CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

NATIONALLY ACCREDITED (III CYCLE) WITH "A" GRADE BY NAAC

ISO 9001:2015 Certified

TIRUCHIRAPPALLI – 18

PG & RESEARCH DEPARTMENT OF PHYSICS

M.Sc., PHYSICS SYLLABUS

(2022-2023 Onwards)

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS), TRICHY-18.

PG AND RESEARCH DEPARTMENT OF PHYSICS

VISION

To establish a substratum for excellence and creation of knowledge by igniting the essence of learning physics and exploring its area of research with novel ideas.

MISSION

Our mission is two – fold.

- To provide an outstanding and distinctive education to our undergraduate and postgraduate students.
- To expand our research enterprises via centers and institutes to achieve national and international prominence in strategic research areas.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs	STATEMENTS
PEO 1	**LEARNING ENVIRONMENT** To facilitate value-based holistic and comprehensive learning by integrating innovative learning practices to match the highest quality standards and train the students to be effective leaders in their chosen fields.
PEO 2	**ACADEMIC EXCELLENCE** To provide a conducive environment to unleash their hidden talents and to nurture the spirit of critical thinking and encourage them to achieve their goal.
PEO 3	**EMPLOYABILITY** To equip students with the required skills in order to adapt to the changing global scenario and gain access to versatile career opportunities in multidisciplinary domains.
PEO 4	**PROFESSIONAL ETHICS AND SOCIAL RESPONSIBILITY** To develop a sense of social responsibility by formulating ethics and equity to transform students into committed professionals with a strong attitude towards the development of the nation.
PEO 5	**GREEN SUSTAINABILITY** To understand the impact of professional solutions in societal and environmental contexts and demonstrate the knowledge for an overall sustainable development.

PROGRAMME OUTCOMES FOR M.Sc PHYSICS PROGRAMME

PO NO.	Programme Outcome On completion of M.Sc Physics Programme, The students will be able to
PO 1	**Problem Analysis:** Provide opportunities to develop innovative design skills, including the ability to formulate problems, to think creatively, to synthesize information, and to communicate effectively.
PO 2	**Scientific Skills:** Create and apply advanced techniques and tools to solve the societal environmental issues.
PO 3	**Environment and sustainability:** Ascertain eco- friendly approach for sustainable development and inculcate scientific temper in the society.
PO 4	**Ethics:** Imbibe ethical and social values aiming towards holistic development of learners.
PO 5	**Lifelong learning:** Instil critical thinking, communication, initiative which potentially leads to higher rates of employment and educational fulfillment.

PROGRAMME SPECIFIC OUTCOME FOR M.Sc PHYSICS PROGRAMME

M.Sc PHYSICS CURRICULUM (2022-2023 onwards)

PSO NO.	Programme Specific Outcomes Students of M.Sc Physics will be able to	POs Addressed
PSO 1	Demonstrate proficiency in the mathematical concepts needed for a proper understanding of Physics	**PO1, PO2, PO5**
PSO 2	Understand the basic concepts of Physics particularly concepts in classical mechanics, quantum mechanics, electrodynamics and electronics to appreciate how diverse phenomena observed in nature follow from a small set of fundamental laws.	**PO2, PO5**
PSO 3	Learn numerous numerical problem-solving approaches and the fundamentals of curve fittings.	**PO1, PO2**
PSO 4	Learn about microprocessors and microcontrollers, as well as practical microprocessor programming abilities	**PO1, PO2**
PSO 5	Provide students with broad theoretical and practical knowledge in all specialization of Physics with required qualitative and quantitative techniques.	**PO1, PO2' PO5**

Cauvery College for Women (Autonomous)
PG & Research Department of Physics
M.Sc., Physics
LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (CBCS – LOCF)
(For the Candidates admitted from the Academic year 2022-2023 onwards)

Semester	Course	Course Title	Course Code	Inst. Hrs. / week	Credits	Exam			Total
						Hrs.	Marks		
							Int.	Ext.	
I	Core Course– I (CC)	Mathematical Physics	22PPH1CC1	6	5	3	25	75	100
	Core Course – II (CC)	Classical Dynamics and Relativity	22PPH1CC2	6	5	3	25	75	100
	Core Course –III (CC)	Quantum Mechanics - I	22PPH1CC3	6	5	3	25	75	100
	Core Practical - I (CP)	General Physics and Electronics - I (P)	22PPH1CC1P	6	5	3	40	60	100
	Discipline Specific Elective Course-I (DSE)	Microprocessor and Microcontroller	22PPH1DSE1A	6	3	3	25	75	100
		Non – Destructive Evaluation Techniques	22PPH1DSE1B						
		Astrophysics	22PPH1DSE1C						
	Total			30	23	-	-	-	**500**
	15 Days INTERNSHIP during Semester Holidays								
II	Core Course– IV (CC)	Electromagnetic Theory	22PPH2CC4	6	5	3	25	75	100
	Core Course – V (CC)	Quantum Mechanics -II	22PPH2CC5	6	5	3	25	75	100
	Core Choice Course– I (CCC)	Electronics	22PPH2CCC1A	6	4	3	25	75	100
		Nonlinear Dynamics	22PPH2CCC1B						
		Spectroscopy	22PPH2CCC1C						
	Core Practical - II (CP)	Microprocessor and Python Programming (P)	22PPH2CC2P	6	5	3	40	60	100
	Discipline Specific Elective Course-II (DSE)	Numerical Methods and Python Programming	22PPH2DSE2A	6	3	3	25	75	100
		Physics of Sensor and Transducer	22PPH2DSE2B						
		Material Characterization and Measurement Techniques	22PPH2DSE2C						
	Internship	Internship	22PPH2INT	-	2	-	25	75	100
	Extra Credit Course	SWAYAM	As per UGC Recommendation						
	Total			30	24	-	-	-	**600**

III	Core Course– VI (CC)	Statistical Mechanics	22PPH3CC6	6	5	3	25	75	100
	Core Course – VII (CC)	Solid State Physics	22PPH3CC7	5	5	3	25	75	100
	Core Choice Course– II (CCC)	Cyber Security	22PGCS3CCC2A	5	4	3	25	75	100
		Communication Electronics	22PPH3CCC2B						
		Physics of Semiconductor Devices	22PPH3CCC2C						
	Core Practical - III (CP)	General Physics and Electronics - II (P)	22PPH3CC3P	6	5	3	40	60	100
	Discipline Specific Elective Course-III (DSE)	Crystal Growth and Thin Film Physics	22PPH3DSE3A	5	3	3	25	75	100
		Physics for Competitive Examinations	22PPH3DSE3B			2	-	100	
		Weather Forecasting	22PPH3DSE3C			3	25	75	
	Generic Elective Course -I (GEC)	Science of Materials	22PPH3GEC1	3	2	3	25	75	100
	Extra Credit Course	SWAYAM	As per UGC Recommendation						
	Total			30	24	-	-	-	**600**
IV	Core Course–VIII (CC)	Nuclear and Particle Physics	22PPH4CC8	6	5	3	25	75	100
	Core Choice Course– III (CCC)	Nonlinear Optics	22PPH4CCC3A	6	4	3	25	75	100
		Nanophysics	22PPH4CCC3B						
		Space Physics	22PPH4CCC3C						
	Core Practical - IV (CP)	Electronics (P)	22PPH4CC4P	6	5	3	40	60	100
	Generic Elective Course-II (GEC)	Trouble Shooting of Home Appliances	22PPH4GEC2	3	2	3	25	75	100
	Project	Project Work	22PPH4PW	9	5	-	-	100	100
	Total			30	21	-	-	-	**500**
	Grand Total			120	92	-	-	-	**2200**

Courses & Credits for M.Sc., Physics

Sl. No	Courses	No of Courses	No of Credits	Marks
1.	Core Course – (CC)	8	40	800
2.	Core Choice Course– (CCC)	3	12	300
3.	Core Practical - (CP)	4	20	400
4.	Discipline Specific Elective- (DSE)	3	9	300
5.	Generic Elective Course - (GEC)	2	4	200
6.	Project	1	5	100
7.	Internship	1	2	100
	Total	22	92	2200

- Project : 100
- Marks Dissertation : 80 Marks
- Viva Voce : 20 Marks
- Core Papers : 08
- Core Choice Course : 03
- Core Practical : 04
- Discipline Specific Elective : 03
- Generic Elective Course:02
- Project : 01
- Internship : 01

Note:

1. Theory Internal 25 marks External 75 marks
2. Practical " 40 marks " 60 marks 3. Separate passing minimum is prescribed for Internal and External

a) The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks)

b) The passing minimum for End Semester Examinations shall be 40% out of 75 marks (i.e. 30 mark

c) The passing minimum not less than 50% in the aggregate.

Internal Component (Theory)

Component	Marks
Library	5
Assignment	5
Seminar	5
CIA I &II	10
	25

Internal Component (Practical)

Component	Marks
Observation	5
Record	10
Continuous Performance in Practical	10
Model	15
	40

INTERNSHIP COMPONENTS

Internal components	Marks	External components	Marks
Communication skill	5	Regularity	10
Presentation skill	10	Problem solving	10
		Participation and Hands-on training	20
Report evaluation	10	Professional attitude	15
		Report writing	20
Total	**25**		**75**

SEMESTER -I	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22PPH1CC1	**MATHEMATICAL PHYSICS**	**CC - I**	**6**	**5**

Course Objectives

- To provide a strong mathematical foundation in vector calculus, matrices and differential equations
- To learn complex variables and residue theorem technique to solve real integrals appearing in physics problems
- To understand basics of Fourier Transform and Laplace Transform.
- To demonstrate competence with the basic ideas of linear algebra including concepts of linear systems, theory of matrices, , eigenvectors and diagonalization.
- To enhance problem solving skills and to give the ability to formulate, interpret and draw inferences from the mathematical solutions.

Pre-requisites

- Strong Foundation of vector Analysis.
- Understand and appreciate the properties of complex variable.
- Commendable knowledge of special functions to apply physics problems.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO 1	Remember and Understand the various mathematical concepts used in physics.	K1, K2
CO 2	Analyze mathematical tools like vector, matrix, group theory, complex integration, Fourier and Laplace series, special function will prepare the student to solve ODE; PDE's which model physical phenomena.	K3
CO 3	Evaluate the vector, linear, simultaneous and differential equations which will be necessary to pursue other areas in physics.	K4
CO 4	Apply mathematical methods to predict the problems in classical physics, statistical physics and quantum mechanics as well as electrodynamics.	K5
CO 5	Solve the physical problems using mathematical techniques.	K6

Mapping of CO with PO and PSO

Cos	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	1	2	1	1	3	3	2	2	2
CO 2	3	1	1	1	1	3	1	2	2	2
CO 3	3	1	1	1	1	3	3	1	2	2
CO 4	3	1	3	1	1	1	3	2	2	2
CO 5	3	1	2	1	1	3	3	2	3	1

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation;
"3" – Substantial (High) Correlation "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Vector Analysis** Vector integration – Line integral– Surface integral – Flux – Volume integral – Green's theorem – Stokes' theorem – Divergence theorem – Orthogonal curvilinear coordinates – Unit vectors in curvilinear coordinate system – The gradient, divergence, curl and Laplacian in cylindrical and spherical polar coordinates.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**Matrix and Group theory** Characteristic equation of a matrix – Matrix algebra – Rank of a Matrix – System of linear equations –Types of matrix – Inverse of a matrix – Eigenvalues and eigenvectors – Cayley–Hamilton theorem – Reduction of a matrix to diagonal form – Jacobi method. Introduction to Group Theory – Group Multiplication Table – Cyclic Group – Subgroup – Cosets – Classes – Invariant Subgroup – Homomorphism and Isomorphism – Reducible and Irreducible Representation – Formation of character table of C_{2v}– SU(2) and SO(3)	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**ComplexVariables** Complex functions and variables – Condition for a function to be analytic– Complex integration – Cauchy's theorem – Taylor expansion – Laurent series – Cauchy's residue theorem – Computations of residue – Evaluation of integrals using residues.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**Fourier and Laplace's Integral Transforms** Fourier's Transform– Infinite Fourier Sine and Cosine Transforms– Properties of Fourier's Theorem– Finite Fourier sine and cosine transforms. Laplace transforms– Properties of Laplace Transforms– Convolution Theorem– Evaluation of Inverse Laplace Transforms by Convolution Theorem– Evaluation of Laplace Transform using Differential Equations.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Special Functions** Solution of Differential Equations – Legendre, Hermite and Bessel Differential Equations using Power Series method – Generating Function, Rodrigues Formula, Recurrence relation, Orthogonality relations.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self-Study for Enrichment** **(Not included for End Semester Examinations)** Exact differential –Sylvester's theorem–Formation of character table of C_{3v}– Elementary ideas in Lie Groups and Lie Algebras –Cauchy's integral formula– Simple applications of Fourier Transforms– Laguerre differential equation.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Gupta.B.D., (2015). *Mathematical Physics*. (2nd Edition)Vikas Publishing House, Mumbai.

2. Satya Prakash., (2014). *Mathematical Physics*.(1st Edition) Sultan chand & sons, Newdelhi.

3. Sexena.A.K., (2015). *Mathematical Physics*.(1st Edition) Narosa Pub, Newdelhi.

4. Joshi.A.W., (2006). *Matrices and Tensors in Physics*. (4th Edition)New Age, Newdelhi.

5. MurraySpiegel., (2009). *Schaum Series of Complex.* (2nd Edition) *Analysis* .McGraw-Hill, Newyork.

6. Balakrishnan.V., (2018). *Mathematical Physics with Applications*. Indian Academy of Science, Bangalore.

Reference Books

1. Dass, H.K., & Rama Verma., (2018).*Mathematical Physics*.(1st Edition) S.Chand & Co, New Delhi.

2. Pipes, L.A.,& Harvill,L.R., (1970).*Mathematical Physics for Engineering*.(3rd Edition) McGraw-Hill, Newyork.

Web References

1. https://nptel.ac.in/courses/115/106/115106086/

2. https://nptel.ac.in/courses/115/103/115103036/

3. https://www.classcentral.com/course/swayam-mathematical-methods-in-physics-1-23045

Pedagogy

Chalk and Talk, Seminar, Assignment, Power point Presentation, Group discussion and Quiz

Course Designer

Dr.R.Gayathri

SEMESTER - I	INTERNAL MARKS : 25	EXTERNAL MARKS : 75		
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PPH1CC2	CLASSICAL DYNAMICS AND RELATIVITY	CC - II	6	5

Course Objectives

- To acquire Basic Knowledge about Lagrangian formulation
- To expose the students to the fundamentals of Hamiltonian equation.
- To demonstrate knowledge and understanding of the fundamental concepts of Rigid body dynamics
- To acquire knowledge of real time problems in macroscopic view and applying it to the microscopic level
- To develop critical thinking and problem solving skills

Pre-requisites

- Knowledge about Lagrange's equation
- Knowledge about Motion under a central force
- Fundamental knowledge of physical concepts , mathematical methods of classical mechanics

Course Outcome and Cognitive Level Mapping:

CO Number	CO Statement On the successful completion of course, the student will be able to	Cognitive Level
CO 1	Remember and Understand the primary idea and principle governing the concept of tensor as well as the discrete and continuous mechanical systems related concepts in classical mechanics.	K1,K2
CO 2	Analyze the constraints on mechanical systems and Interpret the importance of concepts such as generalized coordinates.	K3
CO 3	Evaluate the ideas of rigid body dynamics and kinematics as well as the central force acting on the objects.	K4
CO 4	Apply the Lagrangian and Hamiltonian formulation of classical mechanics,poisson brackets and canonical transformations are used in order to simplify the methods to be used in solving physics problems.	K5
CO 5	Create conclusions about classical dynamics, including matrix generalization and special relativity.	K6

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	1	3	3	2	2	2	2
CO 2	3	3	2	1	3	3	2	2	2	2
CO 3	3	3	2	1	3	3	2	2	2	2
CO 4	3	3	2	1	3	3	2	2	2	2
CO 5	3	3	2	1	3	3	2	2	2	2

"1"-Slight (Low) Correlation "2"-Moderate (Medium) Correlation
"3"- Substantial (High) Correlation "-"indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Lagrangian Formalism:** Mechanics of a system of particles – Conservation of linear momentum, Angular momentum and Energy-constraints – Classification of constraints – Degrees of freedom – Generalized coordinates – Principle of virtual work – D'Alembert's principle – Lagrange's equation of motion – Applications – Linear harmonic oscillator – Simple Pendulum – Compound Pendulum – Atwood's Machine.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**Hamilton's Formulation:** Phase space and motion of the system -Hamiltonian function – Hamiltonian Variation principle – Hamilton's canonical equations of motion – physical significance of H – advantages of Hamiltonian approach – Applications of Hamilton's equations of motion – Simple Pendulum – Principle of least action- Canonical Transformations- Infinitesimal constant transformations- Poisson brackets -Equation of motion in Poisson brackets and its relation	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**Central Force Problems:** Equations of motion and first integrals - The equivalent One - Dimensional problem and General features of orbits - The Kepler problem: Inverse square law of force-the Laplace-Runge - Lenz Vector – Scattering in a central force field - Scattering in a Problem to laboratory coordinates	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**Rigid Body Dynamics and Oscillatory Motion:** Euler angles - Moments and Products of inertia - Euler's equations – Symmetric top under the action of gravity -Applications-Theory of small Oscillations and normal modes-Frequencies of free Vibration and normal coordinates-Linear triatomic molecule.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Tensor and Relativistic Mechanics:** Occurrence of tensor in physics-Kronecker delta-Dummy and Free index-Covariant and Contravariant-Inner and Outer Product-Quotient Law-Basic Postulates of special theory of relativity-Lorentz transformationsin real four dimensional spaces, force and energy equations in relativistic mechanics- Lagarangian formulation of relativistic mechanics-Hamiltonian formulation of relativistic mechanics	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self Study for Enrichment** **(Not included for End Semester Examinations)** Superiority of Lagrangian approach over Newtonian approach-Application of Lagrangian and Hamiltonian: motion in a Uniform gravitational field-Advantage of Hamiltonian approach-Advantage of Canonical transformation-Relation between Lagrange and Poisson brackets-One dimensional harmonic oscillator- Special theory of relativity- Relativistic Generalization of Newton's laws.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Herbert Goldstein., (2001) *Classical Mechanics*, Narosa Publishing House , 2nd Edition, New Delhi.

2. Upadhyaya J.C.,(2015) *Classical Mechanics*, Himalaya Publishing House.

3. Gupta, Kumar &Sharma .,(2012) *Classical Mechanics*, PragatiPrakashan, India.

4. Takwale R G &Puranik P S .,(2010) *Classical Mechanics*, Tata McGraw Hill Education Pvt. Ltd Noida.

5. Joshi A.W.,(2002) *Matrices and Tensors in Physics*,New Ag International(P)Ltd.,Publishers,Newdelhi.

Reference Books

1. Rana N.C. and Joag P. S (1998) *Classical Mechanics*, Tata McGraw Hill, New Delhi.

2. Douglas Gregory (2008) *Classical Mechanics*,University press , Cambridge.

Web Resources

1. https://sites.astro.caltech.edu/~golwala/ph106ab/ph106ab_notes.pdf
2. http://users.uoa.gr/~pjioannou/mechgrad/chapter3_Goldstein.pdf
3. http://www.cds.caltech.edu/~marsden/wiki/uploads/projects/geomech/Alemicds205final.pdf
4. https://www.physics.rutgers.edu/~shapiro/507/book7.pdf
5. https://phys.libretexts.org/Bookshelves/Classical_Mechanics/Classical_Mechanics_(Tatum)/04%3A_Rigid_Body_Rotation/4.08%3A_Force-free_Motion_of_a_Rigid_Symmetric_Top
6. https://byjus.com/jee/what-is-cartesian-coordinate-system/
7. https://phys.libretexts.org/Bookshelves/Classical_Mechanics/Variational_Principles_in_Classical_Mechanics_(Cline)/17%3A_Relativistic_Mechanics

Pedagogy

Lecture, Seminar, Assignment and power point presentation

Course Designer

Ms.R.A.Kiruthika

SEMESTER- I	INTERNAL MARKS : 25	EXTERNAL MARKS : 75		
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PPH1CC3	QUANTUM MECHANICS - I	CC-III	6	5

Course Objectives

- To study the fundamentals of wave mechanics.
- To study the stationary state and eigen spectrum of systems using time dependent Schrodinger equation.
- To solve the exactly soluble eigen value problems.
- To know the matrix formulation of quantum theory and how it can be used to understand the equation of motion.
- To understand the theory of identical particles and angular momentum.

Pre-requisites

- A thorough understanding of mechanics.
- Knowledge of partial differential equation and variable separable method.
- Commendable knowledge of integral and differential calculus.

Course Outcomes and Cognitive Levels Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall and interpret the classical and quantum mechanics	K1,K2
CO2	Analyze the various applications of quantum mechanics	K3
CO3	Discover the formalism in quantum mechanics	K4
CO4	Apply the different type of approaches to solve quantum mechanical systems	K5
CO5	Elaborate the operators in both classical and Quantum Mechanics	K6

Mapping of CO with PSO and PO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO1	3	3	3	1	2	3	3	3	3	3
CO2	3	3	3	1	3	3	3	3	3	3
CO3	3	3	3	1	3	2	2	3	2	2
CO4	3	3	2	1	2	1	1	1	1	1
CO5	3	3	2	1	3	3	3	3	3	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation;
"3" – Substantial (High) Correlation "-" – Indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**SCHRÖDINGER EQUATION APPROACH** Recapitulation of the need for Quantum Mechanics - Thought experiments using Young's double slit -Motivation to introduce a wave function-probabilistic interpretation and Normalization - Time dependent Schrödinger equation (free particle in one dimension) - Generalization to three dimension - Non-normalizablewavefunction and Box normalization - Expectation values: Ehrenfest theorem - Conditions on the wave function-The time-independent Schödinger equation. **APPLICATIONS** Particle in a square well potential - Solution of wave equation in bound states - Energy Eigenvalues - Energy Eigenfunctions - Square potential barrier: Quantum mechanical tunnelling - Reflection at potential barrier and walls -The free particle - Deutron	20	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**ABSTRACT FORMALISM- I** Linear vector space - linear operator - Eigenfunctions - Eigenvalues - Hermitian operator- - Commutation relations- Their connection with Poisson Brackets of Classical Mechanics - Properties of Unitary operator- Postulates of quantum mechanics - Observables and their connection with Hermitian operators	17	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**ABSTRACT FORMALISM- II** Uncertainty relation – Dirac's notation - Equation of motion - Momentum representation - Heisenberg method: Matrix representation of quantum states and operator-Properties of matrix element – Evolution of Schrodinger equation in matrix form - Unitary transformation-Linear harmonic oscillator in matrix form.	17	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**SIMPLE HARMONIC OSCILLATOR** **Wave-function approach:** Schrödinger equation and Energy eigenvalues - Energy eigenfunctions: Series Solution; Asymptotic behavior- Orthonormality - Properties of stationary states **Abstract Operator Approach:** Formulation of Harmonic oscillator problem in abstract notation - Creation, Annihilation and number operators- Solving the Eigen value problem in Abstract Notation - Eigen states and Energy eigenvalues	17	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

V	**ANGULAR MOMENTUM** **Wave-function approach:** Angular momentum operators – Commutations relations of Angular momentum - Eigenvalues and eigenfunctions of L^2 andL_z- Separation of variables- Admissibility conditions on solutions - Spherical harmonics - Physical interpretation - Angular Momentum in Stationary States of Systems with Spherical Symmetry **Abstract Operator Approach:** Constructing the Operators for J^2 andJ_z - Raising and lowering operators - Eigenvalues of J^2 and J_z - Angular momentum matrices -Spin angular momentum – Addition of angular momentum- Clebsch Gordon Coefficients – Selection rules – Recursion relations - Computation of Clebsch Gordon Coefficients	19	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self Sstudy for Enrichment** **(Not included for End Semester Examination)** De Broglie's Hypothesis-Interpretation of the Wave-Particle Dualism - Photons: The Quantization of Fields -Alpha emission-Coherent state- Parity.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1.Mathews P. M.,andVenkatesan K.,.(1987),*A Text Book of Quantum Mechanics,*Tata McGraw Hill, New Delhi.

2.Aruldhas G., (2009),.*Quantum Mechanics,*Prentice Hall of India.

3. Ghatak .A., and Lokanathan S., (1987),*A Text Book of Quantum Mechanics.*Tata McGraw Hill, New Delhi.

4. EugenMerzbacher., (1998),*Quantum Mechanics,* John Wiley &Son,Inc,Newyork

Reference Books

1. DevanathanV.,(2006) *Quantum Mechanics,*Narosa Publishing House, New Delhi

2. Scfiff .L.,(2004) *Quantum Mechanics,*Tata McGraw Hill, New Delhi

3. Shankar.R., (2007),*Principles of Quantum Mechanics,*Springer, New Delhi

4. Thankappan V.K., *Quantum*Mechanics., Wiley Eastern Ltd, New Delhi

Pedagogy

Chalk and Talk ,Lecture, Seminar, Assignment, Power point presentation

Web References

1. https://www.britannica.com/science/quantum-mechanics-physics
2. https://www.livescience.com/33816-quantum-mechanics-explanation.html
3. https://plato.stanford.edu/entries/qm/

Course Designer

Dr.R.MEENAKSH

SEMESTER-I	INTERNAL MARKS: 40	EXTERNAL MARKS: 60		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22PPH1CC1P	**GENERAL PHYSICS AND ELECTRONICS-I(P)**	**CP-I**	**6**	**5**

Course Objectives

- To determine certain physical constants
- Demonstrate the concepts of spectrometry and to find optical constants
- Explore the concepts of electrical discharge in applied magnetic field
- Explain the operation of IC 555 timer as multivibrators
- To understand properties and characteristics of electronic components and devices

Pre-requisites

- Fundamental knowledge of Physical and optical constants
- Understand the concepts of specific charge of an electron by Magnetron method
- Experimental knowledge of IC 555 timers as multivibrators

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO 1	Explain the basics of experimental physics.	K2
CO 2	Understand the fundamental physics behind many scientific discoveries through hands on experience.	K2
CO 3	Explore the concepts of spectrometry involved in the optic processes.	K3
CO 4	Verify experimentally the basic laws of physics	K4
CO 5	Develop the skill in handling instrumentsin the construction of circuits	K6

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1	2	2	3	2	1	2	1
CO 2	1	3	2	3	1	3	3	2	2	1
CO 3	3	3	2	3	2	3	2	3	3	2
CO 4	2	3	2	3	3	2	3	2	3	2
CO 5	3	2	3	3	3	2	2	2	3	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no correlation.

SYLLABUS

LIST OF EXPERIMENTS (Any 10)	Hours	COs	COGNITIVE LEVEL
1. DETERMINATION OF Q, N, Σ BY ELLIPTICAL FRINGES METHOD 2. DETERMINATION OF RYDBERG'S CONSTANT USING SPECTROMETER 3. .DETERMINATION OF WAVELENGTH BY USING MICHELSON'S INTERFEROMETER. 4. CHARGE OF AN ELECTRON BY SPECTROMETER 5. STUDY OF HALL EFFECT IN A SEMICONDUCTOR 6. DETERMINATION OF E/M OF ELECTRON BY MAGNETRON METHOD 7. DESIGN AND STUDY OF ASTABLE AND MONOSTABLE MULTIVIBRATORS USING IC555 8. DESIGN AND STUDY OF WEIN BRIDGE OSCILLATOR 9. DESIGN AND STUDY OF PHASE SHIFT OSCILLATOR 10. OPERATION OF SHIFT REGISTER USING SISO, SIPO, PIPO 11. DESIGN OF REGULATED POWER SUPPLY 12. FREQUENCY DIVIDER USING IC 555. 13. CHARACTERISTICS OF SCR/CHARACTERISTICS OF DIAC/CHARACTERISTICS OF TRIAC	6 Hrs Week	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Ouseph, C.C., Rao, U.J., & Vijayendran, V., (2009). *Practical Physics and Electronics*. S.Viswanathan, Printers & Publishers Pvt Ltd.
2. Dr.Somasundaram, S., (2012). *Practical Physics*. Apsara Publications.

Reference Books

1. Dunlap, R.A., (1988). *Experimental Physics: Modern Methods*. Oxford University Press, New Delhi.
2. Jones, B.K., (1986). *Electronics for Experimentation and Research*. Prentice-Hall.
3. Zbar, P.B., Malvino, A.P., & Miller, M.A., (1994). *Basic Electronics: A Text-Lab Manual.* Tata Mc-Graw Hill, New Delhi.

Web References

1. https://www.msuniv.ac.in/Download/Pdf/b2efcbdbc4be452
2. https://www.studocu.com/in/document/reva-institute-of-technology-and-management/bachelors/msc-electronics-lab-student-copy/17586392
3. https://www.vlab.co.in/broad-area-physical-sciences

Pedagogy

Demonstration, practical sessions and viva voce

Course Designer

Dr.S.Gowri

SEMESTER-I	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS / WEEK**	**CREDITS**
22PPH1DSE1A	**MICROPROCESSOR AND MICROCONTROLLER**	**DSE-I**	**6**	**3**

Course Objectives

- To understand the architecture of 8085 & 8051
- To impart the knowledge about the instruction set
- To understand the interfacing circuits for various applications of 8051 microcontroller.
- To introduce the architecture of advanced microprocessors and microcontroller.
- To analyse the basic concepts and programming of 8051 microcontroller

Pre-requisites

- Knowledge about Digital circuits
- Understanding of Programming languages

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the ourse,students will be able to	Cognitive Level
CO 1	Understand the Basics of Microprocessor and impart the knowledge about the instruction set	K1,K2
CO 2	Demonstrate programming proficiency using the various addressing modes and data transfer instructions of microprocessor/Microcontroller	K3
CO 3	Explain the data transfer schemes and interfacing devices	K4
CO 4	Distinguish the instruction set of microprocessor and microcontroller and Create program with Microcontroller	K5
CO 5	Develop programming skill using interfacing and Peripheral devices of Microprocessor	K6

Mapping of CO with PO and PSO

Cos	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	1	1	3	1	1	1	3	2	2
CO 2	2	2	1	3	1	3	3	2	2	3
CO 3	1	1	2	3	1	2	3	1	2	2
CO 4	1	1	2	3	1	3	3	3	2	3
CO 5	2	2	1	3	1	3	3	3	2	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation
"3" – Substantial (High) Correlation "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	CONGNITIVE LEVEL
I	**ARCHITECTURE OF 8085:** Architecture of 8085 - Data and Address buses - Registers in 8085- Addressing modes in 8085- Pin configuration of 8085 - Instruction set of 8085-Instruction types (based on number of bytes, operation) data transfer - Arithmetic - Logical- Branching- Stack and I/O instructions - Instruction cycles - Fetch operation - Execute operation - Machine cycle and State - Instruction and data flow - Timing diagram - Memory read and memory write cycles.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**MICROPROCESSOR PROGRAMING :** Assembly language - Stacks - Subroutines - MACRO - Delay Subroutine - Examples of Assembly language Programming - Addition-Subtraction – Shift an 8-bit number left by one bit-Mask off Least Significant 4Bits of an 8-bit number-Find the largest and Smallest number in a data array - Sum of a series - Multiplication - Division -Multi-byte addition and subtraction.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**DATA TRANSFER SCHEMESAND INTERFACING AND PERIPHERAL DEVICES:** Programmed data transfer scheme-Synchronous and Asynchronous and serial data transfer schemes-Interfacing devices- Types of interfacing devices-Programmable Peripheral Interface (PPI- 8255)-Communication interfacing device (Universal Synchronous Asynchronous Receiver Transmitter (USART- 8251))- Programmable DMA controller (8257).	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**MICROCONTROLLER-8051:** Introduction to microcontroller-Difference between microprocessor and microcontroller. 8051 microcontroller: Pin configuration- Architecture and Key features 8051-Data types and directives Instruction set: Data transfer instructions - Arithmetic instructions – Logical instructions- Branching instructions- Addressing modes - Simple programs – Addition and subtraction of two 8-bit numbers – Multiplication-Division-Largest Number in an array -Sum of a set of numbers.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**MICROPROCESSOR APPLICATIONS:** Microprocessor Interfacing and Applications: Programmable peripheral interface Intel 8255-Interfacing 7 segment LED display-Measurement of temperature-Microprocessor based traffic control-To generate square wave or pulse using Microprocessor.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

VI	**SELF STUDY FOR ENRICHMENT** **(Not included for End Semester Examination)** Assembly language Programs using Microprocessor - Decimal to Hexadecimal Conversion - Ascending and Descending order- Shift an 8-bit number left by 2 bit - Shift a 16-bit number left by one bit - Shift a 16-bit number left by 2 bit - Mask off Most Significant 4Bits of an 8-bit number.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Ram B. (2013). *Fundamental of Microprocessor and Microcontroller*.Dhanpat Rai Publications(P) Ltd, New Delhi.8 thEdition
2. GodseA.P ,Godse D.A. (2017).*Microprocessorsandmicrocontrollers*.Technical Publications,Pune.4 th Revised Edition

Reference Books

1. Muhammad AliMazidi, JiniceGillispieMazidi.(2004) *The 8051 microcontroller and embedded systems.* Pearson Education, Delhi.2nd Edition.
2. A.Nagoorkani.(2012*) Microprocessors & Microcontrollers*. RBA Publications, Chennai.2nd Edition.

Web References

1. http://nptel.ac.in/noc20_ee42
2. http://classcentral.com/course/swayam-micropocessor-an-interfacing-17694**.**

Pedagogy

Chalk and Talk, Seminar, Assignment, Power point Presentation, Group discussion and Quiz

Course Designer

Dr.T.Noorunnisha

SEMESTER-I	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS / WEEK**	**CREDIT**
22PPH1DSE1B	**NON - DESTRUCTIVE EVALUATION TECHNIQUES**	**DSE-I**	**6**	**3**

Course Objectives

- To impart the knowledge in various Non-destructive testing (NDT) techniques.
- To overview the concepts and methods employed for NDT of Structures and materials.
- To understand the concept of Ultrasonic testing.
- To understand the limitations of NDT techniques.
- To introduce the concept of Real time Radiography Techniques.

Pre-requisites

- Knowledge about Acoustics
- Understanding of Ultrasonics
- Basic ideas about X- Rays

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course ,students will be able to	Cognitive Level
CO 1	Understand the basic working principles of various NDT methods and importance of NDT.	K1,K2
CO 2	Identify and Demonstrate the limitations of NDT techniques and codes.	K2,K3
CO 3	Analyze and Interpret Non-destructive testing and Mechanical testing.	K4,K5
CO 4	Examine the Real time Radiography Techniques.	K4
CO 5	Test the instrumentation techniques with the aid of basic Principles.	K5

Mapping of CO with PO and PSO

Cos	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	1	1	1	1	3	3	3	2	2
CO 2	2	1	1	1	2	3	3	2	2	1
CO 3	1	1	1	1	1	3	3	3	2	2
CO 4	1	1	1	1	1	3	3	1	2	1
CO 5	1	2	1	1	2	3	1	3	1	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation
"3" – Substantial (High) Correlation "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	CONGNITIVE LEVEL
I	**Overview of NDT:** NDT Versus Mechanical testing - Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects- Merits and limitations -Visual inspection - Unaided and aided - Visual Examination- Optical aids used for visual inspection-Applications.	18	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6
II	**Surface NDE Methods:** Liquid Penetrant Testing- Basic principles – Procedure for penetrant testing - Penetrant testing materials - Testing methods - Applications and limitations - Magnetic Particle Testing Principle- Magnetizing techniques- Procedure-Equipment used for MPT- Limitations-Eddy Current Testing principles- Applications –Limitations.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**Radiography:** Radiography Basic principle -X ray source - production of X rays – High energy X ray source- Properties of X rays and gamma rays- radiographic imaging -Inspection techniques - Applications - Limitations - Safety in radiography.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**Ultrasonic Testing:** Ultrasonic Testing - Ultrasonic transducers-Inspection methods- Techniques for normal beam inspection - Techniques for angle beam inspection - Flaw characterization techniques - detection equipment - Modes of display- Immersion testing- Applications - Advantages-Limitations.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Acoustic Emission:** Testing Principles of Acoustic Emission Testing - Techniques- Applications - Thermography: Contact and non-contact inspection methods – Heat sensitive paints and other coatings – Heat sensitive papers – Advantages and limitations – Instrumentations and methods – Applications.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self Study for Enrichment (Not included for End Semester Examination)** Basic properties of sound - Difference between Testing and Non Destructive Testing -Different types of Non Destructive Testing methods- Liquid Penetrant Testing and its application - Radio activity testing in Industries- Fundamentals of X-Rays.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Dr.BaldevRaj, T.Jayakumar and M.Thavasimuthu.,(2018).*Practical Non- Destructive Testing*., Narosa Publications, New Delhi.3 rd Edition
2. Ravi Prakash.(2010). *Non-Destructive Testing Techniques.,* New AgeInternational Publishers.1 st Revised Edition

Reference Books

1. BarryHull&Vernun John.,(1988).Non Destructive Testing.Springer.
2. Hull B., (2012). Non-destructive Testing., Springer Verlag., Springer Verlag.1 st Edition
3. Charles,J. Hellier.,(2013). Handbook of Nondestructive evaluation.,McGrawHill, New York.2 nd Edition.
4. Aquil Ahmad Leonard J. Bond.,(1989) Non Destructive Examination and Quality Control, Metals Handbook.,American Metals Society,MetalsPark,OH.Vol.17 9th Edition.

Pedagogy

Chalk and Talk, Seminar, Assignment, Power Point Presentation, Group discussion and Quiz

Course Designer

Dr.T.Noorunnisha

SEMESTER-I	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS / WEEK	CREDITS
22PPH1DSE1C	ASTROPHYSICS	DSE-I	6	3

Course Objectives

- To study the positional astronomy such as measurement of distances, and angular positions of celestial objects
- To identify the physical principles involved in stellar processes
- To study the types of galaxies, dynamics of stars in a galaxy and its implication for dark matter.
- To understand the physics of the formation of white dwarfs and neutron stars
- To study the expansion of the universe and evolution of temperature in the Universe

Pre-requisites

- A thorough knowledge in Mechanics and Relativity
- Basic Knowledge in Calculus
- A basic insight in Electromagnetism

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO 1	Recall & interpret the basic concepts of Astrophysics	K1,K2
CO 2	Relate and identify the principles of physics in the study of astronomical objects	K2,K3
CO 3	Analyse the celestial objects in the universe	K4
CO 4	Classify and explain the stars, galaxies and stellar evolution	K4,K5
CO 5	Discuss the knowledge of the physical universe and its evolution	K6

Mapping of CO with PO and PSO

Cos	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO1	3	3	3	1	3	3	3	3	2	3
CO2	3	2	3	1	3	3	3	3	2	3
CO3	3	3	3	1	3	3	2	2	1	2
CO4	3	3	3	1	3	3	3	2	1	2
CO5	3	3	3	1	3	2	3	2	1	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation
3" – Substantial (High) Correlation "-" – Indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Distance measurements** Historical measurement of the Radius of the Earth Distance to Moon and Sun –Parallax method to measure the distance to nearby stars – Distance to inner planets – Cepheid Variables and distance to nearby Galaxies. Angular coordinates to describe angular positions on the Celestial Sphere – RA and Declination	**18**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**Stellar structure** Virial Theorem –application of virial theorem to stellar systems – Formation of stars – Hertzsprung Russell Diagram – main sequence – Mass – Luminosity – Temperature relations of stars in Main Sequence – Post main sequence evolution of stars	**18**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**Compact Objects** Formation of White dwarf and neutron stars – Mass estimation of relativistic and non-relativistic white dwarf – Chandrasekhar Mass limit – Mass of Neutron stars – Binary stars in a co rotating frame –Lagrange points – Qualitative aspects of mass transfer and accretion disk formation.	**18**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**Galaxies** Types of Galaxies – Hubble's tuning fork diagram – dynamics of stars in galaxies – rotation curve in spiral galaxies – velocity distribution of stars in Elliptical Galaxies– Problems on density profile calculation using different rotation curves.	**18**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Basic Cosmology** Newtonian derivation for the expansion of the Universe – Hubble's law –Radiation and matter in Cosmology – evolution of radiation Temperature in the Universe – Basics of Cosmic Microwave Background Radiation	**18**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self-Study for Enrichment** **(Not included for End Semester Examinations)** Concept of Zenith – Nadir– Star clusters- types of binaries – the Discovery of Dark Matter– the importance of 21 cm radiation.	**-**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Book

1. Frank H. Shu. (1982). *The physical universe –An introduction to astronomy*. University Science books.1st Edition.

2. V. B. Bhatia. (2001). *A Textbook of Astronomy and Astrophysics with Elements of Cosmology*. Narosa Publishing House. Revised Edition.

3. K.D.Abhyankar. (1999). *Astrophysics: Stars and Galaxies.* Universities Press.1st Edition.

Reference Books

1. S.L. Shapiro, S. A. Teukolsky.(1983). *Black holes, white dwarfs and neutron stars.* John Wiley.1st Edition.

2. S.Chandrasekhar.(2003).*An introduction to the study of stellar structure*. Dover publications.1st Edition.

Web References

1. https://www.coursera.org/courses?query=astrophysics
2. https://onlinecourses.swayam2.ac.in/arp19_ap73/preview

Pedagogy

Chalk and Talk, Seminar, Assignment, Power point Presentation

Course Designers

1. Ms. J. Aarthi
2. Dr. B. Anitha

SEMESTER -II	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS / WEEK**	**CREDITS**
22PPH2CC4	**ELECTROMAGNETIC THEORY**	**CC-IV**	**6**	**5**

Course Objectives

- To learn the theory for the field produced by stationary and moving charges.
- To study the charged systems and propagation of electromagnetic fields.
- To learn the basics of electromagnetic theory in electromagnetic waves
- To get knowledge about different geometrics of wave guides

Pre-requisites

- Strong foundation of basic Laws of Electromagnetic theory
- Commendable Knowledge of Electrostatic and Magnetostatic Boundary conditions
- Grasping Power in the concepts Field equations, conservation laws and Gauge transformations

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO 1	Remember and Understand the fundamentals of Electrostatics, Magneto statics and Electromagnetic waves.	K1,K2
CO 2	Analyze the concept of Electrodynamic fields and electromagnetic theory in Electrostatics	K3
CO 3	Evaluate the magnetic and electric field using various laws of magnetostatics and electrostatics.	K4
CO 4	Apply the transverse behavior of electromagnetic field equations for different propagating media and boundary value problems in electro-magneto statics	K5
CO 5	Create ability to evaluate electromagnetic wave equations and to solve problems in electro-magneto statics	K6

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	2	3	3	2	2	2
CO 2	3	3	2	2	2	3	1	2	2	1
CO 3	2	3	3	2	2	3	3	1	2	2
CO 4	3	3	2	2	2	1	2	2	2	2
CO 5	3	2	2	2	1	3	3	2	3	1

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation,

"3" – Substantial (High) Correlation "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**ELECTROSTATICS** Coulomb's law – The electric field – Continuous charge distributions- Field lines, Flux and Gauss's law and its application - Field due to an infinite, straight, uniformly charged wire – Multipole expansion of a charge distribution- The Divergence of E – The curl of E – Electric potential - Poisson's and Laplace Equation - Potential of a localized charge distribution –Uniqueness theorems.	**18**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**BOUNDARY VALUE PROBLEMS IN ELECTROSTATICS** Boundary conditions – Potential at a point between the plates of a spherical capacitor –Potential at a point due to uniformly charged disc – Method of image charges –Point charge in the presence of a grounded conducting sphere-Point charge in the presence of a charged, insulated conducting sphere -Conducting sphere in a uniform electric field –Laplace equation in rectangular coordinates.	**18**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**MAGNETOSTATICS** The Lorentz Force Law – The Biot- Savart Law – The magnetic field of steady current - The Divergence and Curl of B – Applications of Ampere's Law – Magnetic scalar and vector potentials– Magnetic dipole in a uniform field– Magnetization current- Magnetic intensity–Magnetic susceptibility and permeability	**18**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**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.	**18**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**ELECTROMAGNETIC WAVES AND WAVE PROPAGATION** Electromagnetic waves in frees pace –Propagation of electromagnetic waves in isotropic dielectrics and in anisotropic dielectrics–Reflection and refraction of electromagnetic waves: Kinematic and dynamic properties – TM and TE modes–Propagation in rectangular waveguides– Cavityresonator.	**18**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**SELF STUDY FOR ENRICHMENT:** **(Not to be included for External Examination)** Electrostatic Boundary conditions-boundary value problems on spherical symmetry-Method of images -Magnetic potential from uniform surface current - of a long solenoid-Potential formulation-Energy and momentum in EM waves	**-**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Jackson.J.D. (1999), *Classical Electrodynamics*, 3rd edition John-Wiley, New York
2. Chopra.K.K and. Agarwal.G.C, (1999), *Electromagnetic Theory* 3rdedition K.Nath & Co.,Meerut
3. Jordan . E.C. and K.G.Balmain,(2015), *Electromagnetic Waves and Radiating Systems*, 3rd edition New Delhi.

Reference Books

1. Griffiths. D.J.(2014) Introduction *to Electrodynamics* 4th edition. Pearson, Essex,
2. Chow. T.L.(2012)*Electromagnetic Theory* 4th edition. Jones and Bartlett Learning.

Web References

1. https://bbsbec.edu.in/wp-content/uploads/2020/01/Question-Bank2.pdf
2. https://studentsfocus.com/ee8391-et-question-papers-electromagnetic-theory-previous-year-question-papers- eee-3rd-sem/
3. https://learnengineering.in/ee8391-electromagnetic-theory/

Pedagogy

Chalk and Talk, Lecture, Seminar, Assignment and Power Point Presentation

Course Designer

Dr.K.KANNAGI

SEMESTER -II	INTERNAL MARKS : 25	EXTERNAL MARKS : 75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22PPH2CC5	**QUANTUM MECHANICS – II**	**CC-V**	**6**	**5**

Course Objectives

- To demonstrate the use of Schrodinger wave equation through some simple one-dimensional problems and their solutions.
- To familiarize the students to the new mathematical tools such as operators and linear vector space required for venturing into the realm of quantum mechanics and to introduce Schrodinger wave equation.
- To analytically and algebraically treat the orbital angular momentum problem, to bring out its quantum nature and to port it to have a theory of spin angular momentum.
- To generalize the one-dimensional problems to three dimensional ones to broaden the horizon of the students leading to the understanding of the concept of degeneracy.
- To solve hydrogen atom problem to explain atomic spectrum.

Pre - requisites

- A thorough understanding of mechanics.
- Knowledge of partial differential equation and variable separable method.
- Commendable knowledge of integral and differential calculus.

Course Outcomes and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the Course, the Student will be able to	Cognitive Level
CO 1	Remember and Understand the perturbation theory to formulate problems for proper understanding of Physics	K1,K2
CO 2	Analyze the advanced techniques in Physics to gain insights towards quantum mechanics	K3
CO 3	Evaluate and ascertain the mathematical concepts behind fundamentals of quantum mechanics.	K4
CO 4	Apply the development of mathematical skills and problem solving in perturbation theory	K5
CO 5	Create the critical thinking over the relativistic quantum physics	K6

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	3	3	3	2	2	3
CO 2	3	2	2	2	2	2	1	2	3	2
CO 3	2	3	3	2	3	3	3	1	2	3
CO 4	2	3	2	2	2	1	2	2	2	2
CO 5	3	2	2	2	1	3	3	2	3	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**TIME-INDEPENDENT PERTURBATION THEORY I** Perturbation theory for discrete levels: Equation in various orders-Non-degenerate levels - degenerate levels: Removal of Degeneracy - Stark effect: Ground state of Hydrogen atom - First excited state of Hydrogen atom – Spin orbit interaction - Two electron atoms	**17**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**TIME-INDEPENDENT PERTURBATION THEORY II** Variational method: Upper bound on ground state energy - Application to excited states -Ground state of a two electron atom - Hydrogen molecule - Exchange Interaction - WKB approximation: One dimensional Schrödinger equation with asymptotic solution-Solution near a turning point-Bohr-Sommerfeld Quantum Condition - WKB solution of the radial wave equation	**17**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**TIME-DEPENDENT PERTURBATION THEORY** Perturbative solution for transition amplitude - Selection rule - First order and second transitions: Constant perturbation - Fermi's golden rule - Scattering of a particle by a potential - Inelastic Scattering: Exchange Effects - Harmonic perturbations: Amplitude for transition with change of energy - Transition induced by incoherent spectrum of perturbing frequencies - The Dipole Approximation: Selection Rules- The Einstein Coefficients: Spontaneous Emission	**17**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**SCATTERING THEORY** The Born approximation - Validity of Born approximation - Born Series- Eikonal approximation- Partial wave analysis: Asymptotic behaviour of partial waves - Scattering amplitude in terms of phase shifts - Optical theorem - Exactly Soluble Problems :Scattering by a square well potential- Scattering by coluomb potential -Scattering by a hard sphere-Mutual Scattering Of Two Particles: Reduction of the Two - Body Problem-Transformation from Centre of Mass to Laboratory Frame of Reference-Collisions between Identical Particles.	**22**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

V	**RELATIVISTIC QUANTUM MECHANICS** Generalization of the Schrodinger equation-Hydrogen like atom-The Klein - Gordan equation: Plane Wave Solutions; Charge and Current Densities –Non relativistic Limit - Dirac Equation: Dirac's Relativistic Hamiltonian-Position Probability Density; Expectation Values - Dirac's matrices -Plane Wave Solutions of the Dirac Equation - Spin of the Dirac particle .	**17**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V1	**SELF STUDY FOR ENRICHMENT:** **(Not to be included for External Examination)** Differential and total cross section-Scattering amplitude - Scattering amplitude in terms of Green's functions- Significance of Negative Energy State - Spin Orbit Energy	**-**	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Mathews.P. M. and Venkatesan K, (1987), *A Text Book of Quantum Mechanics*, Second edition Tata
2. McGraw Hill, New Delhi.
3. Aruldhas G, (2009), *Quantum Mechanics*, Second edition , Prentice Hall of India. Ghatak A & Lokanathan S, (1987), *A Text Book of Quantum Mechanics*, Tata McGraw Hill, New
4. Delhi
5. Eugen Merzbacher, (1998), *Quantum Mechanics,* Third edition, John Wiley & Son, Inc, Newyork

Reference Books

1. Devanathan V, (2006), *Quantum Mechanics,* Narosa Publishing House, New Delhi,
2. Schiff L , (2014), *Quantum Mechanics,* 4th edition, Tata McGraw Hill, New Delhi,
3. Shankar R, (2007), *Principles of Quantum Mechanics*, 2nd edition, Springer, New Delhi.
4. Thankappan V.K, *Quantum Mechanics,* 2nd Edition Wiley Eastern Ltd, New Delhi.

WebReferences

1. https://www.britannica.com/science/quantum-mechanics-physics
2. https://plato.stanford.edu/entries/qm/
3. https://www.newscientist.com/definition/quantum-mechanics/

Pedagogy

Chalk and talk , Lecture, Seminar, Assignment and Power Point Presentation

Course Designer

Dr.R.MEENAKSHI

SEMESTER -II	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS / WEEK**	**CREDITS**
22PPH2CCC1A	**ELECTRONICS**	**CCC- I**	**6**	**4**

Course Objective

- To Provide the working of advanced semiconductor devices and digital circuits
- To Understand the utility of OP-AMP
- To learn the basics of integrated circuit fabrication, applications of timer IC-555
- To get knowledge about building block of digital systems.
- To enhance problem solving skills and to promote the ability to apply digital circuits

Pre-requisites

- A Thorough Knowledge of Semiconducting Devices
- Strong Insight in IC Fabrication Technique
- Grasping Power in the concepts OP-AMP

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO 1	Remember and Understand the concepts of semiconductor devices	K1,K2
CO 2	Analyze the working function of Semiconductor and ICs	K3
CO 3	Evaluate the basic concepts of Sensor ,Transducers, operational amplifier , oscillator circuits and IC	K4
CO 4	Apply the Principles and Concepts of Sensor ,Transducers and Semiconductor devices in digital and analog circuits.	K5
CO 5	Recommend projects in electronics relevant to industrial and R &D needs	K6

Mapping of CO with PO and PSO

Cos	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	1	3	3	2	2	2
CO 2	3	3	2	2	2	3	1	2	2	2
CO 3	2	3	3	2	2	3	3	1	2	2
CO 4	3	3	2	2	2	1	2	2	2	2
CO 5	3	2	2	2	1	3	3	2	3	1

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation,

"3" – Substantial (High) Correlation "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**SPECIAL DEVICES, SENSORS AND TRANSDUCER** Device construction and characteristics of Schottky Diode, Step Recovery Diode, MOSFET, UJT, SCR - Optoelectronic devices: Light Emitting Diode (LED), LASER Diode, Photo Multiplier Tube – Sensors: Photoconductive Cell, Photo Voltaic Cell - Transducers: Electromagnetic Flow meter, Linear Variable Differential Transformer (LVDT), Strain Gauge, Resistance Temperature Detectors.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**OPERATIONAL AMPLIFIER** Characteristics of an Op – amp -inverting and non-inverting amplifier–adder,subtractor,differentiator–integrator– Active filters: low pass – high pass filters – voltage comparator – Wave form generators: Phase shift and Wein's Bridge Oscillator - Schmitt trigger– Design of Binary weighted and R- 2R ladder method - D/A converter – A/D converter, Counter Method, Solving Simultaneous equation.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**IC FABRICATION AND IC 555 TIMER** Basic monolithic ICs – epitaxial growth, masking, and etching – Diffusion of impurities – monolithic transistors – integrated diodes – resistors and inductors –monolithic circuit layout – metal semiconductor contact. IC 555 Timer – Functional diagram of 555 timer – Astable multivibrator – Monostable multivibrator – Voltage Controlled Oscillator (VCO).	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**COMBINATIONAL AND ARITHMETIC LOGIC CIRCUIT** Combinational logic circuit design – Karnaugh map method – Quine Mc Cluskey's tabular method– decoders: 1 of 16 Decoder –BCD to seven segments decoder - totalizing counter- Encoder: 8input priority encoder - 16 line to 1 line multiplexer – Demultiplexer: 1to 16 Demultiplexer controlled inverter - half adder/ subtractor – Arithmetic logic unit – 2's complement, adder, subtractor, one digit BCD adder and subtractor using IC7483- Serial and parallel adder units.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**SYNCHRONOUS COUNTERS AND MEMORY DEVICES** Universal synchronous counter stage–counter functions–module N counter using IC74193–design of synchronous counters– ring counter –Johnson counter – Memory classification –ROM –Memory organization -PROM- EPROM- RAM- Block Diagram of Static RAM-Serial and Parallel Expansion of RAM – memory–DRAM- Basic DRAM memory cell-Magnetic disk memory: Charge Coupled device-Magnetic bubble memory.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

VI	**SELF STUDY FOR ENRICHMENT:** (Not to be included for External Examination) Gunn Diode- IMPATT Diode-Successive Approximation method-Fabrication Process-Concepts of combinational Logic circuit-PAL and PLA	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Virendra Kumar (2003) *Digital Technology Principles* and Practice New Age International Prentice Hall New Jersey.
2. Albert Paul , Melvino (1982) *Electronic Principles* Tata MC Graw– Hill publishing company Limited, New Delhi.
3. Malcolm Goodge, (2010) *Semiconductor device Technology*, TATA McGraw Hill publications, New Delhi.
4. Millmanand Halkias(1983), *Integrated Electronics*, TATA McGraw Hill publications, New Delh,.
5. AllenMottershed, (1982)*Semiconductor devices and applications*, New Age International publishers.

Reference Books

1. Chattopadhyay. D and Rakshit P.C, (2010),*Electronics Fundamentals and Applications*, New age international Publications, New Delhi.
2. Gayakwad *R*.A, (1999) *Op. amps & linear integrated circuits*, Prentice HallIndiaPvt.Ltd.
3. Salivahanan S, Suresh Kumar N,(2011)*Electronic devices and Circuits*, Tata McGraw Hill.
4. L.Floyd, *Electronic Devices*, (2006) Pearson Education New York.
5. Theraja B.L, (2012) *Basic electronics*, S.Chand.

Web References

1. http://www.analog.com/en/education/education-library/tutorials/ analog- electronics.html
2. https://www.tutorialspoint.com/digital_electronics/index.asp

Pedagogy

Chalk and Talk, Seminar, Assignment, Power point Presentation, Group discussion and Quiz

Course Designer

Dr.K.KANNAGI

SEMESTER-II	INTERNAL MARKS: 25	EXTERNAL MARKS: 75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22PPH2CCC1B	**NONLINEAR DYNAMICS**	**CCC-I**	**6**	**4**

Course Objectives

- To provide an introduction to discrete and continuous nonlinear dynamical systems
- To analyze an advanced level learning of Nonlinear Dynamics, Chaos and applications.
- To understand the concepts of integrable dynamical systems and solitons.
- To understand the concepts on the linear stability analysis

Pre-requisites

- Basic understanding of non-linear differential equations.
- Concepts of solitons.
- Understanding the basic needs of controlling chaos.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the Course, the Student will be able to	Cognitive Level
CO 1	Understanding the concepts on the linear stability analysis	K2
CO 2	Explain the basic bifurcations with suitable examples.	K2
CO 3	Illustrate the various characterizing tools such as power spectrum and Lyapunov exponents.	K3
CO 4	Identify numerical experiment of Fermi, Pasta and Ulam and its outcome.	K4
CO 5	Analyze linear and nonlinear systems and appreciate the concept of nonlinearity	K5,K6

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	3	3	3	3	3	3	2	2	3
CO 2	2	3	3	3	3	3	3	2	2	3
CO 3	2	3	3	3	3	3	3	2	3	3
CO 4	2	3	3	2	3	3	2	2	2	3
CO 5	2	3	3	2	3	3	2	2	2	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**NON-LINEAR DYNAMICS** Dynamical systems–linear and nonlinear forces–mathematical implications of nonlinearity–working definitions and effects of nonlinearity –damped and driven nonlinear oscillators– autonomous and non-autonomous systems – dynamical systems as coupled first – order differential equations: equilibrium points – phase space/phase plane and phase trajectories – stability – attractors and repellers – classification of equilibrium – points – limit cycle motion – periodic attractor.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**BIFURCATIONS AND CHAOS** Bifurcation theory–Local and global bifurcations - Three dimensional autonomous systems and chaos, Lyapunov exponents –Torus–quasi-periodic attractor – Poincaré map – Period doubling cascades–Feigenbaum number–characterization–Homoclinic orbits, heteroclinic orbits–Strange attractor and strange non-chaotic attractor.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**DISCRETE DYNAMICS SYSTEMS, SYNCHRONIZATION AND CONTROLLING OF CHAOS** Linear and nonlinear discrete dynamics systems – complex iterated maps–Logistic map–Linear stability–Period doubling phenomena and chaos–Lyapunov exponents–Chaos synchronization– Synchronization manifold and stability properties – Controlling of Chaos –applications.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**FRACTALS, CELLULAR AUTOMATA AND PATTERN FORMATION** Dimension of regular and chaotic attractors – Fractals – Koch curve Cantor set – Sierpinskiset–Julia and Mandelbrot sets–Cellular automata–Self organized criticality–Stochastic resonance–pattern formation–Time series analysis	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**INTEGRABLE SYSTEMS AND SOLITONS** Finite dimensional integrable systems - Linear and nonlinear dispersive systems – Cnoidal and solitary waves - The Scott Russel phenomenon and derivation of Korteweg- de Vries (KdV)equation–Fermi–Pasta–Ulam(FPU)numerical problem–FPU recurrence phenomenon – Numerical experiments of Zabusky and Kruskal – Explicit soliton solutions :one- ,two- and N-soliton solutions of KdVequation– Hirota's bilinear method.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**SELF STUDY FOR ENRICHMENT** **(Not to be included for External Examination)** Simple bifurcations- Chaos-Dynamics systems-Exercise and Problems.		CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Lakshmanan M & Rajasekar S., (2003*). Nonlinear Dynamics: Integrability, Chaos & Pattern*, New Delhi: Springer (India) Pvt. ltd. Print.
2. Wolfram. S. (2002), *A New Kind of Science*, Wolfram Media Inc.,
3. Schuster H.G., (2005), *Deterministic Chaos : An Introduction*, Wiley-VCH

Reference Books

1. Lakshmanan M, and Murali K, (1996), *Choas in Nonlinear Oscillators*, World Scientific, Singapore.
2. Fuchs A, (2013) *Nonlinear Dynamics in Complex Systems: Theory and Applications for the Life, Neuro- and Natural Sciences*, Springer.
3. Strogatz, S.H. (2014), *Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering*, 2nd Edition CRC Press.
4. Misbah. C,(2017) *Complex Dynamics and Morphogenesis: An Introduction to Nonlinear Science*, Springer.
5. Robert C. Hilborn. (2004). *Chaos and Nonlinear Dynamics*, 2nd Edition, India: Oxford University press. Print.

Web References

1. https://onlinecourses.nptel.ac.in/noc19_cy33/preview
2. https://www.youtube.com/watch?v=A9x2hmSmVjs

Pedagogy

Chalk and Talk, Power Point Presentation, Seminar, Quiz, Assignment and Group discussion.

Course Designer

Dr. R. MEKALA

SEMESTER -II	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS / WEEK	CREDITS
22PPH2CCC1C	SPECTROSCOPY	CCC - I	6	4

Course Objectives

- To understand the vibrational and rotational spectroscopic principles.
- To know the fundamentals of FTIR, NMR techniques.
- To use spectroscopic instruments like FTIR for analyzing the samples.
- To understand the theory of electronic spectroscopy and ESR instrumentation.
- To procure knowledge on advanced level spectroscopic techniques.

Pre-requisites

- Fundamental knowledge on electromagnetic radiation.
- Basic ideas in molecular spectra.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO 1	Understand and explain the fundamental concepts and applications of microwave, IR, Raman and other spectroscopic methods.	K1,K2
CO 2	Make use of electronic spectroscopy for chemical analysis.	K3
CO 3	Analyze the NMR and FTIR spectra of various samples and identify their chemical structure.	K4
CO 4	Choose suitable spectroscopic technique and examine the chemical composition of a material.	K5
CO 5	Apply the knowledge acquired and use spectroscopic instruments to examine and develop new materials.	K6

Mapping of CO with PO and PSO

Cos	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	1	1	3	3	2	2	2	2
CO 2	3	2	1	1	3	3	3	2	2	3
CO 3	3	2	1	1	3	3	3	2	2	3
CO 4	3	2	1	1	3	3	3	3	2	3
CO 5	3	2	1	1	3	3	3	3	2	3

"1" – Slight (Low) Correlation; "2" – Moderate (Medium) Correlation;

"3" – Substantial (High) Correlation; "4" – Indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**MICROWAVE SPECTROSCOPY:** Rotation of molecules-Rotational spectra - Rigid and non-rigid diatomic rotator-Intensities of spectral lines- Effect of Isotopic substitution-Polyatomic molecules (Linear, symmetric top and asymmetric top)-Chemical analysis by microwave spectroscopy- Techniques and instrumentation- microwave oven.	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**INFRARED SPECTROSCOPY:** Vibration of Diatomic molecules-Simple Harmonic Oscillator-Anharmonic oscillator-Diatomic vibrating rotator- The vibration-rotation spectrum-Interactions of rotations and vibrations-The vibrations of polyatomic molecules-Influence of rotation on the Vibrational spectra of linear and symmetric top molecules-Analysis by infrared techniques-Instrumentation-FTIR spectroscopy.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**RAMAN SPECTROSCOPY:** Classical and quantum mechanical picture of Raman effect - Polarizability-Pure rotational Raman spectra- Vibrational Raman Spectra-Raman activity of vibrations of CO_2 and H_2O-Rule of mutual exclusion-Overtone and combination vibrations-Rotational fine structure -Vibrations of spherical top molecule-structure determination from Raman and IR spectroscopy-techniques and instrumentation-FT Raman spectroscopy - Surfaces for SERS study-SERS microbes Surface selection rules.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**ELECTRONIC SPECTROSCOPY:** Electronic spectra of diatomic molecule - Frank-Condon principle-Dissociation energy and dissociation products - Rotational fine structure- Fortrat diagram- Predissociation-Shapes of some molecular orbits- Chemical analysis by electronic spectroscopy-Techniques and instrumentation- ESR spectroscopy-Introduction- Techniques and instrumentation.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**NUCLEAR SPECTROSCOPY:** Nuclear magnetic resonance spectroscopy-Introduction-Interaction of spin and magnetic field- population of energy levels-Larmor precession-Relaxation time-Double resonance-Chemical shift and its measurement- Coupling constant-Coupling between several nuclei- Quadrupole effects C^{13} NMR spectroscopy- Interpretation of simple spectrum - Mossbauer spectroscopy:Principle-instrumentation - Applications of Mossbauer spectroscopy: Chemical shift effect of electric and magnetic fields.	20	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

VI	**SELF-STUDY FOR ENRICHMENT:** **(Not to be included for External Examination)** Principle of atomic absorption spectra - Applications of atomic absorption spectra - Application of FTIR Spectroscopy - Introduction to UV spectroscopy - Types of transition in Organic molecules - Atomic emission Spectroscopy – Difference between atomic absorption spectra and atomic emission spectra.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Banwell C.N and Mc Cash E.M, (1994), *Fundamentals of Molecular Spectroscopy*, 4thEdition, Tata Mc Graw-Hill, New Delhi.
2. Aruldhas G, (2001), *Molecular structure and spectroscopy*, Prentice Hall of India Pvt. Ltd., New Delhi
3. Sindhu P.S, (1990), *Molecular Spectroscopy*, 1st Edition, Tata McGraw-Hill, New Delhi.
4. D.N.Sathyanarayana, (2004), *Vibrational Spectroscopy*,1st Edition, New age International Publishers, Tamilnadu.

Reference Books

1. King G.W, (1964), *Spectroscopy and molecular structure*, 1st Edition, Holt Rinehart and Winston Inc, London
2. Kaur H, (2009), *Spectroscopy*, 5th Edition, A Pragati Prakashan, Uttarpradesh, India.
3. Raymond Chang, (1980), *Basic Principles of Spectroscopy* Mc Graw-Hill, New York.
4. Engel T. (2015), *Quantum Chemistry and Spectroscopy*, 3rd Edition, Pearson, New York.
5. Carlson T. (2013), *Photoelectron and auger Spectroscopy*. Springer.

Web References

1. JLExp13.pdf (mit.edu)
2. https://nptel.ac.in/courses/115101003
3. B-2 Mossbauer Spectroscopy - Physics 191r (harvard.edu)

Pedagogy

Chalk and Talk, Seminar, Assignment, Power point Presentation, Group discussion and Quiz

Course Designer

Ms. D.DEVI

SEMESTER -II	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS / WEEK**	**CREDITS**
22PPH2CC2P	**MICROPROCESSOR AND PYTHON PROGRAMMING(P)**	**CP-II**	**6**	**5**

Course Objective

- To understand the fundamental Formulation of Numerical Problems of various methods.
- To solve Numerical problems and their applications
- To develop the programming skills of Microprocessor and Python programming
- To Design the Numerical Programmes in Python Language.

Pre-requisites

- Basic ideas in doing experiments in Programmed and formula skills.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the Course, the student will be able to	Cognitive Level
CO 1	Understand the basic operations of 8085	K2
CO 2	Apply the knowledge about the code conversions of 8085	K3
CO 3	Analyze the skills in decimal counting of 8085	K4
CO 4	Evaluate the Numerical Problems using Python programming	K5
CO 5	Develop skills in Python Programming.	K6

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	2	2	3	2	1	1
CO 2	2	3	3	3	2	3	2	3	2	2
CO 3	3	3	2	3	3	2	3	3	2	1
CO 4	3	2	3	3	2	3	3	2	3	2
CO 5	3	2	2	2	2	3	3	2	1	1

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation,

"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

Syllabus

LIST OF EXPERIMENTS (ANY 15)

A. Microprocessor (8085)

1. Finding the largest and smallest numbers in a data array
2. Arranging a set of numbers in ascending and descending orders
3. Study of multibyte decimal addition
4. Study of multibyte decimal subtraction
5. Study of seven segment display
6. Study of ADC interfacing (ADC 0809)
7. Traffic control system
8. Digital clock
9. Generation of square and sine waves using DAC 0800

B. Python Programming

1. Least-squares curve fitting– Straight-line fit
2. Least-squares curve fitting– Exponential fit
3. Real roots of one-dimensional nonlinear equations-Newton Raphson method
4. Numerical integration – Composite trapezoidal rule
5. Numerical integration – Composite Simpson's 1/3 rule
6. Solution of a second-order ODE – Euler method
7. Solution of a first-order ODE – Fourth-order Runge-Kutta method
8. Solution of a second-order ODE – Fourth-order Runge--Kutta method

Text Books

1. Ouseph C.C, Rao U.J &Vijayendran V. (2009) , *Practical Physics and Electronics*, S.Viswanathan, Printers & Publishers Pvt Ltd
2. Dr. Somasundaram S,(2012) , *Practical Physics,* Apsara Publications
3. Jeeva Jose &P.Sojan Lal, (2016) *Introduction to Computing and Problem Solving with Python*, khanna Book Publishing Co.(P).Ltd,
4. Qingai Kong, Timmy Siauw & Alexandre Bayen,(2020) ,*Python Programming and Numerical Methods: A Guide For Engineers And Scientists,* Academic Press Inc.

Reference Books

1. Department of Physics, *Practical Physics, (M.sc),* St.Joseph's College,
2. Mark Lutz, (2014), *Python Pocket Reference*, O'Reilly Media.

Web References

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/8051-Microcontroller-Lab/labs/exp2/index.php
2. www.tutorialspoint.com
3. https://pythonnumericalmethods.berkeley.edu/notebooks/chapter21.03-Trapezoid-Rule.html

Pedagogy

Demonstration and Practical sessions and viva voce

Course Designer

Dr. S.GOWRI

SEMESTER -II	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS / WEEK**	**CREDITS**
22PPH2DSE2A	**NUMERICAL METHODS AND PYTHON PROGRAMMING**	**DSE - II**	**6**	**3**

Course Objectives

- To understand the Basics Concepts and impart the knowledge about the Numerical problems and Python
- To analyse the basic concepts of Numerical Problems and Python
- To impart the knowledge about Finding the solution of Boundary value and Eigen value Problems.
- To understand the basic Formulation of Numerical Problems of various methods.
- To Design the Numerical Programmes in Python Language.

Pre-requisites

- Basic Knowledge about Python Language
- Understanding of Basic concepts of Integration, Differentiation and Interpolation

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO 1	Understand the Basics Concepts and impart the knowledge about the Numerical problems and Python	K1,K2
CO 2	Apply and Demonstrate programming proficiency of Numerical Problems using Python	K3,K4
CO 3	Explain to find the Solution of Boundary value problems and Eigen value problem, Interpolation, Differentiation and Integration	K4,K5
CO 4	Distinguish the various methods of finding the Solution of Boundary value problems and Eigen value problem, Interpolation, Differentiation and Integration	K5,K6
CO 5	Develop programming skill in Boundary value problems and Eigen value problem, Interpolation, Differentiation and Integration	K5,K6

Mapping of CO with PO and PSO

Cos	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	3	1	3	3	3	1	1	3
CO 2	3	2	3	1	3	3	3	1	1	3
CO 3	3	2	3	1	3	3	3	1	1	3
CO 4	3	2	3	1	3	3	3	1	1	3
CO 5	3	2	3	1	3	3	3	1	1	3

"1" – Slight (Low) Correlation , "2" – Moderate (Medium) Correlation ,

"3" – Substantial (High) Correlation, "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	Cos	CONGNITIVE LEVEL
I	**SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS** Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method-Solution of linear system of equations – Gauss elimination method -Pivoting – Gauss Jordan method –Iterative methods of Gauss Jacobi and Gauss Seidel-Matrix Inversion by Gauss Jordan method – Eigen values of a matrix by Power method.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**INTERPOLATION AND APPROXIMATION** Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines – Interpolation with equal intervals - Newton's forward and backward difference formulae.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Approximation of derivatives using interpolation polynomials- Numerical integration using Trapezoidal, Simpson's1/3 rule - Simpson's 3/8 rule -Taylor's series method–First order differential equation: Euler's method - Modified Euler's method – Improved Euler's method – Second Order Differential equation: Fourth order Runge - Kutta method and Euler's method.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**INTRODUCTION TO PYTHON** Operators – Data types and Operations- Numbers – Strings-List – Tuple – Set – Dictionary - Flow control – Decision Making – Loops – Nested Loops – Control Statement – Functions.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**NUMERICAL ALGORITHMS IN PYTHON** Real roots of one-dimensional nonlinear equations - Newton Raphson method - Numerical integration – Composite trapezoidal rule - Numerical integration – Simpson's 1/3 rule - Simpson's 3/8 rule – Euler methods- Solution of a first-order ODE – Runge-Kutta method - Solution of a second-order ODE – Runge - Kutta method	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**SELF STUDY FOR ENRICHMENT (Not included for End Semester Examination)** Least-squares curve fitting – Straight-line fit - Least-squares curve fitting – Exponential fit .	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Venkataraman M K, (1999), *Numerical Methods in Science and Engineering*, 5th Edition, The National Publishing Company, Madras.
2. Mathews J H, (1998), *Numerical Methods for Mathematics, Science and Engineering*, 2nd Edition, Prentice-Hall of India, New Delhi.
3. Jeeva Jose & Sojan Lal P, (2016), *Introduction to Computing and Problem Solving with Python*, khanna Book Publishing Co.(P).Ltd
4. Qingai Kong, Timmy Siauw, Alexandre Bayen, (2020), *Python Programming and Numerical Methods: A Guide For Engineers And Scientists*, Academic Press Inc.

Reference Books

1. Jain M.K, Iyengar S.R.K and Jain Muhammad R.K, (1993), *Numerical Methods for Scientific and Engineering Computation*, New Age International, New Delhi.
2. Mark Lutz (2014), *Python Pocket Reference*, O'Reilly Media.

Web References

1. https://www.youtube.com/watch?v=QqhSmdkqgjQ
2. https://www.vedantu.com/maths/numerical-analysis
3. https://www.math.hkust.edu.hk/~machas/numerical-methods.pdf

Pedagogy

Chalk and Talk, Seminar, Assignment, Power point Presentation, Group discussion and Quiz

Course Designer

Ms. S. PRIYA

SEMESTER - II	INTERNAL MARKS : 25	EXTERNAL MARKS : 75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22PPH2DSE2B	**PHYSICS OF SENSOR AND TRANSDUCER**	**DSE - II**	**6**	**3**

Course Objectives

- To acquire Basic Knowledge Sensing and transducer devices.
- To develop critical thinking and problem-solving skills.
- To acquire critical thinking and problem solving skills.
- To acquire Basic Knowledge capacitive and inductive transducers.

Pre-requisites

- Knowledge of physical parameters
- Knowledge of Sensing devices and transducers

Course Outcome and Cognitive Level Mapping:

CO Number	CO statement On the successful completion of the course, students will be able to	Cognitive level
CO 1	Remember and Understand the Primary idea in Sensor and transducers in instrumentation.	K1,K2
CO 2	Analyze the different types of sensors and Transducers.	K3
CO 3	Evaluate the working function of sensor transducers for measurement of displacement, strain, velocity, acceleration etc.	K4
CO 4	Apply the function and view for the sensor, transducer construction, classification, principle of operation and characteristics in proper applications.	K5
CO 5	Create the Critical thinking in sensing and transducer devices.	K6

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	1	3	3	2	2	2	2
CO 2	3	3	2	1	3	3	2	2	2	2
CO 3	3	3	2	1	3	3	2	2	2	2
CO 4	3	3	2	1	3	3	2	2	2	2
CO 5	3	3	2	1	3	3	2	2	2	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation,

"3" – Substantial (High) Correlation "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**SENSOR BASICS** Introduction-Mechanical-Electronic Transitions in Sensing-Nature of Sensors-Difference between sensor, transmitter and transducer-Primary measuring elements - Selection and characteristics: Range; resolution, Sensitivity, error, repeatability and linearity.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**SEMICONDUCTOR SENSOR** Introduction-Sensor Output Characteristics-Wheatstone Bridge- Piezo resistivity in Silicon-Semiconductor Sensor Definitions.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**SENSING TECHNOLOGIES** Capacitive Sensing- Piezoelectric Sensing- Hall Effect-Chemical Sensors- Improving Sensor Characteristics- Digital Output Sensors- Incremental Optical Encoders- Digital Techniques- Noise/Interference Aspects- Analysis of Sensitivity Improvement- Thin Diaphragm- Increased Diaphragm Area	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**INDUCTIVE & CAPACITIVE TRANSDUCER** **INDUCTIVE TRANSDUCERS**: - Principle of operation-construction details-characteristics and Applications of LVDT Induction potentiometer-variable reluctance transducer. **CAPACITIVE TRANSDUCERS**: - Principle of operation-construction details-characteristics of Capacitive transducers – different types & signal conditioning- Applications:-capacitor Microphone-capacitive pressure sensor.	18	CO1, CO2, CO3, CO4, CO5	K1, K2 ,K3, K4, K5, K6
V	**TRANSDUCERS FOR TEMPERATURE** Scale of temperature- Temperature transducers- Resistive temperature transducers-Thermistors- Thermoelectric transducers- Solid-state devices	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**SELFSTUDY FOR ENRICHMENT:** **(Not to be included for External Examination)** Characteristics -Static characteristics-Dynamic characteristics Chemical / biological characterization - Thermal Sensors Recent- Trends in Sensor Technologies	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books:

1. Patranabis.D, *Sensors and Transducers,* Wheeler publisher.
2. Randy Frank, (1995) *Unsderstanding Smart Sensor,* Artech House Boston,London. Second edition
3. Usher.M.J and Keating.D.A (1996), *Sensors and Transducers Characteristics, Applications, Instrumentation, Interfacing* ,Macmillan Press Ltd. Second edition
4. DVS Murthy,(2013) *Transducers and Instrumentation,* PHI 2nd Edition

Reference Books:

1. Arun K. Ghosh,(2012) *Introduction to measurements and Instrumentation,* PHI, 4th Edition.
2. Helfrick.A.D and Cooper W.D, (2001) *Modern Electronic Instrumentation& Measurement Techniques*, PHI.
3. Hermann K.P. Neubert,(2012), *Instrument Transducers,* 2nd Edition, Oxford University Press.

Web References

1. https://www.geeksforgeeks.org/difference-between-sensor-and-actuator/
2. https://www.variohm.com/news-media/technical-blog-archive/difference-between-a-sensor-and-a-transducer

Pedagogy

Lecture, Seminar, Assignment and Power Point Presentation

Course Designer

Ms.R.A.KIRUTHIKA

SEMESTER II	INTERNAL MARKS: 25	EXTERNAL MARKS: 75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22PPH2DSE2C	**MATERIAL CHARACTERIZATION AND MEASUREMENT TECHNIQUES**	**DSE-II**	**6**	**3**

Course Objectives

- To illustrate the basic knowledge of optical microscope and image formation.
- To demonstrate X-ray diffractometer and its applications.
- To analyze the concept on fluorescence.
- Examine the formation of SEM images.

Pre-requisites

- Basic understanding on structure of materials.
- Knowledge of the fundamentals of the electron microscope.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the Course, the Student will be able to	Cognitive Level
CO 1	Summarize the knowledge in basic concepts and experimental methods.	K2
CO 2	Make use of the knowledge of material characterization and measurement techniques.	K3
CO 3	Examine the instrumentation details of image formation techniques and application.	K4
CO 4	Explain structure of materials.	K5
CO 5	Discuss the latest developments in measurement techniques and to analyze the usage of materials.	K6

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	2	3	2	3	2	3	3
CO 2	3	3	3	2	3	3	3	3	3	3
CO 3	3	3	3	2	3	3	3	3	3	3
CO 4	3	3	2	2	3	3	3	2	3	3
CO 5	3	3	3	2	3	3	3	3	3	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**SCOPE OF OPTICAL METALLOGRAPHIC STUDIES:** Image formation - resolving power - numerical aperture - empty magnification - depth of focus - components of microscopes - principles of phase contrast - interference and polarized light microscopy - elements of quantitative metallography and image processing.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**X RAY DIFFRACTION AND THEIR APPLICATIONS:** X-ray - diffraction directions - diffraction methods - X-ray - diffraction intensities - factors affecting intensity - structure factor - Working principles of diffractometer - counters and cameras - Chemical analysis by X-ray diffraction and fluorescence - determination of particle size and micro/macro strains.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**STUDIES BY MOLECULAR LUMINESCENCE:** Introduction – Fluorescence and phosphorescence – Internal conversion – External conversion – Quenching – Theory – Relation between intensity of fluorescence and concentration – Calculation of results – Measurement of fluorescence – Spectrofluorometers – Advantages and limitations.	20	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**STUDIES BY ELECTRON MICROSCOPES:** Construction and working principles of transmission electron microscopes - Image formation - resolving power – magnification - depth of focus - elementary treatment of image contrasts - Bright field and dark field images- Scanning electron microscope –construction - interaction of electrons with matter - modes of operation - image formation of plane and fractured surfaces.	20	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**METALLOGRAPHIC TECHNIQUES:** Optical metallography - image analysis - X-ray fluoroscopy – spectrometry – DTA DSC and TGA - working principle – applications - Types and applications of strain gauges.	14	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**SELF STUDY FOR ENRICHMENT:** **(Not to be included for External Examination)** Moseley's law – Continuous and discontinuous spectra from electron beam sources – Factors affecting fluorescence and phosphorescence – principle and instrumentation of electron microscope.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books:

1. Michael Spencer, (1982). *Fundamentals of Light Microscopy*. Cambridge University Press, UK.
2. Joseph Goldstein, Dale E. Newbury, David C. Joy, Charles E. Lyman, Patrick Echlin, Eric Lifshin,
3. Linda Sawyer, Michael, J.R., (2003). *Scanning Electron Microscopy and X-Ray Microanalysis.* (3rd edition), Springer, US.
4. Cullity, B.D., and Stock, S.R., (2001). *Elements of X-Ray Diffraction.* (3rd edition), Prentice Hall, New York.
5. Hohne, G.W.H., Hemminger, W.F., Flammersheim, H.J., (2003), *Differential Scanning Calorimetry.* (2nd edition), Springer, US.
6. Champness, P.E., (2001). *Electron Diffraction in the Transmission Electron Microscope.* Garland Science, London.
7. Smallman, R.E., (1985). *Modern Physical Metallurgy.* (4th edition) Butterworth-Heinemann, UK. Philips, V.A., (1971), *Modern Metallographic Techniques and their Applications.* Wiley Interscience, New York.

Reference Books:

1. Sharma, B.K., (2013), *Instrumental methods of chemical analysis.* (29th edition), GOEL Publishing House, Meerut.

Web References

1. https://www.rp-photonics.com/numerical_aperture.html
2. https://physicswave.com/x-ray-diffraction-analysis-principle-instrument-and-applications/
3. https://conductscience.com/fluorescence-spectrophotometry-principles-and-applications/
4. https://www.slideshare.net/akhtarkamal94/scanning-electron-microscope-38294237
5. http://www.chem.latech.edu/~upali/chem466/TA/TA.pdf

Pedagogy

Chalk and Talk, Assignment, Group discussion and Tutorial session in the laboratory

Course Designer

Dr.N.MANOPRADHA