Learning Pvt. Ltd., New Delhi, (2012). 4. Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press, (2002). 5. Nanotechnology and Nanoelectronics, D.P. Kothari, V. Velmurugan and Rajit Ram Singh, Narosa Publishing House Pvt.Ltd, New Delhi. (2018)
REFERENCE BOOKS	1. Nanostructures and Nanomaterials – HuozhongGao – Imperial College Press (2004). 2. Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA 3. Nano particles and Nano structured films; Preparation, Characterization and Applications, J.H.Fendler John Wiley and Sons. (2007) 4. Textbook of Nanoscience and Nanotechnology, B.S.Murty, et al., Universities Press. (2012) 5. The Nanoscope (Encyclopedia of Nanoscience and Nanotechnology), Dr. Parag Diwan and Ashish Bharadwaj (2005) Vol. IV - Nanoelectronics Pentagon Press, New Delhi.
WEB SOURCES	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:

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

CO1	Learn about the fundamental concept of nano science and nano technology. And to establish the knowledge in Quantum dots, wires and quantum wells.	K1
CO2	Study on physical, electrical and magnetic properties of nanomaterials	**K2,K3**
CO3	Study on synthesis of nano materials from Top down and bottom up approaches method.	**K2, K3**
CO4	Get the knowledge on characterization techniques of nano material	**K3, K5**

CO5	Study the applications on nano materials in various field	**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) **and** LOW (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

SEC – I	OBJECT – ORIENTED PROGRAMMING USING C++	I YEAR – SECOND SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	OBJECT – ORIENTED PROGRAMMING USING C++	SEC				2	4	75

Pre-Requisites
Basic knowledge in Object – Oriented Programming
Learning Objectives
• To understand the basic concepts of object oriented programming using C++ • To impart practical training of real time problems in C++

UNITS	Course Details
UNIT I: **BASICS OF OOP AND C++ PROGRAMMING**	Basic concepts of Object-Oriented Programming–Tokens, Expressions– Control Structures - Decision Making Statements : If .. else ,jump, goto, break, continue, Switch case statements - Loops in C++ : For, While, Do – Operators – scope resolution, member dereferencing, memory management operators – Manipulators – Operator overloading - Overloading unary, binary operators.
UNIT-II : **CLASSES AND INHERITANCE**	Functions in C++ - Inline functions – Function Overloading - class – specifying a class- Defining member functions - Objects – private and static member functions – array of objects - friend function - Constructors – types - Destructors - Inheritance– Single, Multilevel, Multiple, Hierarchal, Hybrid inheritance.
UNIT-III: **POINTER AND TEMPLATES**	Pointers –Pointer to Class and Object – this pointer – Pointers to derived classes and Base classes -Virtual Functions and Polymorphism- Files – File stream classes – file modes – Sequential Read / Write operations – Binary and ASCII Files – Random Access Operation.
UNIT-IV: **LIBRARIES AND SYSTEM DEVELOPMENT**	Templates – Class templates – Function templates - Exception Handling – Throwing, catching and trying mechanisms - Standard Template Library – Containers – Algorithms – iterators - Object oriented system development – Procedure oriented – Object oriented paradigms – String manipulation.

UNIT- V: **PROGRAMS**	1. Calculate the total and average of a set of numbers in an array. 2. Add/Subtract two matrices using class and objects. 3. Multiply two matrices using operator overloading. 4. Find the smallest and largest elements in an array. 5. Sorting a set of numbers in ascending/descending order
TEXT BOOKS	E. Balagurusamy, OBJECT-ORIENTED PROGRAMMING WITH C++, Tata Mc-Grawhill Publication, 6th Ed 2013
REFERENCE BOOKS	1. Ashok N Kamthane , OBJECT-ORIENTED PROGRAMMING WITH ANSI AND TURBOC C++, Pearson Education publication. 2003. 2. Maria Litvin & Gray Litvin , C++ for you, Vikas publication, 2002. 3. John R Hubbard, Programming with C++, 2nd Edition, TMH publication, 2002.

COURSE OUTCOMES:

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

CO1	Understand the difference between the top-down and bottom up approach	K1, K2
CO2	Describe the object oriented programming approach in connection with C++.	**K1**
CO3	Apply the concepts of object oriented programming and procedural programming	**K2, K3**
CO4	Illustrate the process of data file manipulations using C++.	**K4**
CO5	Apply virtual and pure virtual function and complex programming situations.	**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	3	3	3	2	1	1	3	3	3	3
CO2	3	3	3	2	1	1	3	3	3	3
CO3	3	3	2	2	1	1	3	3	3	3
CO4	3	3	3	2	1	1	3	3	3	3
CO5	3	3	2	2	1	1	3	3	3	3

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

CORE COURSE V - CONDENSED MATTER PHYSICS	II YEAR - THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	CONDENSED MATTER PHYSICS	Core				4	5	75

Pre-Requisites
Basic knowledge of atomic physics, quantum mechanics and statistical mechanics.
Learning Objectives
➢ To describe various crystal structures, symmetry and to differentiate different types of bonding. ➢ To construct reciprocal space, understand the lattice dynamics and apply it to concept of specific heat. ➢ To critically assess various theories of electrons in solids and their impact in distinguishing solids. ➢ Outline different types of magnetic materials and explain the underlying phenomena. ➢ Elucidation of concepts of superconductivity, the underlying theories – relate to current areas of research.

UNITS	Course Details
UNIT I: CRYSTAL PHYSICS	Symmetry elements and allowed rotations - Types of lattices - Miller indices – Simple crystal structures – Atomic Packing Factor- Crystal X-ray diffraction - Bragg's law – The Von Laue treatment- Laue equations – Laue method – Reciprocal Lattice (sc, bcc, fcc)- Bragg's law in reciprocal lattices - Brillouin zone – Types of crystal bonding (general ideas)- Binding energy of ionic crystals - Madelung constant .
UNIT II: LATTICE DYNAMICS	Vibration of mono atomic lattices - Lattice with two atoms per primitive cell - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Umkalapp processes - Inelastic scattering by phonons – Classical theory of specific heat - Debye's theory of lattice heat capacity - Thermal Conductivity.
UNIT III: THEORY OF METALS AND SEMICONDUCTORS	Free electron gas in three dimensions – Sommerfeld model of electrical conductivity - Wiedemann-Franz law- Hall effect - Bloch theorem - Kronig-Penney model - Band theory of metals and semiconductors – Semiconductors - Intrinsic carrier concentration - Fermi surfaces and construction - de Hass-van Alphen effect .
UNIT IV: MAGNETISM	Diamagnetism - Quantum theory of paramagnetism - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall - Spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism - Neel temperature.
UNIT V: SUPERCONDUCTIVITY	**Experimental facts:** Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - Entropy and heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors.

	Theoretical Explanation: Thermodynamics of super conducting transition - London equation - Coherence length – Isotope effect - Cooper pairs – Bardeen Cooper Schrieffer (BCS) Theory –Josephson tunneling - DC and AC Josephson effects.
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. Gupta & Kumar,Solid state physics, K. Nath & co. educational publishers, Meerut - 250 002. 2. C. Kittel, 1996, *Introduction to SolidState Physics*, 7th Edition, Wiley, New York. 3. Rita John, Solid State Physics,Tata Mc-GrawHill Publication. 4. A. J. Dekker, *Solid State Physics*, Macmillan India, New Delhi. 5. M. Ali Omar, 1974, *Elementary SolidState Physics – Principles and Applications*, Addison - Wesley 6. H. P. Myers, 1998, *Introductory SolidState Physics*, 2nd Edition, Viva Book, New Delhi.
REFERENCE BOOKS	1. J. S. Blakemore, 1974, *Solid state Physics*, 2nd Edition, W.B. Saunder, Philadelphia 2. H. M. Rosenburg, 1993, *The SolidState*, 3rd Edition, OxfordUniversity Press, Oxford. 3. J. M. Ziman, 1971, Principles *of the Theory of Solids*, CambridgeUniversity Press, London. 4. C. Ross-Innes and E. H. Rhoderick, 1976, *Introduction to Superconductivity*, Pergamon, Oxford. 5. J. P. Srivastava, 2001, *Elements of Solid State Physics*, Prentice-Hall of India, New Delhi.
WEB SOURCES	1. http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html 2. http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html 3. https://www.britannica.com/science/crystal 4. https://www.nationalgeographic.org/encyclopedia/magnetism/ 5. https://www.brainkart.com/article/Super-Conductors_6824/

COURSE OUTCOMES:

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

CO1	Student will be able to list out the crystal systems, symmetries allowed in a system and also the diffraction techniques to find the crystal structure	K1
CO2	Students will be able to visualize the idea of reciprocal spaces, Brillouin Zone and their extension to band theory of solids.	**K1, K2**
CO3	Student will be able to comprehend the heat conduction in solids	**K3**
CO4	Student will be able to generalize the electronic nature of solids from band theories.	**K3, K4**
CO5	Student can compare and contrast the various types of magnetism and conceptualize the idea of superconductivity.	**K5**
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	3	2	2	2	2	2	2	2
CO2	3	2	3	2	3	2	3	3	2	3
CO3	3	3	3	2	3	2	3	3	2	3
CO4	2	2	2	2	2	2	2	2	2	3
CO5	2	2	2	2	2	2	2	2	2	3

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

CORE COURSE VI – ELECTROMAGNETIC THEORY	II YEAR – THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	ELECTROMAGNETIC THEORY	Core				4	5	75

Pre–Requisites
Knowledge of different coordinate systems, Laplace's equation, conducting & non–conducting medium, basic definitions in magnetism, propagation of electromagnetic waves, plasma
Learning Objectives
➢ To acquire knowledge about boundary conditions between two media and the technique of method of separation of variables ➢ To understand Biot – Savart's law and Ampere's circuital law ➢ To comprehend the physical ideas contained in Maxwell's equations, Coulomb & Lorentz gauges, conservation laws ➢ To assimilate the concepts of propagation, polarization, reflection and refraction of electromagnetic waves ➢ To grasp the concept of plasma as the fourth state of matter

UNITS	Course Details
UNIT I: ELECTROSTATICS	Coulomb's law - Electric field - Continuous charge distributions - Field lines, Flux and Gauss's law - Divergence of E - Applications of Gauss's Law - curl of E - Electric potential - Poisson's and Laplace's Equation - Potential of a localized charge distribution – Multipole expansion of a charge distribution - Electrostatic Boundary conditions - Uniqueness theorems - Method of images: Classic image problem - induced surface charge - Force and energy - other image problems - boundary value problems on spherical symmetry, cylindrical symmetry and plane symmetry.
UNIT II: MAGNETOSTATICS	Lorentz Force Law - Biot-Savart Law - magnetic field of steady current - The Divergence and Curl of B - Applications of Ampere's Law - magnetic potential - uniform surface current of a long solenoid - torroidal coil - large parallel plate capacitor - magnetic field inside and outside a cylindrical wire - magnetic field inside and outside the slab - Magnetic vector potential - magnetostatic boundary conditions.

UNIT III: FIELD EQUATIONS AND CONSERVATION LAWS	Ohm's law - Faraday's law - induced electric field - Inductance - Energy in magnetic fields - Maxwell's equations in free space and linear isotropic media - Boundary conditions on fields at interface - continuity equations - Poynting's theorem - Potential formulation - Lorentz and Coulomb Gauge transformations - retarded potentials

UNIT IV: ELECTROMAGNETIC WAVES	Waves in one dimension - Reflection, transmission and polarization – Brewster's law and polarization of electromagnetic waves – Total internal reflection - wave equation for E and B - monochromatic plane waves - Energy and momentum in EM waves - Propagation in linear media - Reflection and transmission at normal and oblique incidence - EM waves in conductors - Absorption, dispersion and reflection at a conducting surface
UNIT V: GUIDED WAVES AND RADIATION	Wave guides - TE and TM waves in a rectangular wave guide - Coaxial transmission line - Electric dipole radiation - Magnetic dipole radiation - Radiation from an arbitrary source -power radiated by a point charge - Radiation reaction - radiation damping of a charged particle - Physical basis of the radiation reaction
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. K.K.Chopra & G.C. Agrawal, |Electromagnetic theory, K. Nath & co, Meerut. 2. D. J. Griffiths, 2002, *Introduction to Electrodynamics*, 3rd Edition, Prentice–Hall of India, New Delhi. 3. J. R. Reitz, F. J. Milford and R. W. Christy, 1986, *Foundations of Electromagnetic Theory,* 3rd edition, Narosa Publishing House, New Delhi. 4. J. D. Jackson, 1975, *Classical Electrodynamics,* Wiley Eastern Ltd. New Delhi. 5. J. A. Bittencourt, 1988, *Fundamentals of Plasma Physics*, Pergamon Press, Oxford. 6. Gupta, Kumar and Singh, Electrodynamics, S.Chand & Co., New Delhi
REFERENCE BOOKS	1. W. Panofsky and M. Phillips, 1962, *Classical Electricity and Magnetism,* Addison Wesley, London. 2. J. D. Kraus and D. A. Fleisch, 1999, *Electromagnetics with Applications,* 5th Edition, WCB McGraw–Hill, New York. 3. B. Chakraborty, 2002, *Principles of Electrodynamics*, Books and Allied, Kolkata. 4. P. Feynman, R. B. Leighton and M. Sands, 1998, *The Feynman Lectures on Physics*, Vols. 2, Narosa Publishing House, New

	Delhi. 5. Andrew Zangwill, 2013, Modern Electrodynamics, Cambridge University Press, USA.
WEB SOURCES	1. http://www.plasma.uu.se/CED/Book/index.html 2. http://www.thphys.nuim.ie/Notes/electromag/frame–notes.html 3. http://www.thphys.nuim.ie/Notes/em–topics/em–topics.html 4. http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/ 5. https://www.cliffsnotes.com/study–guides/physics/electricity–and–magnetism/electrostatics

COURSE OUTCOMES:

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

CO1	Solve the differential equations using Laplace equation and to find solutions for boundary value problems	K1, K5
CO2	Use Biot–Savart's law and Ampere circuital law to find the magnetic induction & magnetic vector potential for various physical problems	**K2, K3**
CO3	Apply Maxwell's equations to describe how electromagnetic field behaves in different media	**K3**
CO4	Apply the concept of propagation of EM waves through wave guides in optical fiber communications and also in radar installations, calculate the transmission and reflection coefficients of electromagnetic waves	**K3, K4**
CO5	Investigate the interaction of ionized gases with self–consistent electric and magnetic fields	**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	3	1	2	2	3	3	1	3
CO2	3	3	3	1	2	2	3	3	1	3
CO3	3	3	3	1	2	2	3	3	1	3
CO4	3	3	3	1	2	2	3	3	1	3
CO5	3	3	3	1	2	2	3	3	1	3

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

CORE COURSE VII - NUCLEAR AND PARTICLE PHYSICS	II YEAR - THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	NUCLEAR AND PARTICLE PHYSICS	Core				4	6	75

Pre-Requisites
Knowledge of basic structure of atom and nucleus.
Learning Objectives
➢ Introduces students to the different models of the nucleus in a chronological order ➢ Imparts an in-depth knowledge on the nuclear force, experiments to study it and the types of nuclear reactions and their principles ➢ Provides students with details of nuclear decay with relevant theories ➢ Exposes students to the Standard Model of Elementary Particles and Higgs boson

UNITS	Course Details
UNIT I: **NUCLEAR MODELS**	Liquid drop model – Weizacker mass formula – Isobaric mass parabola – Mirror Pair - Bohr Wheeler theory of fission – shell model – spin-orbit coupling – magic numbers –magnetic moment – Schmidt model – electric Quadrapole moment - Bohr and Mottelson collective model.
UNIT II: **NUCLEAR FORCES**	Properties of nuclear forces – ground state of deuteron – Exchange Forces - Meson theory of nuclear forces – Yukawa potential – n-p scattering at low energy – effective range theory – spin dependence of nuclear forces - charge independence and charge symmetry – isospin formalism.
UNIT III: **NUCLEAR REACTIONS**	Kinds of nuclear reactions – Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nuclear reactions – Reciprocity theorem – Resonances – Breit Wigner one level formula.
UNIT IV: **NUCLEAR DECAY**	Beta decay – Continuous Beta spectrum – Fermi theory of beta decay - Comparative Half-life –Fermi Kurie Plot – mass of neutrino – allowed and forbidden decay — neutrino physics – Helicity - Parity violation - Gamma decay – multipole radiations – Angular Correlation - internal conversion – nuclear isomerism.

UNIT V: **ELEMENTARY PARTICLES**	Classification of Elementary Particles – Types of Interaction and conservation laws – Families of elementary particles – Isospin – Quantum Numbers – Strangeness – Hypercharge and Quarks –SU (2) and SU (3) groups-Gell Mann matrices– Gell Mann Okuba Mass formula-Quark Model. Standard model of particle physics – Higgs boson.
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. D. C. Tayal – Nuclear Physics – Himalaya Publishing House (2011) 2. K. S. Krane – Introductory Nuclear Physics – John Wiley & Sons (2008) 3. R. Roy and P. Nigam – Nuclear Physics – New Age Publishers (1996) 4. S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers (2011) 5. S. Glasstone – Source Book of Atomic Energy – Van Nostrand Reinhold Inc.,U.S.- 3rd Revised edition (1968)
REFERENCE BOOKS	1. L. J. Tassie – The Physics of elementary particles – Prentice Hall Press (1973) 2. H. A. Enge – Introduction to Nuclear Physics – Addison Wesley, Publishing Company. Inc. Reading. New York, (1974). 3. Kaplan – Nuclear Physics – 1989 – 2nd Ed. – Narosa (2002) 4. Bernard L Cohen – Concepts of Nuclear Physics – McGraw Hill Education (India) Private Limited; 1 edition (2001) 5. B.L. Cohen, 1971, Concepts of Nuclear Physics, TMCH, New Delhi.
WEB SOURCES	1. http://bubl.ac.uk/link/n/nuclearphysics.html 2. http://www.phys.unsw.edu.au/PHYS3050/pdf/Nuclear_Models.pdfhttp://www.scholarpedia.org/article/Nuclear_Forces 3. https://www.nuclear-power.net/nuclear-power/nuclear-reactions/ 4. http://labman.phys.utk.edu/phys222core/modules/m12/nuclear_models.html 5. https://www.ndeed.org/EducationResources/HighSchool/Radiography/radioactivedecay.html

COURSE OUTCOMES:

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

CO1	Gain knowledge about the concepts of helicity, parity, angular correlation and internal conversion.	K1, K5
CO2	Demonstrate knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter.	**K2, K3**
CO3	Use the different nuclear models to explain different nuclear phenomena and the concept of resonances through Briet-Weigner single level formula	**K3**
CO4	Analyze data from nuclear scattering experiments to identify different properties of the nuclear force.	**K3, K4**

CO5	Summarize and identify allowed and forbidden nuclear reactions based on conservation laws of the elementary particles.	**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	2	2	2	2	2	2
CO2	3	3	2	2	1	2	1	2	2	2
CO3	3	3	1	2	1	2	1	1	2	2
CO4	3	3	2	3	2	3	2	2	3	3
CO5	3	3	2	3	2	3	2	3	3	3

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

CORE Practical – III –NUMERICAL METHODS AND COMPUTER PROGRAMMING - C	II YEAR – THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	Practical – III NUMERICAL METHODS AND COMPUTER PROGRAMMING - C	Core				4	6	75

Pre–Requisites
Basic knowledge in differential equation and linear algebra Basic knowledge of operating system and computer fundamentals.
Learning Objectives
➢ The aim and objective of the course on Computational Practical is to familiarize the of M.Sc. students with the numerical methods used in computation and programming using any high level language such as C ➢ To equip the computational skill using various mathematical tools. ➢ To apply the software tools to explore the concepts of physical science. ➢ To approach the real time activities using physics and mathematical formulations.

Course Details
(Minimum of Twelve Experiments from the list) 1. Lagrange interpolation with Algorithm, Flow chart and output. 2. Newton forward interpolation with Algorithm, Flow chart and output. 3. Curve–fitting: Least squares fitting with Algorithm, Flow chart and output. 4. Finding Roots of a Polynomial – Bisection Method 5. Finding Roots of a Polynomial – Newton Raphson Method 6. Solution of Simultaneous Linear Equation by Gauss elimination method. 7. Solution of Ordinary Differential Equation by Euler 8. Runge Kutta Fourth Order Method for solving first order Ordinary Differential Equations 9. Trapezoidal rule 10. Simpson's 1/3 rule 11. Simpson's 3/8 rule 12. Boole's rule 13. Giraffe's root square method for solving algebraic equation

TEXT BOOKS	1. Numerical methods using Matlab – John Mathews & Kurtis Fink, Prentice Hall, New Jersey 2006 2. Numerical methods in Science and Engineering – M.K. Venkataraman, National Publishing Co. Madras, 1996 3. V. Rajaraman, 1993, Computer Oriented Numerical Methods, 3rd Ed. (Prentice–Hall, New Delhi. 4. M.K. Jain, S.R. Iyengar and R.K. Jain, 1995, Numerical Methods for

	Scientific and Engineering Computation, 3rd Ed. New Age International, New Delhi. 5. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, New Delhi.
REFERENCE BOOKS	1. S.D. Conte and C. de Boor, 1981, Elementary Numerical Analysis, An Algorithmic Approach, 3rd Ed., International Ed. (McGraw–Hill). 2. B.F. Gerald and P.O. Wheately, 1994, Applied Numerical Analysis, 5th Edition, Addison Wesley, Reading, MA. 3. B. Carnahan, H.A. Luther and J.O. Wikes, 1969, Applied Numerical Methods (Wiley, New York. 4. S.S. Kuo, 1996, Numerical Methods and Computers, Addison – Wesley, London. 5. V. Rajaraman,Programming in FORTRAN/ Programming in C, PHI, New Delhi.

COURSE OUTCOMES:

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

CO1	Program with the C Program with the C or any other high level language	K1
CO2	Use various numerical methods in describing/solving physics problems.	**K4**
CO3	Solve problem, critical thinking and analytical reasoning as applied to scientific problems.	**K5**
CO4	To enhance the problem–solving aptitudes of students using various numerical methods.	**K5**
CO5	To apply various mathematical entities, facilitate to visualise any complicate tasks.	**K3**
CO6	Process, analyze and plot data from various physical phenomena and interpret their meaning	**K4**
CO7	Identify modern programming methods and describe the extent and limitations of computational methods in physics	**K1**
CO8	Work out numerical differentiation and integration whenever routine are not applicable.	**K5**
CO9	Apply various interpolation methods and finite difference concepts.	**K4**
CO10	Understand and apply numerical methods to find out solution of algebraic equation using different methods under different conditions, and numerical solution of system of algebraic equation.	**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) **and** LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**

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	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

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
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	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

METHOD OF EVALUATION:

Continuous Internal Assessment	**End Semester Examination**	**Total**	**Grade**
25	75	**100**	

ELECTIVE V – NUMERICAL METHODS AND COMPUTER PROGRAMMING	II YEAR – THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	NUMERICAL METHODS AND COMPUTER PROGRAMMING	Core				4	5	75

Pre–Requisites
Prior knowledge on computer and basic mathematics
Learning Objectives
➢ To make students to understand different numerical approaches to solve a problem. ➢ To understand the basics of programming

UNITS	Course Details
UNIT I: SOLUTIONS OF EQUATIONS	Non–linear algebraic equation and transcendental equations –, nonlinear algebraic equations and transcendental equations using Bisection and Newton–Raphson methods – Convergence of solutions in Bisection and Newton–Raphson methods – Limitations of Bisection and Newton–Raphson methods.
UNIT II: LINEAR SYSTEM OF EQUATIONS	Simultaneous linear equations and their matrix representation– Inverse of a Matrix – Solution of simultaneous equations by Matrix inversion method and its limitations – Gaussian elimination method – Gauss Jordan method – Inverse of a matrix by Gauss elimination method – Eigen values and eigenvectors of matrices –Jacobi Method to find the Eigen values and Eigen vectors.
UNIT III: INTERPOLATION AND CURVE FITTING	Interpolation with equally spaced points – Newton forward and backward interpolation – Interpolation with unevenly spaced points – Lagrange interpolation – Exponential Curve fitting – Method of least squares – Fitting a polynomial.
UNIT IV: DIFFERENTIATION, INTEGRATION AND SOLUTION OF DIFFERENTIAL EQUATIONS	Numerical differentiation – Numerical integration – Trapezoidal rule – Simpson's rule – Gauss–Legendre, Gauss–Laguerre, Gauss–Hermite – solution of ordinary differential equations – Euler's method – Error estimates for the Euler method and Runge Kutta methods.
UNIT V: PROGRAMMING WITH C	Flow–charts – Integer and floating point arithmetic expressions – Built–in functions – Executable and non–executable statements – Subroutines and functions – Programs for the following computational methods: (a) Zeros of polynomials by the bisection method, (b) Zeros of polynomials/non–linear equations by the Newton–Raphson method, (c) Newton's forward and backward interpolation, Lagrange Interpolation, (d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method.

COURSE OUTCOMES:

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

CO1	Recall the transcendental equations and analyze the different root finding methods. Understand the basic concept involved in root finding procedure such as Newton Raphson and Bisection methods, their limitations.	K1, K2
CO2	Relate Simultaneous linear equations and their matrix representation Distinguish between various methods in solving simultaneous linear equations.	**K5**

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. S. Sastry, Introductory Methods of Numerical analysis, PHI, New Delhi. 2. Dr.A.Singaravelu, Numerical Methods, New Revised Edition, Meenakshi agency. 3. V. Rajaraman, 1993, Computer oriented Numerical Methods, 3rd Edition. PHI, New Delhi 4. M. K .Jain, S. R. Iyengar and R. K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age Intl., New Delhi 5. F. Scheid, 1998, Numerical Analysis, 2nd Edition, Schaum's series, McGraw Hill, New York 6. W. H. Press, S. A. Teukolsky, W. T. Vetterling and B. P. Flannery, 1992, Numerical Recipes in FORTRAN, 2nd Edition, Cambridge Univ. Press
REFERENCE BOOKS	1. S. D. Conte and C. de Boor, 1981, Elementary Numerical analysis–an algorithmic approach, 3rd Edition, McGraw Hill,) 2. B. F. Gerald, and P. O. Wheatley, 1994, Applied Numerical analysis, 5th Edition, Addison–Wesley, MA. 3. B. Carnagan, H. A. Luther and J. O. Wilkes, 1969, Applied Numerical Methods, Wiley, New York. 4. S. S. Kuo, 1996, Numerical Methods and Computers, Addison–Wesley. 5. V. Rajaraman, Programming in FORTRAN / Programming in C, PHI, New Delhi
WEB SOURCES	1. https://www.scribd.com/doc/202122350/Computer–Oriented–Numerical–Methods–by–V–RajaRaman 2. https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/referencespapers.aspx?referenceid=1682874 3. https://nptel.ac.in/course/122106033/ 4. https://nptel.ac.in/course/103106074/ 5. https://onlinecourses.nptel.ac.in/noc20_ma33/preview

CO3	Understand, how interpolation will be used in various realms of physics and	**K2, K3**

	Apply to some simple problems Analyze the newton forward and backward interpolation	
CO4	Recollect and apply methods in numerical differentiation and integration. Assess the trapezoidal and Simson's method of numerical integration.	**K3, K4**
CO5	Understand the basics of C–programming and conditional statements.	**K2**
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)

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

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

SEC II – SOLAR ENERGY UTILISATION	II YEAR - THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	SOLAR ENERGY UTILISATION	Core				4	6	75

Pre-Requisites
Basic knowledge of heat energy, way of transfer of heat, solar energy, materials types
Learning Objectives
➢ To impart fundamental aspects of solar energy utilization. ➢ To give adequate exposure to solar energy related industries ➢ To harness entrepreneurship skills ➢ To understand the different types of solar cells and channelizing them to the different sectors of society ➢ To develop an industrialist mindset by utilizing renewable source of energy.

UNITS	Course Details
UNIT I: HEAT TRANSFER &RADIATION ANALYSIS	Conduction, Convection and Radiation–Solar Radiation at the earth's surface-Determination of solar time–Solar energy measuring instruments.
UNIT II: SOLAR COLLECTORS	Physical principles of conversion of solar radiation in to heat flat plate collectors-General characteristics–Focusing collector systems– Thermal performance evaluation of optical loss.
UNIT III: SOLAR HEATERS	Types of solar water heater-Solar heating system–Collectors and storage tanks–Solar ponds–Solar cooling systems.
UNIT IV: SOLAR ENERGY CONVERSION	Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo-electric conversion-process flow of silicon solar cells –different approaches on the process-texturization, diffusion, Anti reflective coatings, metallization.
UNIT V: NANOMATERIALS IN FUEL CELL APPLICATIONS	Use of nano structures and nano materials in fuel cell technology - high and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts. Use of Nano technology in hydrogen production and storage. Industrial visit–data collection and analysis-presentation
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. Solar energy utilization -G.D. Rai –Khanna publishers – Delhi 1987. 2. Maheshwar Sharon, Madhuri Sharon, Carbon "Nano forms and Applications", Mc Graw-Hill, 2010. 3. Soteris A. Kalogirou, „Solar Energy Engineering: Processes and Systems", Academic Press, London, 2009 4. Tiwari G.N, "Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002 5. Sukhatme S.P. Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

REFERENCE BOOKS	1. Energy – An Introduction to Physics – R.H.Romer, W.H.Freeman.(1976) 2. Solar energy thermal processes – John A.Drife and William. (1974) 3. John W. Twidell & Anthony D.Weir, 'Renewable Energy Resources,2005 4. John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4th Edition, john Wiley and Sons, 2013 5. Duffie, J.A., Beckman, W.A. , "Solar Energy Thermal Process", John Wiley and Sons,2007.

WEB SOURCES	1.https://pdfs.semanticscholar.org/63a5/a69421b69d2ce9f359bbfc86c63556f9a4fb 2. https://books.google.vg/books?id=l-XHcwZo9XwC&sitesec=buy&source=gbs_vpt_read 3. www.nptel.ac.in/courses/112105051 4. www.freevideolectures.com 5. http://www.e-booksdirectory.com

COURSEOUTCOMES:

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

CO1	Gained knowledge in fundamental aspects of solar energy utilization	**K1**
CO2	Equipped to take up related job by gaining industry exposure	**K3**
CO3	Develop entrepreneurial skills	**K5**
CO4	Skilled to approach the needy society with different types of sola rcells	**K4**
CO5	Gained industrialist mindset by utilizing renewable source of energy	**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)** inthe 3-pointscale of STRONG (3), MEDIUM(2) and LOW (1)**.**

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO 7**	**PO8**	**PO 9**	**PO1 0**
CO1	3	2	3	3	3	2	2	2	3	2
CO2	2	3	2	2	3	3	2	3	2	2
CO3	2	3	2	2	2	2	3	3	3	2
CO4	2	2	2	3	2	3	2	3	3	2
CO5	2	2	3	2	3	3	3	3	3	3

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

CORE COURSE VIII– SPECTROSCOPY	II YEAR – FOURTH SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	SPECTROSCOPY	Core				4	6	75

Pre–Requisites
Thorough understanding of electromagnetic spectrum, mathematical abilities, knowledge of molecules, their structure, bond nature, physical and chemical behaviour
Learning Objectives
➢ To comprehend the theory behind different spectroscopic methods ➢ To know the working principles along with an overview of construction of different types of spectrometers involved ➢ To explore various applications of these techniques in R &D. ➢ Apply spectroscopic techniques for the qualitative and quantitative analysis of various chemical compounds. ➢ Understand this important analytical tool

UNITS	CourseDetails
UNITI: **MICROWAVE SPECTROSCOPY**	Rotational spectra of diatomic molecules – Rigid Rotor (Diatomic Molecules)– reduced mass – rotational constant – – Effect of isotopic substitution – Non rigid rotator – Polyatomic molecules – linear – symmetric asymmetric top molecules – Hyperfine structure and quadrupole moment of linear molecules – Instrumentation techniques – block diagram –Information Derived from Rotational Spectra.
UNITII: **INFRA–RED SPECTROSCOPY**	Vibrations of simple harmonic oscillator – zero–point energy– Anharmonic oscillator – Diatomic Vibrating Rotator– PR branch – PQR branch– Fundamental modes of vibration of H_2O and CO_2 –Introduction to application of vibrational spectra– IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy.
UNITIII: **RAMAN SPECTROSCOPY**	Theory of Raman Scattering – Classical theory – molecular polarizability — Quantum theory of Raman effect – rotational Raman spectra of linear molecule – symmetric top molecule – Stokes and anti–stokes line– SR branch –Raman activity of H_2O and CO_2 –Mutual exclusion principle– determination of N_2O structure –Instrumentation technique and block diagram –structure determination of planar and non–planar molecules using IR and Raman techniques – FT Raman spectroscopy.
UNITIV: **RESONANCE SPECTROSCOPY**	Nuclear and Electron spin–Interaction with magnetic field – Population of Energy levels – Larmor precession– Relaxation times – Double resonance– Chemical shift and its measurement – NMR of Hydrogen nuclei – Indirect Spin –Spin Interaction – interpretation of simple organic molecules – Instrumentation techniques of NMR spectroscopy -Electron Spin Resonance: Basic principle –

	Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals –g–factors – Medical applications of ESR
UNIT V: UV SPECTROSCOPY	Origin of UV spectra – Laws of absorption – Lambert Beer law – molar absorptivity – transmittance and absorbance – Color in organic compounds– Absorption by organic Molecule –Chromophores –Effect of conjugation on chromophores – Choice of Solvent and Solvent effect – Absorption by inorganic systems – Instrumentation – double beam UV–Spectrophotometer.
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	6. C N Banwell and E M McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi. 7. G Aruldhas, 1994, Molecular Structure and Molecular Spectroscopy, Prentice–Hall of India, New Delhi. 8. D.N. Satyanarayana, 2001, *Vibrational Spectroscopy and Applications*, New Age International Publication. 9. B.K. Sharma, 2015, *Spectroscopy*, Goel Publishing House Meerut. 10. Kalsi.P.S, 2016, Spectroscopy of Organic Compounds (7^{th} Edition), New Age International Publishers.
REFERENCE BOOKS	1. J L McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi. 2. J M Hollas, 2002, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge. 3. B. P. Straughan and S. Walker, 1976, Spectroscopy Vol. I, Chapman and Hall, New York. 4. K. Chandra, 1989, Introductory Quantum Chemistry, Tata McGraw Hill, New Delhi. 5. Demtroder. W, Laser Spectroscopy: Basic concepts and Instrumentation, SpringerLink.
WEB SOURCES	1. https://www.youtube.com/watch?v=0iQhirTf2PI 2. https://www.coursera.org/lecture/spectroscopy/introduction–3N5D5 3. https://www.coursera.org/lecture/spectroscopy/infrared–spectroscopy–8jEee 4. https://onlinecourses.nptel.ac.in/noc20_cy08/preview 5. https://www.coursera.org/lecture/spectroscopy/nmr–spectroscopy–introduction–XCWRu

COURSE OUTCOMES:

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

CO1	Understand fundamentals of rotational spectroscopy, view molecules as elastic rotors and interpret their behaviour. Able to quantify their nature and correlate them with their characteristic properties.	**K2**
CO2	Understand the working principles of spectroscopic instruments and theoretical background of IR spectroscopy. Able to correlate mathematical process of Fourier transformations with instrumentation. Able to interpret vibrational spectrum of small molecules.	**K2, K3**
CO3	Interpret structures and composition of molecules and use their knowledge of Raman Spectroscopy as an important analytical tool	**K5**
CO4	Use these resonance spectroscopic techniques for quantitative and qualitative estimation of a substances	**K4**
CO5	Learn the electronic transitions caused by absorption of radiation in the UV/Vis region of the electromagnetic spectrum and be able to analyze a simple UV spectrum.	**K1, K5**
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	3	3	3	3	3	2
CO2	2	2	2	3	3	3	3	3	3	2
CO3	3	2	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	3	3	3	3

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

CORE PRACTICAL IV	II YEAR – FOURTH SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	PRACTICAL IV	Core				3	6	75

Pre–Requisites

Knowledge and handling of general and experiments of Physics, as well as fundamentals of digital principles,

Learning Objectives

- To understand the theory and working of Microprocessor and its applications
- To use microprocessor in different applications
- To understand the applications of Op amp
- To use ICs for performing various digital operations
- To understand the performance of Guoy's/Quincke's methods for the measurement of magnetic parameters.

Course Details

(Minimum of Twelve Experiments from the list)

1. Determination of velocity and compressibility of a liquid using Ultrasonics Interferometer
2. Measurement of Magnetic Susceptibility – Guoy's method/Quincke's method
3. Junction diode – Determination of Energy gap
4. Construction of Op–Amp– 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
5. Construction of square wave generator using IC 555 – Study of VCO
6. Construction of Encoder and Decoder circuits using ICs.
7. Study of synchronous parallel 4–bit binary up/down counter using IC 74193
8. Study of asynchronous parallel 4–bit binary up/down counter using IC 7493
9. Study of Modulus Counter
10. Construction of Multiplexer and Demultiplexer using ICs.
11. 8–bit addition and subtraction, multiplication and division using microprocessor 8085
12. Sum of a set of N data (8–bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending orderusing microprocessor 8085
13. Code conversion (8–bit number): a) Binary to BCD b) BCD to binaryusing microprocessor 8085
14. Addition of multi byte numbers, Factorial using microprocessor 8085
15. Display of characters using microprocessor 8085
16. Interfacing of 8–bit R / 2R ladder DAC (IC 741) – Wave form generation – Square, Rectangular, Triangular, Saw tooth and Sine waves using microprocessor 8085

17. Interfacing of DC stepper motor – Clockwise, Anti–clockwise, Angular movement and Wiper action using microprocessor 8085	
TEXT BOOKS	1. Practical Physics, Gupta and Kumar, Pragati Prakasan 2. Op–Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition. 3. Electronic lab manual Vol I, K ANavas, Rajath Publishing 4. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008) 5. V. Vijayendran, 2005, Fundamentals of Microprocessor–8085", 3rd Edition S.Visvanathan Pvt, Ltd.
REFERENCE BOOKS	1. Advanced Practical Physics, S.P Singh, Pragati Prakasan 2. A course on experiment with He–Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. ltd 3. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing 4. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi 5. Microprocessor and Its Application – S. Malarvizhi, Anuradha Agencies Publications

COURSE OUTCOMES:

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

CO1	Develop the programming skills of Microprocessor	K5
CO2	Appreciate the applications of Microprocessor programming	**K3**
CO3	Understand the structure and working of 8085 microprocessor and apply it.	**K1, K3**
CO4	Acquire knowledge about the interfacing peripherals with 8085 microprocessor.	**K1, K4**
CO5	Acquire knowledge about the sequential and combinational logic 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) and LOW (1)**.**

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

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

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

ELECTIVE VI CHARACTERIZATON OF MATERIALS	II YEAR – FOURTH SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	CHARACTERIZATON OF MATERIALS	ELECTIVE				4	4	75

Pre–Requisites
Fundamentals of Heat and Thermodynamics, Basics of Optical systems, Microscopic systems, Electrical measurements and Fundamentals of Spectroscopy.
Learning Objectives
➢ To make the students learn some important thermal analysis techniques namely TGA, DTA, DSC and TMA. ➢ To make the students understand the theory of image formation in an optical microscope and to introduce other specialized microscopic techniques. ➢ To make the students learn and understand the principle of working of electron microscopes and scanning probe microscopes. ➢ To make the students understand some important electrical and optical characterization techniques for semiconducting materials. ➢ To introduce the students the basics of x–ray diffraction techniques and some important spectroscopic techniques.

UNITS	Course details
UNIT I THERMAL ANALYSIS	Introduction – thermogravimetric analysis (TGA) – instrumentation – determination of weight loss and decomposition products – differential thermal analysis (DTA)– cooling curves – differential scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements – determination of thermomechanical parameters.
UNIT II MICROSCOPIC METHODS	Optical Microscopy: optical microscopy techniques – Bright field optical microscopy – Dark field optical microscopy – Dispersion staining microscopy – phase contrast microscopy –differential interference contrast microscopy – fluorescence microscopy – confocal microscopy – – digital holographic microscopy – oil immersion objectives – quantitative metallography – image analyzer.
UNIT III ELECTRON MICROSCOPY AND SCANNING PROBE MICROSCOPY	SEM, EDAX, EPMA, TEM: working principle and Instrumentation – sample preparation –Data collection, processing and analysis– Scanning tunnelingmicroscopy (STEM) – Atomic force microscopy (AFM) – Scanning new field optical microscopy.
UNIT IV	Two probe and four probe methods– van der Pauw method – C–V

ELECTRICAL METHODS AND OPTICAL CHARACTERISATION	characteristics – Schottky barrier capacitance – impurity concentration – electrochemical C–V profiling – limitations. Photoluminescence – light – matter interaction – instrumentation – electroluminescence – instrumentation – Applications.
UNIT V X–RAY AND SPECTROSCOPIC METHODS	Principles and instrumentation for UV–Vis–IR, FTIR spectroscopy, Raman spectroscopy, ESR, NMR and XPS– Powder diffraction – Powder diffractometer –interpretation of diffraction patterns – indexing – phase identification – residual stress analysis – Particle size, texture studies – X–ray fluorescence spectroscopy – uses.
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. R. A. Stradling and P. C. Klipstain. Growth and Characterization of semiconductors. Adam Hilger, Bristol, 1990. 2. J. A. Belk. Electron microscopy and microanalysis of crystalline materials. Applied Science Publishers, London, 1979. 3. Lawrence E. Murr. Electron and Ion microscopy and Microanalysis principles and Applications. Marcel Dekker Inc., New York, 1991 4. D. Kealey and P. J. Haines. Analytical Chemistry. Viva Books Private Limited, New Delhi, 2002. 5. Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press,(2008).
REFERENCE BOOKS	1. Cullity, B.D., and Stock, R.S., "Elements of X–Ray Diffraction", Prentice–Hall, (2001). 2. Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging,Wiley–Liss, Inc. USA, (2001). 3. Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S., Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series), Volumes 49 – 51, (2009).Volumes 49 – 51, (2009). 4. Wendlandt, W.W., Thermal Analysis, John Wiley & Sons, (1986). 5. Wachtman, J.B., Kalman, Z.H., Characterization of Materials, ButterworthHeinemann, (1993)
WEB SOURCES	1. https://cac.annauniv.edu/uddetails/udpg_2015/77.%20Mat%20Sci(AC).pdf 2. http://www.digimat.in/nptel/courses/video/113106034/L11.html 3. https://nptel.ac.in/courses/104106122 4. https://nptel.ac.in/courses/118104008 5. https://www.sciencedirect.com/journal/materials–characterization

COURSE OUTCOMES:

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

CO1	Describe the TGA, DTA, DSC and TMA thermal analysis techniques and make interpretation of the results.	K1, K3
CO2	The concept of image formation in Optical microscope, developments in other specialized microscopes and their applications.	**K2**
CO3	The working principle and operation of SEM, TEM, STM and AFM.	**K2, K3**

CO4	Understood Hall measurement, four –probe resistivity measurement, C–V, I–V, Electrochemical, Photoluminescence and electroluminescence experimental techniques with necessary theory.	**K3, K4**
CO5	The theory and experimental procedure for x– ray diffraction and some important spectroscopic techniques and their applications.	**K4,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) **and** LOW (1)**.**

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

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

SEC-III- PHYTHON PROGRAMMING		II YEAR – FOURTH SEMESTER						
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
	PHYTHON PROGRAMMING	SEC				2	3	75

Pre–Requisites
Fundamentals of expressions, statements, functions arrays and files handling in object Oriented Programming.
Learning Objectives
➢ To read and write simple Python programs. ➢ To develop Python programs with conditionals and loops. ➢ To define Python functions and call them. ➢ To use Python data structures –- lists, tuples, dictionaries. ➢ To do input/output with files in Python.

UNITS	**Course details**
UNIT I INTRODUCTION DATA,EXPRESSIONS STATEMENTS	Introduction to Python and installation, variables, expressions, statements, Numeric data types: Int, float, Boolean, string. Basic data types: list--- list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters. Tuple --- tuple assignment, tuple as return value, tuple methods. Dictionaries: operations and methods.
UNIT II : CONTROL FLOW, LOOPS, FUNCTIONS	**Conditionals**: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if- elif-else); Iteration: statements break, continue. Functions--- function and its use, pass keyword, flow of execution, parameters and arguments.
UNITIII: ADVANCED FUNCTIONS, ARRAYS	**Fruitful functions** : return values, parameters, local and global scope, function composition, recursion; Advanced functions: lambda, map, filter, reduce, basic data type comprehensions. Phython arrays: create an array, Access the elements of an array, array methods.
UNIT IV FILES AND EXCEPTIONS	File I/O, Exception Handling, introduction to basic standard libraries, Installation of pip, Demonstrate Modules: Turtle, pandas, numpy, pdb, Explore packages
UNIT V	Object, Class, Method, Inheritance, Polymorphism, Data Abstraction,

OOPS FRAME WORK	Encapsulation, Python Frameworks: Explore django framework with an example.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars – Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10

TEXT BOOKS	1.Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist__, 2nd edition,Updated for Python 3, Shroff/O_Reilly Publishers, 2016. 2.R. Nageswara Rao, –Core Python Programming‖, dreamtech 3. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
REFERENCE BOOKS	1,Core Python Programming, W.Chun, Pearson. 2.Introduction to Python, Kenneth A. Lambert, Cengage 3.Learning Python, Mark Lutz, Orielly

COURSE OUT COMES:

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

CO1	Study the fundamentals of Phython such as data, expressions and statements	**K1**
CO2	To study the various loops and function in phython	**K1**
CO3	Understand the advanced functions and arrays	**K2, K3**
CO4	Acquire knowledge about the files and exceptions.	**K2, K4**
CO5	To develop the oops frame works	**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) and LOW (1)**.**

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

CO1	2	2	2	3	3	2	2	1	3	2
CO2	2	1	3	3	3	2	2	1	3	2
CO3	3	3	1	3	3	2	2	1	3	2
CO4	3	3	3	3	3	2	2	1	3	2
CO5	3	3	3	3	3	2	2	1	3	2

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	