ST. MARY'S COLLEGE (AUTONOMOUS)

Re-accredited with A+ Grade by NAAC

Thoothukudi – 628001, Tamil Nadu

(Affiliated to Manonmaniam Sundaranar University)

Syllabus

M.Sc. Physics

School of Physical Sciences

Outcome Based

Curriculum(w.e.f. 2024)

(I & II Semester only)

Preamble

The PG department of Physics aims to develop the potential of students through rigorous academic and practical exposure, field projects and robust industry interactions. Industrial visits, workshops, guest lectures and skill development programmes are conducted to hone the skills of students to suit the requirement of recruiters, thereby enhancing the career aspects of our students. We promote a nurturing environment to help our students in identifying their core competencies and refining them.

Vision

To build a foundation for excellence and encourage the development of the institution as a premier institution by igniting and promoting enthusiasm, interests and passion, in the study of Physics as a part of curriculum.

Mission

To awaken the young minds and discover their talents both in theory and in practical Physics, through dedication to teach, commitment towards students and innovative instructional methods like PPT and visual aids.

To develop strategy in the department for continuous improvement.

Programme Outcomes

PO No.	After completion of the Postgraduate programme the students of St. Mary's College will be able to
PO 1	acquire expertise knowledge in their respective disciplines and become professionals.
PO 2	develop critical/logical thinking skills, managerial skills and become locally, nationally & globally competent and be a lifelong learner
PO 3	pursue research / higher learning programme & apply their experiment and research skills to analyse and solve complex problems.
PO 4	compete in the job market by applying the knowledge acquired in Arts, Science, Economics, Commerce and Management studies
PO 5	be an empowered and economically independent woman with efficient leadership qualities and develop the themselves as a holistic person

Program Specific Outcomes:

PSO No	Students of M.Sc., Physics will be able to	PO Mapped
PSO 1	To prepare the students who will demonstrate respectful engagement with others' ideas, behaviours, beliefs and apply diverse frames of reference to decisions and actions.	1
PSO 2	To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.	2
PSO 3	Design and implement HR systems and practices grounded in researches that comply with employment laws, leading the organization towards growth and development.	3
PSO 4	To produce employable, ethical and innovative professionals to sustain in the dynamic business world.	4
PSO 5	To contribute to the development of the society by collaborating with stakeholders for mutual benefit.	5

ST. MARY'S COLLEGE (AUTONOMOUS), THOOTHUKUDI

Course Structure (w. e. f 2024)

Semester – I

Course	Course Code	Course Title	Contact Hours / Week	Credits	Max Marks		
					CIA	ESE	Total
Core	24PPHC11	Mathematical Physics I	6	4	40	60	100
Core	24PPHC12	Classical Mechanics	5	4	40	60	100
Core	24PPHC13	Linear and Integrated Circuits	5	4	40	60	100
Core Practical	24PPHCR1	Electronics I	3	2	40	60	100
Core Practical	24PPHCR2	Non Electronics I	3	2	40	60	100
Elective	24PPHE11	Crystal Growth and Thin Films	4	3	40	60	100
Skill Enhancement Course	24PPHSE1	Aptitude Physics	4	3	40	60	100
MOOC (Compulsory)				+2			
		Total	**30**	**22+2**	**280**	**420**	**700**

Semester – II

Course	Course Code	Course Title	Contact Hours / Week	Credits	Max Marks		
					CIA	ESE	Total
Core	24PPHC21	Mathematical Physics II	6	4	40	60	100
Core	24PPHC22	Electromagnetic Theory	5	4	40	60	100
Core	24PPHC23	Thermodynamics and Statistical Mechanics	5	4	40	60	100
Core Practical	24PPHCR3	Electronics II	3	2	40	60	100
Core Practical	24PPHCR4	Non Electronics II	3	2	40	60	100
Elective	24PPHE21	Microprocessor and Microcontroller	4	3	40	60	100
Skill Enhancement Course	24PPHSE2	Characterization of materials	4	3	40	60	100
		Total	**30**	**22**	**280**	**420**	**700**

Note: MOOC should be completed in the I Year.

Internship can be completed during the II Semester vacation.

Semester – III

Course	Course Code	Course Title	Contact Hours / Week	Credits	Max Marks		
					CIA	ESE	Total
Core	24PPHC31	Quantum Mechanics II	6	5	40	60	100
Core	24PPHC32	Solid State Physics I	5	4	40	60	100
Core	24PPHC33	Atomic and Molecular Spectroscopy	5	4	40	60	100
Core Practical	24PPHCR5	Microprocessor and Microcontroller -I	3	2	40	60	100
Core Practical	24PPHCR6	Programming in C++- I	3	2	40	60	100
Elective	24PPHE31	Nano Science and Technology	4	3	40	60	100
Skill Enhancement Course	24PPHSE3	Numerical Methods and Computer Programming (C++)	4	3	40	60	100
Internship / Self Study (Optional)	24PPHSS1	Physics for Lectureship		+2			
		Total	**30**	**23+2**	**280**	**420**	**700**

Semester – IV

Course	Course Code	Course Title	Contact Hours / Week	Credits	Max Marks		
					CIA	ESE	Total
Core	24PPHC41	Quantum Mechanics I	6	5	40	60	100
Core	24PPHC42	Solid State Physics II	6	5	40	60	100
Core	24PPHC43	Nuclear and Particle Physics	6	5	40	60	100
Core Practical	24PPHCR7	Microprocessor and Microcontroller -II	3	2	40	60	100
Core Practical	24PPHCR8	Programming in C++- II	3	2	40	60	100
Core	24PPHP41	Project	6	4	40	60	100
		Total	**30**	**23**	**240**	**360**	**600**

SEMESTER - I			
CORE - I	**MATHEMATICAL PHYSICS – I**		
Code : 24PPHC11	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

Objectives:

- Enable the students to solve simple mathematics and make them understand the physical significance behind them
- Enable the students to understand the concepts and applications of mathematical theories.

Course Outcomes:

CO No.	At the end of the course the student will be able to:	CL
CO 1	Understand the special functions and beta & gamma functions	K1
CO 2	Recall the basic and the special types of matrices.	K2
CO 3	Apply group theory to various disciplines of Physics.	K3
CO 4	Analyse the geometrical interpretation of complex numbers.	K4
CO 5	Evaluate the advanced concepts in evaluating double integral and area enclosed by plane curves	K5

SEMESTER - I			
CORE - I	**MATHEMATICAL PHYSICS – I**		
Code : 24PPHC11	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

UNIT I: Vector calculus

∇ operator – divergence – second derivative of vector functions or fields – Laplacian operator – curl of a vector - line integral – line integral of a vector field around an infinitesimal rectangle- curl of a conservative field - surface integral – volume integral –Gauss theorem of divergence and proof – Stoke's theorem and proof

UNIT II: Matrices

Introduction - special type of matrices – transpose - Conjugate – Conjugate Transpose – Symmetric and AntiSymmetric – Hermitian and Skew-Hermitian – orthogonal and unitary-properties - Characteristic equation- roots and characteristic vectors – diagonalization – Cayley-Hamilton theorem.

UNIT III: Special Functions I and Beta & Gamma funtions

Legendre Function: Legendre's Equation – Generating Function – Rodrigue's Formula – Orthogonality – Recurrence Formulae – Bessel Function: Bessel's Function of the First kind – Generating Function – Recurrence Formulae.

Beta & Gamma functions: beta function-evaluation of beta function- evaluation of gamma function-relation between beta and gamma function

UNIT IV: Complex Analysis

Complex variables– Limits and continuity – Differentiability –Analytic function- Cauchy-Riemann equations (necessary and sufficient condition, polar form)– Cauchy theorem – Cauchy integral formula- Taylor's theorem –Singular points – Residues- Method of finding residues- Residue theorem – Evaluation of definite integrals (integration round the unit circle only)

UNIT V: Group Theory

Group, subgroup, classes – invariant, subgroups, factor groups, cyclic groups – homomorphism and isomorphism –permutation groups-cayley's theorem-group symmetry of an equilateral trainagle- rearrangement theorem- group representation – reducible and irreducible representation – Schur'slemmas, great orthogonality theorem.

Text Books:

1. Satya Prakash. *Mathamatical Physics.* New Delhi: Sultan Chand & Sons. 6th edition 2019.
2. Dass H K. *Mathematical Physics*. New Delhi: S.Chand & Company LTD. 8th Edition 2018.
3. Chattopadhyay P K. *Mathematical Physics.* New Delhi: New Age International Publishers. 2nd Edition 2013.

Books for reference:

1. Erwin Kreyszig, *Advanced Engineering Mathematics.* Asia: John Wiley and sons.8th Edition 2005.
2. Gupta B D. *Mathematical Physics.* Vikas Publishing house PVT LTD. 4th Edition 2010.

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	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	3	3	2	3	3	3	3	2	3
CO-2	2	2	2	3	3	2	2	2	3	3
CO-3	3	2	3	3	3	3	2	3	3	2
CO-4	3	2	3	3	3	3	2	3	3	3
CO-5	3	3	3	3	3	3	3	3	3	2
Ave.	2.8	2.4	2.9	2.8	3	2.8	2.4	2.8	2.8	2.6

SEMESTER - I			
CORE - II	**CLASSICAL MECHANICS**		
Code : 24PPHC12	**Hrs/Week: 5**	**Hrs/Semester: 90**	**Credits:4**

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.

Course Outcomes:

CO No.	At the end of the course, the student will be able to	CL
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**

SEMESTER - I			
CORE - II	**CLASSICAL MECHANICS**		
Code : 24PPHC11	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

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

Unit III: Hamiltonian Formulation

Phase space – generalized momentum and cyclic coordinates – conjugate momentum–Hamiltonian function and conservation of energy – Hamilton's canonical equations of motion – applications: (i) one dimensional simple harmonic oscillator (ii) motion of particle in a central force field.

Unit IV: Small Oscillations

Stable and unstable equilibrium –Formulation of the problem: Lagrange's equations of motion for small oscillations – Properties of T, V and w –Normal co-ordinates and normal frequencies of vibration – free vibrations of a 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,accelerationandforceinforvectornotation and their transformations

Text Books:

1. H.Goldstein, 2002, Classical Mechanics, 3rd Edition, Pearson Edu.
2. J.C.Upadhyaya, Classical Mechanics, Himalaya Publshing.Co.New Delhi.
3. R.Resnick, 1968, Introductionto 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

Books for Reference:

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

Relation Matrix – Specimen Table

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	3	3	3	3	3	3	3	3	3
CO-2	3	2	3	3	3	3	3	3	3	3
CO-3	3	3	1	2	3	3	3	3	3	3
CO-4	3	3	1	2	2	3	3	3	3	3
CO-5	3	3	2	1	1	2	2	2	2	2
Ave.	3	2.8	2	2.2	2.4	2.8	2.8	2.8	2.8	2.8

SEMESTER-I			
CORE LINEAR AND DIGITAL ICs AND APPLICATIONS			
Code:24PPHC13	**Hrs/Week:5**	**Hrs/Semester:75**	**Credits:4**

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

Course outcomes:

CO1	Recall the basic terms related to linear integrated circuits	**K1**
CO2	Understand the principles involved in the design of integrated circuits	**K2**
CO3	Apply the knowledge in various integrated circuits such as convertors, counters and registers	**K3**
CO4	Analyse the concepts of waveform generation and introduce one special function ICs.	**K4**
CO5	Evaluate the lock range and capture range of PLL and use in various applications of communications.	**K5**

SEMESTER-I			
CORE LINEAR AND DIGITAL ICs ANDAPPLICATIONS			
Code:24PPHC13	**Hrs/Week:5**	**Hrs/Semester:75**	**Credits:4**

Unit I: INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER

Introduction - Classification of IC's - basic information of Op -Amp 741 and its features - the ideal Operational amplifier - Op-Amp internal circuit and Op-Amp Characteristics.

Unit II: APPLICATIONS OF OP-AMP

LINEAR APPLICATIONS OF OP-AMP: Solution to simultaneous equations and differential equations - Instrumentation amplifiers - V to I and I to V converters.

NON-LINEAR APPLICATIONS OF OP-AMP: Sample and Hold circuit - Log and Antilog amplifier - multiplier and divider - Comparators - Schmitt trigger - Multivibrators - Triangular and Square wave form generators.

Unit III: ACTIVE FILTERS & TIMER AND PHASE LOCKED LOOPS

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

TIMER AND PHASE LOCKED LOOPS: Introduction to IC 555 timer -description of functional diagram - monostable and astable operations and 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:CMOS LOGIC, COMBINATIONAL CIRCUITS USING TTL 74XX ICs

CMOS LOGIC:CMOS logic levels - MOS transistors- Basic CMOS Inverter- NAND and NOR gates- CMOS AND-OR-INVERT and OR- AND-INVERT gates- implementation of any function using CMOS logic.

COMBINATIONAL CIRCUITS USING TTL 74XX ICs: Study of logic gates using 74XX ICs - decoder (IC 74138, IC 74154)- BCD to7-segment decoder (IC7447) - Encoder (IC74147)- Multiplexer (IC74151)-Demultiplexer (IC 74154).

TEXT BOOKS

1. D.Roy Choudhury, Shail B. Jain (2012),Linear Integrated Circuit,4th edition, New Age International Pvt.Ltd.,New Delhi,India
2. Ramakant A.Gayakwad,(2012),OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, New Delhi.
3. B.L.Theraja and A.K.Theraja, 2004,AText book 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.

REFERENCEBOOKS

1. Sergio Franco(1997),Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi.
2. Gray,Meyer(1995),Analys is 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, 8thedition,Pearson Education, New Delhi.
5. Integrated Electronics, Millman & Halkias,Tata McGrawHill,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/

PSO Relation Matrix – Specimen Table

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	3	3	3	3	3	3	3	3	3
CO-2	3	2	3	3	3	3	3	3	3	3
CO-3	3	3	1	3	2	3	3	3	3	3
CO-4	2	2	3	3	3	3	3	2	2	3
CO-5	2	3	2	2	2	2	2	2	2	2
Ave.	2.6	2.6	2.4	2.8	2.6	2.8	2.8	2.6	2.6	2.8

SEMESTER - I			
CORE PRACTICAL – I ELECTRONICS - I			
Code : 24PPHCR1	**Hrs/Week: 3**	**Hrs/Semester: 60**	**Credits:2**

(Any 7 experiments)

1. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
2. Constructions of Schmidt trigger circuit using IC741 for a given hysteresis – application as squarer.
3. Construction of square wave Triangular wave generator using IC 741
4. Construction of a quadrature wave using IC 324
5. Construction of pulse generator using the IC 741 – application as frequency divider
6. Study of R-S, clocked R-S and D-Flip flop using NAND gates
7. Study of J-K, D and T flip flops using IC 7476/7473
8. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.
9. Study of Arithmetic logic unit using IC 74181.
10. Design of asynchronous counter
11. FET characteristics
12. Verification of Boolean algebra

SEMESTER - I			
CORE PRACTICAL II - NON-ELECTRONICS I			
Code : 24PPHCR2	**Hrs/Week: 3**	**Hrs/Semester: 45**	**Credits:2**

(Any 7 Experiments)

1.Hyperbolic fringes - Young's modulus of glass plate

2. Susceptibility- Quincke's method

3. BH curve tracing and Hysteresis loss

4. Resolving Power of grating and prism using spectrometer.

5. Rydberg's constant

6. Resistivity of semiconductor by Four Probe method at different temperatures

7. Iodine Absorption Spectra

8. Ultrasonic interferometer

9. LASER Experiment: Thickness of insulation of a wire by Diffraction method

10. Interpretation of vibrational spectra of a given material

SEMESTER - I			
Elective – CRYSTAL GROWTH AND THIN FILMS			
Code: 24PPHE11	**Hrs/Week: 4**	**Hrs/Semester: 60**	**Credits:3**

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

Course Outcomes:

CO No.	**Upon completion of this course, students will be able to**	**Cognitive Level**
CO 1	Acquire the Basic Concepts, Nucleation and Kinetics of crystal growth	K1
CO 2	Understand the Crystallization Principles and Growth techniques	K2
CO 3	Study various methods of Crystal growth techniques	K3
CO 4	Develop the knowledge of Thin film deposition methods	K4
CO 5	Apply the techniques of Thin Film Formation and thickness Measurement	K5

SEMESTER - I			
Elective – CRYSTAL GROWTH AND THIN FILMS			
Code: 24PPHE11	**Hrs/Week: 4**	**Hrs/Semester: 60**	**Credits:3**

UNIT I: CRYSTAL GROWTH KINETICS

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.

UNIT II: CRYSTALLIZATION PRINCIPLES

Crystallization Principles and Growth techniques Classes of Crystal system - Crystal symmetry - Solvents and solutions - Solubility diagram -Super solubility - expression for super saturation - Metastable zone and introduction period- Miers TC diagram.

UNIT III: GEL, MELT AND VAPOUR GROWTH

Gel, Melt and Vapour growth techniques Principle of Gel techniques -Various types of Gel - Structure and importance of Gel - Methods of Gel growth and advantages - Melt techniques - Czochralski growth –Bridgeman method - 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 FILMFORMATION

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

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. D. Elwell and H. J. Scheel, "Crystal Growth from High Temperature Solution"
5. Heinz K. Henish, 1973,"CrystalGrowthinGels",Cambridge University Press. USA.

BOOKS for REFERENCE

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. Santhana Raghavan 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/

Relation Matrix – Specimen Table

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	3	3	3	3	3	3	3	3	3	3
CO-2	3	2	3	3	3	3	3	3	3	3
CO-3	3	3	1	2	3	3	3	3	3	3
CO-4	3	3	1	2	2	3	3	3	3	3
CO-5	3	3	2	1	1	2	2	2	2	2
Ave.	3	2.8	2	2.2	2.4	2.8	2.8	2.8	2.8	2.8

SEMESTER - I			
Skill Enhancement Course - APTITUDE PHYSICS			
Code : 24PPHSE1	**Hrs/Week: 4**	**Hrs/Semester: 60**	**Credits:3**

Objectives:

- Helps students to go deeper into core concepts and apply the core ideas to solve complex applied problems.

Course Outcomes:

CO No.	**Upon completion of this course, students will be able to**	**Cognitive Level**
CO 1	Determine the content covered in the competitive exams.	K1
CO 2	Recognize the principles of physics	K2
CO 3	Resolve the physics issues	K3
CO 4	Examine the ideas in Physics.	K4
CO 5	Analyze the results of the competitive exam field.	K5

SEMESTER - I			
Skill Enhancement Course - APTITUDE PHYSICS			
Code : 24PPHSE1	**Hrs/Week: 4**	**Hrs/Semester: 60**	**Credits:3**

Unit-I: General Physics

Units & dimensions - scalars and vectors - linear & angular momentum –Gravity & central force - Kepler's laws–critical velocity- viscosity & Stoke's Law –surface tension- Mass energy equivalence relation.

Unit-II: Heat and Thermodynamics

Various scales of temperatures - thermal expansions- Rayleigh Jeans & Wiens Law- Planks radiation law- Stefan Boltzmann law – Internal energy & entropy- Carnot engine & its efficiency –Maxwell relations - Clausius Clapeyron Equation

Unit-III: Optics

Spherical mirror & lens – refractive index –focal length –Biprism& Newton's rings – Fresnel-Fraunhoffer diffraction-Rayleigh scattering-Resolving power of optical instruments-zone plate & grating theory-Plane- Quarter & Half wave plate

Unit-IV: Electricity and Magnetism

Cells & internal resistance –Wheatstone Bridge& applications -Biot-Savart law - Ampere's circuital Law –LCR circuit- Dia, para & Ferro magnetism – Electromagnetic wave.

Unit-V: Relativity and Modern Physics

Atomic structure - Einstein's photo electric equations – Light - X-ray spectrum - Bohr's atomic theory.- Magic numbers – Nuclear force & its properties -radioactive decay - alpha decay, beta decay and gamma decay - Radioactive dating – Logic gates.

Books for Study

1. Youth Competition Times, A.K. Mahajan, YCT publications limited, 2023

Books for Reference

1. J. Walker, D. Halliday, R. Resnick, Fundamentals of Physics, 10th Edition, Wiley, United states of America, 2007.

2. H.C Verma, Concept of Physics, (Volume II), 1st Edition, BharatiBhawan Publishers & Distributors, New Delhi, 2008.

3. H.C Verma, Concept of Physics, (Volume I), 1st Edition, BharatiBhawan Publishers & Distributors, New Delhi, 2008.

4. A. M. Mahajan, Science Physics, volume I,Youth competition times, 2023

PSO Relation Matrix – Specimen Table

Course Outcomes	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	3	3	3	3	3	3	3	3	3
CO-2	3	3	3	3	3	3	3	3	3	3
CO-3	3	3	3	3	3	3	3	3	3	3
CO-4	3	3	3	3	3	3	3	3	3	3
CO-5	3	3	3	3	3	3	3	3	3	3
Ave.	3	3	3	3	3	3	3	3	3	3

SEMESTER - II			
CORE IV	**MATHEMATICAL PHYSICS II**		
Code : 24PPHC21	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

Objectives:

- Enhance the ability of the students by providing higher level mathematics such as tensor, special functions, transformations etc
- Enable the students to understand the principle behind the concepts and their real life application

Course Outcome:

CO No.	Upon completion of this course, students will be able to	CL
CO 1	Understand the concepts of differential equations of I & II order	K1
CO 2	Recall the basic notations of generating functions and special functions	K2
CO 3	Apply partial differential methods to solve a wide range of numerical problems arising in physics	K3
CO 4	Analyse the experimental data with the aid of Laplace Transform	K4
CO 5	Evaluate mathematical problems arising in physics by a variety of mathematical techniques.	K5

SEMESTER - II			
CORE IV	**MATHEMATICAL PHYSICS II**		
Code : 24PPHC21	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

UNIT I: Linear differential equations of first & second order

Order and degree of a differential equation- solution of differential equations of first order & first degree (variables separable, homogeneous equation)- linear differential equations of second order with constant coefficients-method of finding complementary function- rules to find particular integral- problems.

UNIT II: Tensors

Notations and conventions–contravariant vector-covariant vector- tensors of second rank – equality and null tensor– addition and substraction – outer product of tensors– inner product of tensors– symmetric and anti symmetric tensor– metric tensor– stress, strain and Hooke's law-Moment of inertia tensor.

UNIT III: Special Functions II

Hermite functions: Hermite Differential Equation– Hermite Polynomials– Recurrence Formulae– Rodrigue's Formula **Laguerre function:** Differential equation– Laguerre polynomial – Generating Function– Rodrigue's Formula– Recurrence Relation.

UNIT IV: Partial Differential Equations

Solution of partial differential equations by the method of separation of variables- Solution of Laplace's equation in Cartesian coordinates (2D & 3D)- 2D steady flow of heat-solution of heat flow equation-variable linear flow-linear flow in semi-infinite solid- 2 D Heat flow-equation of motion for the vibrating string-D' Alembert's Solution.

UNIT V: Laplace's Integral Transforms

Properties of Laplace transform-Laplace transformsof derivative of a function– Laplace transform of integral – inverse Laplace transform– properties of inverse Laplace transform-Evaluation of ILT by convolution theorem- Methodof partial fractions for evaluation of ILT

Text Books:

1. Satya Prakash. *Mathematical Physics*. New Delhi: Sultan Chand &Sons. 4th Edition 2004.
2. Joshi A W. *Matrices and tensors in Physics.* Delhi: New Age International Publishers. Reprint, 3rd Edition 2010.
3. Singaravelu A. *Numerical Methods*. Chennai: Meenakshi Agency. 2nd Edition 2011.

Books for Reference:

1. Chattopadhyay P K. *Mathematical Physics.* Delhi: New Age International Publishers. Reprint 2001.
2. Dass H K. *Mathematical Physics.* New Delhi: S.Chand& Company LTD. 4th Edition 2004.

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	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSO)**				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	3	3	2	3	3	3	3	2	3
CO-2	2	2	2	3	3	2	2	2	3	3
CO-3	3	2	3	3	3	3	2	3	3	2
CO-4	3	2	3	3	3	3	2	3	3	3
CO-5	3	3	3	3	3	3	3	3	3	2
Ave.	2.8	2.4	2.9	2.8	3	2.8	2.4	2.8	2.8	2.6

SEMESTER - II			
CORE V	**ELECTROMAGNETIC THEORY**		
Code : 24PPHC22	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Objectives:

- To know the fundamentals of electricity and magnetism
- To study the properties of electromagnetic waves and how they are propagated through waveguides.

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level
CO-1	Recall the fundamental concepts of electromagnetic theory	K1
CO-2	Compare electrostatics with magnetostatics	K2
CO-3	Construct Maxwell's equations and identify each mathematical operator and physical quantity in the equations	K3
CO-4	Distinguish transmission lines and waveguides and analyse propagation of signal in different modes	K4
CO-5	Obtain solutions for the problems in electromagnetic theory	K5

SEMESTER - II			
CORE V	**ELECTROMAGNETIC THEORY**		
Code : 24PPHC22	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Unit I: Electrostatics

Coulomb's Law - Gauss Law – Poisson's Equation and – Laplace's Equation – Work Done to move a point charge – Energy of a point charge and continuous charge distribution – Method of Images – Electric field in dielectric material – Gauss Law in the presence of dielectric – Susceptibility , Permittivity and Dielectric constant of linear dielectrics.

Unit II: Magnetostatics

Biot-Savart's and Ampere's Law - Magnetic vector potential – Multipole expansion of the vector potential – Effects of a Magnetic field on atomic orbits – Bound current and its Physical Interpretation – Ampere's law in Magnetized Materials – Magnetic Energy.

Unit III: Electrodynamics

Equation (Both Differential and Integral Formulations) – Boundary Conditions On field vectors D, E, B and H -Scalar and Vector Potentials - Gauge transformations – Lorentz and Coulomb Gauges - Poynting Vector and Poynting's Theorem – Maxwell's Stress Tensor.

Unit IV: Electromagnetic Waves and Radiations

Wave Equation for E and B – Propagation of EM Waves in Linear media – Reflection and transmission at normal and oblique incidence – EM waves in conductors – Radiation – Electric dipole radiation - Magnetic dipole radiation.

Unit V: **Wave Guides**

Waveguides – Rectangular wave guide TE - Rectangular wave guide TM mode – Circular wave guide – resonant cavities-Rectangular Cavity- Circular Cavity-TE Mode –TM mode – Q of cavity resonator.

Books for Study:

1. David J.Griffiths, Introduction to Electrodynamics, Pretice hall of India,2nd edition(1989)
2. Satya Prakash, Mathematical Physics, Fourth revised Edition 2004, Sultan Chand &Sons.

Books for Reference:

1. Paul Lorraius and Dale Corson, Electromagnetic Fields and Waves, CBS Publishers & distributors, 2nd edition 2003

E-Learning Resources:

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-andmagnetism/ Electrostatics

Relation Matrix – Specimen Table

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	3	3	3	3	3	3	3	3	3
CO-2	3	2	3	3	3	3	3	3	3	3
CO-3	3	3	1	3	3	3	3	3	3	3
CO-4	3	3	3	3	3	3	3	3	3	3
CO-5	2	3	2	2	2	2	2	2	2	2
Ave.	2.8	2.8	2.4	2.8	2.8	2.8	2.8	2.8	2.8	2.8

SEMESTER- II			
CORE	**THERMODYNAMICS AND STATISTICAL MECHANICS**		
Code: 24PPHC23	**Hrs/Week:5**	**Hrs/Semester:75**	**Credits:4**

Objectives:

- Enable the students to understand different ensembles
- Make them to understand different microscopic system

Course Outcomes:

CO No.	**Uponcompletionofthiscourse,studentswillbe ableto**	**CL**
CO1	Recall the term related to thermodynamic potential such as entropy and statistical term ensembles	K1
CO2	Understand the statistics in different systems containing atoms and molecules and how the system respond to temperature	K2
CO3	Apply the knowledge in different systems which is fluctuated due to temperature	K3
CO4	Analyse energy changes in chemical reaction using the first law Of thermodynamics and study the distribution of particles	K4
CO5	Estimate the Statistical properties of Random Walks and Fluctuations in ensembles	K5

SEMESTER- II			
CORE THERMODYNAMICS AND STATISTICAL MECHANICS			
Code: 24PPHC23	**Hrs/Week: 5**	**Hrs/Semester:75**	**Credits:4**

UNIT I:Thermodynamics

Thermodynamics –System and its surroundings- Zeroth, First, Second and Third law of thermodynamics-applications-Reversible and irreversible process-heat engines Kelvin Planck statement of the second law–Entropy–change of entropy in a reversible & irreversible process-Joule Thompson expansion–Maxwell's thermodynamic relations–Thermodynamic potentials

UNIT II:Thermodynamics of Magnetism

Chemical potential–phase equilibrium and the phase rule-dependence of vapour pressure on total pressure-surface tension- vapour pressure of a liquid drop – The Reversible voltaic cell- Black body radiation (Plank's Law)

UNIT III: Basis of Statistical Mechanics

Phase space – Ensemble – Liouville theorem – Equation of motion – Statistical Equilibrium – Micro canonical Ensemble– Quantisation of Phase space–Symmetry of wave functions–Effect of symmetry of counting– Various distributions using micro canonical ensemble.

UNIT IV: Ensemble & Statistical Thermodynamics

Gibbs paradox – Stirrling's approximation – Sackur - Tetrode equation – Entropy of a system in contact with a heat reservoir- Ideal gas in canonical ensemble – Grand canonical ensemble – Ideal gas in grandcanonical ensemble – Comparison of various ensembles — Bose-Einstein distribution function – Fermi-Dirac distribution function–Maxwell-Bolltzman distribution function

UNITV:Ising model and Fluctuations

Phase transitions of the second kind – Ising model – Bragg-Williams approximations – One dimensional Ising model-Fluctuations in ensembles –fluctuations in Energy and density – Probability of one dimensional random walk–Brownian motion.

TextBooks:

1. DassVN.*Heatandthermodynamic*.Delhi:DominantPublishers.1st Edition2005.
2. Gupta M C. *Statistical Thermodynamics.* New Delhi: New Age International P Ltd.Reprint 2009.
3. SearsSalinger.*Thermodynamics,KineticTheoryandStatisticalThermodynamcis.* NewDelhi:NarosapublishinghousepvtLtd.3rd Edition2017.
4. AgarwalBK,MelvinEisner.*StatisticalMechanic*.NewDelhi:NewageinternationalPLtd. Reprint2002.

Booksforreference:

1. Kerson Huang. *Statistical Mechanics.* New York: John Wiley & Sons, Inc. Secondedition.1987.
2. Dasgupta A K. *Fundamentals of Statistical Mechanics. Culcutta:* New Central BookAgency (P)Ltd.2000.
3. Sears and Zymanski. *Statistical Mechanics.* New York: McGraw Hill BookCompany.1961.
4. FederickReif. *Fundamentals of Statistical and thermal Physics,* Singapore: McGrawHillInternationalEditions.1985.

Web Resources

1. **https://www.youtube.com/watch?v=TPRnuIB-WUo**
2. **https://www.youtube.com/watch?v=UQHVyBCO2LY**
3. **https://www.youtube.com/watch?v=o_NY49pHI6o**
4. **https://www.youtube.com/watch?v=Hwhh2QhURbA**
5. **https://www.youtube.com/watch?v=x5dopllixFc**
6. **https://www.youtube.com/watch?v=KBe1d8BdjqQ**

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	2	3	2	2	2	3	2	2	3
CO-2	3	2	3	2	2	2	3	2	2	3
CO-3	3	3	2	3	3	3	3	3	3	3
CO-4	3	3	3	3	3	3	3	3	3	3
CO-5	2	3	2	2	2	2	2	2	2	2
Ave.	2.8	2.6	2.6	2.4	2.4	2.4	2.8	2.4	2.4	2.8

SEMESTER - II			
CORE PRACTICAL – I ELECTRONICS - II			
Code : 24PPHCR3	**Hrs/Week: 4**	**Hrs/Semester: 60**	**Credits:2**

(Any 7 experiments)

1. IC 7490 as scalar and seven segment display using IC7447
2. Solving simultaneous equations – IC 741 / IC LM324
3. Op-Amp – Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
4. Op-Amp: Basic circuit (Inverting amplifier, Non inverting amplifier, Summing amplifier and Difference amplifier)
5. BCD to Excess- 3 and Excess 3 to BCD code conversion
6. Study of binary up / down counters - IC 7476 / IC7473
7. Construction of second order butter worth multiple feedback narrow band pass filter
8. Realization of analog to digital converter (ADC) using 4 -bit DAC and synchronous counter IC74193
9. Construction of Schmidt trigger circuit using IC555 for a given hysteresis–Application as squarer
10. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474
11. Construction of pulse generator using the IC 555 – Application as frequency divider
12. Wien’s Bridge oscillator Op-Amp

SEMESTER - II			
CORE PRACTICAL IV - NON ELECTRONICS II			
Code : 24PPHCR4	**Hrs/Week: 3**	**Hrs/Semester: 45**	**Credits:2**

1. Elliptical fringes – Young's modulus
2. Polarizability of liquids using hollow prism
3. Band Gap measurement
4. Resistivity measurement using two probe at different temperatures.
5. Determination of dielectric constant for Ferro electric substance
6. Solar spectrum
7. Hall Effect, Carrier concentration.
8. Refractive Index of the liquid at various concentrations using laser
9. Wavelength of He-Ne laser
10. Determination of Numerical Apertures and Acceptance angle of optical fibres using Laser Source.

SEMESTER - II			
Elective MICROPROCESSOR 8085 AND MICROCONTROLLER 8051			
Code : 24PPHE22	**Hrs/Week: 4**	**Hrs/Semester: 60**	**Credits: 4**

Objective:

- Toprovideanunderstandingofthearchitectureandfunctioningofmicroprocessor8085Aand to the methods of interfacing I/O devices and memory to microprocessor
- Tointroduce8085Aprogrammingandapplicationsandthearchitectureandinstruction sets of microcontroller 8051

Course Outcomes:

CO No.	**At the end of the course, the student will be able to**	**CL**
CO1	Gain knowledge of architecture and working of 8085 microprocessor.	**K1**
CO2	Get knowledge of architecture and working of 8051 Microcontroller	**K1**
CO3	Be able to write simple assembly language programs for 8085A microprocessor.	**K2, K3**
CO4	Able to write simple assembly language programs for 8051 Microcontroller.	**K3, K4**
CO5	Understand the different applications of microprocessor and microcontroller.	**K4, K5**

SEMESTER - II			
Elective MICROPROCESSOR8085 AND MICROCONTROLLER 8051			
Code : 24PPHE21	**Hrs/Week: 4**	**Hrs/Semester: 60**	**Credits: 4**

UNIT I: Microprocessor Architecture and Instruction set

Intel 8085 Architecture-Instruction format-8085 programming model-instruction classification-8085Instructionset – Data transfer operations –Arithmetic instructions – Logic operations-Branch operations.

UNIT II: Microprocessor Programming & Counters and Time Delays

Writing assembly language programs-Programming techniques: Looping, Counting and Indexing –Stack – Subroutine- -8085 Interrupt-counters and time delays

Unit III: 8051 Microcontroller hardware

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

UNIT IV: Microcontroller Programming

Addressing modes – Data moving (Data transfer) instructions – Data exchange instructions – Logical instructions – Arithmetic instructions – Jump and CALL instructions: Jump and Call program range, Jump, Call and subroutines – Programming.

Unit V: Interrupt Programming and Interfacing 8051

8051 Interrupts –Timer interrupts and programming – Interrupt priority in the 8051 – LED Interface Seven segment display interface – Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface

Text Books

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

Books for Reference:

1. DouglasV.Hall,MicroprocessorsandInterfacingprogrammingandHardware, Tata McGraw Hill Publications (2008)
2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay, The8051 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,"The8086/8088Family-Design,ProgrammingandInterfacing, Software, Hardware and Applications", Prentice-Hall of India,New Delhi.
5. W.A.Tribel,AvtarSingh,"The8086/8088Microprocessors: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/

Relation Matrix – Specimen Table

	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

SEMESTER - II			
SKILL ENHANCEMENT COURSE -CHARACTERIZATION OF MATERIALS			
Code:24PPHSE2	**Hrs/Week:4**	**Hrs/Semester:60**	**Credits:3**

Objectives

- 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.

Course Outcomes:

CONo.	Uponcompletionof thiscourse,studentswillbeable to	CL
CO1	Describe the different techniques to characterize the materials and make Interpretation of the results.	**K1,K3**
CO2	Analyse the concept of image formation in Optical microscope, developments In other specialized microscopes and their applications.	**K4**
CO3	Apply the working principle and operation of SEM, TEM,STM and AFM.	**K3**
CO4	Understand Photoluminescence and electroluminescence experimental Techniques with necessary theory.	**K2**
CO5	Evaluate the properties of materials using the characterization techniques	**K5**

SEMESTER-II			
SKILL ENHANCEMENT COURSE - CHARACTERIZATION OF MATERIALS			
Code:24PPHSE2	**Hrs/Week:4**	**Hrs/Semester:60**	**Credits:3**

Unit I : THERMAL ANALYSIS

Introduction – thermo gravimetric 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 thermo mechanical parameters.

Unit II : MICROSCOPIC METHODS

Optical Microscopy: optical microscopy techniques – Bright field optical microscopy– Dark field optical microscopy – fluorescence microscopy – confocal microscopy—digital holographic microscopy-oil immersion objectives-quantitative metallography-image analyzer.

Unit III :ELECTRON MICROSCOPY AND SCANNING PROBE MICROSCOPE

SEM, EDAX,TEM: working principle and Instrumentation – sample preparation –Data collection, processing and analysis- Scanning tunneling microscopy (STEM) - Atomic force microscopy (AFM)

Unit IV: OPTICAL CHARACTERISATION

Photoluminescence – light – matter interaction – instrumentation –electroluminescence – instrumentation – Applications.Principles and instrumentation for UV-Vis-IR - Cyclic Voltmetric Studies - FTIR spectroscopy,Raman spectroscopy

Unit V : X-RAY AND SPECTROSCOPIC METHODS

Powder diffraction -Powder diffractometer -interpretation of diffraction patterns - indexing - phase identification - residual stress analysis – Particle size, texture studies - X-ray fluorescence spectroscopy – Single Crystal X-ray Diffractometer - uses.

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, Butterworth Heinemann, (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	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	3	3	2	3	3	3	3	2	3
CO-2	2	2	2	3	3	2	2	2	3	3
CO-3	3	2	3	3	3	3	2	3	3	2
CO-4	3	2	3	3	3	3	2	3	3	3
CO-5	3	3	3	3	3	3	3	3	3	2
Ave.	2.8	2.4	2.9	2.8	3	2.8	2.4	2.8	2.8	2.6