CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

NATIONALLY ACCREDITED (IIICYCLE) WITH "A" GRADE BY NAAC

ISO 9001:2015 Certified

TIRUCHIRAPPALLI–18

PG & RESEARCH DEPARTMENT OF PHYSICS

M.Sc., PHYSICS SYLLABUS

(2023-2024 and Onwards)

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

PG &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 post graduate 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
PEO1	**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.
PEO2	**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.
PEO3	**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 multi-disciplinary domains.
PEO4	**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.
PEO5	**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
PO1	**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.
PO2	**Scientific Skills:** Create and apply advanced techniques and tools to Solve the societal environmental issues.
PO3	**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.
PO5	**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

PSO NO.	Programme Specific Outcomes Students of M.Sc., Physics will be able to	Pos Addressed
PSO1	Demonstrate proficiency in the mathematical concepts needed for a proper understanding of Physics	**PO1, PO2, PO5**
PSO2	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**
PSO3	Learn numerous numerical problem-solving approaches and the fundamentals of curve fittings.	**PO1, PO2**
PSO4	Learn about microprocessors and microcontrollers, as well as practical microprocessor programming abilities	**PO1, PO2**
PSO5	Provide 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 OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS – LOCF)

(For the Candidates admitted from the Academic year 2023-2024 and onwards)

Semester	Course	Course Title	Course Code	Inst. Hrs. / week	Credits	Exam			Total
						Hrs.	Marks		
							Int.	Ext.	
I	Core Course -I (CC)	Mathematical Physics	23PPH1CC1	6	5	3	25	75	100
	Core Course -II (CC)	Classical Mechanics and Relativity	23PPH1CC2	6	5	3	25	75	100
	Core Course -III (CC)	Linear and Digital ICs and Applications	23PPH1CC3	6	5	3	25	75	100
	Core Practical -I (CP)	General Physics and Electronics - I(P)	23PPH1CC1P	6	5	3	40	60	100
	Discipline Specific Elective Course -I (DSE)	Physics of Nano Science and Technology	23PPH1DSE1A	6	3	3	25	75	100
		Energy Physics	23PPH1DSE1B						
		Digital Communication	23PPH1DSE1C						
	Total			**30**	**23**	-	-	-	**500**
INTERNSHIP will be carried out during the first semester holidays and the internship reportwill be evaluated and included in the second semester mark statement.									
II	Core Course -IV(CC)	Electromagnetic Theory	22PPH2CC4	6	5	3	25	75	100
	Core Course -V(CC)	Quantum Mechanics	23PPH2CC5	6	5	3	25	75	100
	Core Choice Course -I(CCC)	Microprocessor and Microcontroller	23PPH2CCC1A	6	4	3	25	75	100
		Nonlinear Dynamics	22PPH2CCC1B						
		Physics of Sensor and Transducer	23PPH2CCC1C						
	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
		Biomechanics and Biophysics	23PPH2DSE2B						
		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**

Semester -I	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PPH1CC1	**MATHEMATICAL PHYSICS**	**CC-I**	**6**	**5**

Course Objectives

- To equip students with the mathematical techniques needed for understanding theoretical treatment in different courses taught in their program
- To extend their manipulative skills to apply mathematical techniques in their field.
- To help students apply Mathematics in solving problems of Physics
- 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
CO1	Remember and understandthe various mathematical concepts used in physics.	K1,K2
CO2	Apply mathematical tools like vector, matrix, complex integration, Fourier and Laplace series, special function will prepare the student to solve ODE; PDE's which model physical phenomena.	K3
CO3	Analyse the vector, linear, simultaneous and differential equations which will be necessary to pursue other areas in physics.	K4
CO4	Evaluate the Laplace transform and the Fourier transformations of different function, grasp how these transformations can speed up analysis and correlate their importance in technology	K5
CO5	Solve the physical problems using mathematical techniques.	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	1	3	3	2	2	2
CO2	3	2	1	2	1	3	1	2	2	2
CO3	3	2	1	2	1	3	3	1	2	2
CO4	3	1	3	2	1	1	3	2	2	2
CO5	3	1	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	**LINEAR VECTOR SPACE** Basic concepts – Definitions- examples of vector space – Linear independence - Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure –linear operators – Dual space- ket and bra notation – orthogonal basis – change of basis – Isomorphism of vector space – projection operator –Eigen values and Eigen functions – Direct sum and invariant subspace – orthogonal transformations and rotation	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**COMPLEX ANALYSIS** Review of Complex Numbers -de Moiré's theorem-Functions of a Complex Variable- Differentiability -Analytic functions- Harmonic Functions- Complex Integration- Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion- Zeros and poles – Residue theorem and its Application: Potential theory - (1) Electrostatic fields and complex potentials - Parallel plates - Heat problems - Parallel plates and coaxial cylinders	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**MATRICES** Types of Matrices and their properties, Rank of a Matrix - Conjugate of a matrix - Adjoint of a matrix - Inverse of a matrix - Hermitian and Unitary Matrices -Trace of a matrix- Transformation of matrices - Characteristic equation - Eigen values and Eigen vectors - Cayley–Hamilton theorem – Diagonalization	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**FOURIER TRANSFORMS & LAPLACE TRANSFORMS** Definitions -Fourier transform and its inverse - Transform of Gaussian function and Dirac delta function -Fourier transform of derivatives - Cosine and sine transforms - Convolution theorem. Application: Diffusion equation: Flow of heat in an infinite and in a semi - infinite medium - Laplace transform and its inverse - Transforms of derivatives and integrals – Differentiation and integration of transforms - Dirac delta functions - Application - Laplace equation: Potential problem in a semi - infinite strip	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**DIFFERENTIAL EQUATIONS** Second order differential equation- Sturm-Liouville's theory - Series solution with simple examples - Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations – Legendre polynomials - Generating function - Rodrigue formula – Orthogonality properties - Dirac delta function- One dimensional Green's function and Reciprocity theorem -Sturm-Liouville's type equation in one dimension &their Green's function.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

VI	**SELF-STUDY FOR ENRICHMENT** (Not included for End Semester Examinations) CurlVector in spherical polar coordinates. - harmonic function in complex Analysis - Sylvester's theorem- Laplace transforms in RLC Circuit - Bessel and Hankel functions.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. George Arfken and Hans J Weber, (2012), Mathematical Methods for Physicists – A Comprehensive Guide (7th edition), Academic press.
2. Chattopadhyay P K, (2013), *Mathematical Physics* (2nd edition), New Age, New Delhi
3. Joshi. A.W., (2017). *Matrices and Tensors in Physics*. (4th Edition) New Age, New Delhi**.**
4. Gupta.B. D., (2015). *Mathematical Physics*. (2nd Edition) Vikas Publishing House, Mumbai.
5. DassH.K., &Rama Verma., (2018). *Mathematical Physics* (1st Edition) S. Chand& Co, New Delhi.
6. Satya Prakash (2014). *Mathematical Physics* (1st Edition) Sultan Chand & sons, New Delhi**.**
7. Balakrishnan (2018). *Mathematical Physics with Applications*. Indian Academy of Science, Bangalore.

Reference Books

1. Kreyszig E, (1983), *Advanced Engineering Mathematics*, Wiley Eastern, New Delhi,
2. ZillD G and M. R. Cullen, (2006), *Advanced Engineering Mathematics*, 3rd Ed. Narosa, New Delhi.
3. Lipschutz S, (1987), *Linear Algebra*, *Schaum's Series*, McGraw - Hill, New York

   E. Butkov, 1968, Mathematical Physics Addison - Wesley, Reading, Massachusetts.
4. P. R. Halmos, (1965), *Finite Dimensional Vector Spaces*, Affiliated East West, New Delhi.2nd Edition.
5. C. R. Wylie and L. C. Barrett (1995), *Advanced Engineering Mathematics*, International Edition, McGraw-Hill, New York, 6 th Edition.

Web References

1. https://www.khanacademy.org/
2. https://www.youtube.com/watch?v=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/

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**
23PPH1CC2	**CLASSICAL MECHANICS AND RELATIVITY**	**CC-II**	**6**	**5**

Course Objective

- To understand fundamentals of classical mechanics.
- To remember 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.

Pre-requisites

- Fundamentals of mechanics,
- Foundation in mathematical methods.

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 fundamentals of classical mechanics.	K1
CO 2	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.	K2
CO 3	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.	K3 K5
CO 4	Analyze the small oscillations in systems and determine their normal modes of oscillations.	K4, K5
CO 5	Understand and apply the principles of relativistic kinematics to the mechanical systems.	K2, K3

Mapping of CO with PO and PSO

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	2	3	3	3	2	2	2	3	2	2
CO 2	2	3	3	3	2	2	2	3	2	2
CO 3	2	3	3	3	2	2	2	3	2	2
CO 4	2	3	3	3	2	2	2	3	2	2
CO 5	2	3	3	3	2	2	2	3	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	**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.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,
II	**LAGRANGIAN FORMULATION** D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,
III	**HAMILTONIANFORMULATION** Phase space – cyclic coordinates – conjugate momentum – Hamiltonian function – Hamilton's canonical equations of motion – applications: (i) simple pendulum (ii) one dimensional simple harmonic oscillator (iii) motion of particle in a central force field.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,
IV	**SMALL OSCILLATIONS** Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,
V	**RELATIVITY** Inertial and non-inertial frames – Lorentz transformation equations – length contraction and time dilation – relativistic addition of velocities – Einstein's mass-energy relation – Minkowski's space – four vectors – position, velocity, momentum, acceleration and force in for vector notation and their transformations.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,
VI	**SELF-STUDY FOR ENRICHMENT** (Not included for End Semester Examinations) Simple Applications of the Lagrangian Formulation - Canonical Transformations – Beyond Small Oscillations- The Damped Driven Pendulum and the Josephson Junction – Hamiltonian Formulation.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,

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, *Introduction to Special Theory of Relativity*, Wiley Eastern, New Delhi.
4. R. G. Takwala and P.S. Puranik, *Introduction to Classical Mechanics* –Tata – McGraw Hill,
5. New Delhi, 1980.
6. N. C. Rana and P.S. Joag, Classical Mechanics - Tata McGraw Hill, 2001.

Reference Books

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

Web References

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

Pedagogy

Chalk and Talk, Power point presentation, Assignment, Group discussion and quiz

Course Designer

Dr. M. Kavimani

SEMESTER-I	INTERNALMARKS:25		EXTERNALMARKS:75	
COURSECODE	**COURSE TITLE**	**CATEGORY**	**HRS/ WEEK**	**CREDITS**
23PPH1CC3	**LINEAR AND DIGITAL ICs AND APPLICATIONS**	**CC-III**	**6**	**5**

Course Objective

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

Pre-requisites

- Knowledge of semiconductor devices
- Basic concepts of digital and analog electronics
- 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
CO1	Remember and understand the concepts of linear integrated circuits.	K1, K2
CO2	Analyze the linear and non-linear applications of operational amplifiers.	K3
CO3	Evaluate the basic concepts of operational amplifier, oscillator circuits and IC	K4
CO4	Apply the Principles and Concepts of waveform generation	K5
CO5	Recommend projects in electronics relevant to industrial and R &D needs	K5

Mapping of CO with PO and PSO

Cos	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO 3	PO4	PO5
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 the reisnocorrelation.**

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
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.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K5
II	**APPLICATIONS OF OP-AMP** INEAR 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 waveform generators.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K5
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	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K5
IV	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.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K5

V	**CMOS LOGIC, COMBINATIONAL CIRCUITS USING TTL 74XX ICs & SEQUENTIAL 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, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC 74138, IC 74154), BCD to 7-segment decoder (IC7447), Encoder (IC74147), Multiplexer (IC74151), Demultiplexer (IC 74154). SEQUENTIAL CIRCUITS USING TTL 74XX ICs: Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), 4- bit asynchronous binary counter (IC 7493).	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K5
VI	**SELF- STUDY FOR ENRICHMENT:** (Not to be included for External Examination) Applications of operational Amplifier: inverting, non-inverting amplifier–adder, subtractor, differentiator–integrator. Applications of Multiplexer and Demultiplexer.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K5

Text Books

1. D. Roy Choudhury, Shail B. Jain (2012), *Linear Integrated Circuit*, 4th edition, New Age
2. International Pvt. Ltd., New Delhi, India
3. Ramakant A. Gayakwad, (2012), *OP-AMP and Linear Integrated Circuits*, 4th edition, Prentice
4. Hall, Pearson Education, New Delhi.
5. B.L. Theraja and A.K. Theraja, 2004, *A Textbook of Electrical technology*, S. Chand & Co.
6. V.K. Mehta and Rohit Mehta, 2008, *Principles of Electronics*, S. Chand & Co, 12th Edition.
7. V. Vijayendran, 2008, *Introduction to Integrated electronics (Digital & Analog)*, S. Viswanathan
8. Printers & Publishers Private Ltd, Reprint. V.

Reference Books

1. Sergio Franco (1997), *Design with operational amplifiers and analog integrated circuits*,
2. Mc Graw Hill, New Delhi.
3. Gray, Meyer (1995), *Analysis and Design of Analog Integrated Circuits*, Wiley International,
4. New Delhi.
5. Malvino and Leach (2005), *Digital Principles and Applications* 5th Edition, Tata McGraw
6. Hill, New Delhi
7. Floyd, Jain (2009), *Digital Fundamentals*, 8th edition, Pearson Education, New Delhi.
8. Millman & Halkias (2000) *Integrated Electronics*, Tata McGraw Hill, 17th Reprint.

Web References

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/

Pedagogy

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

Course Designer

Dr.K.Kannagi

Semester I	Internal Marks: 40			External Marks: 60
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PPH1CC1P	**GENERAL PHYSICS AND ELECTRONICS - I (P)**	**CP-I**	**6**	**5**

Course Objectives

- To acquire knowledge of spectrometry and to find optical constants
- To understand the concept of thermal behavior of the materials.
- Explain the operation about arithmetic and combinational logic circuits using IC's
- To acquire knowledge about combinational Logic circuits and sequential logic circuits
- To analyze the various parameters related to operational amplifiers.

Pre-requisites

Fundamental knowledge and hands on experience of general and electronics experiments of Physics

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	Explain the basic concepts of experimental physics.	K2
CO 2	Understand knowledge the principles of magnetism through the experiments	K2
CO 3	Explore the concepts of spectrometry involved in the optic processes.	K3
CO 4	Verify experimentally the concepts about combinational Logic circuits	K4
CO 5	Develop the skill in handling instruments in 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	2	2	1	2	1
CO 2	1	2	2	2	2	2	2	2	2	1
CO 3	1	2	2	2	2	2	2	2	1	1
CO 4	2	2	2	2	3	2	2	2	1	1
CO 5	2	2	2	2	3	2	2	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 TEN)

1. Determination of Rydberg's constant - Hydrogen Spectrum
2. Measurement of Band gap energy- Thermistor
3. Determination of Compressibility of a liquid using Ultrasonics
4. Determination of wavelength, separation of wavelengths - Michelson Interferometer
5. Measurement of Conductivity - Four probe method.
6. Construction of relaxation oscillator using UJT
7. FET CS amplifier- Frequency response, input impedance, output impedance
8. Study of important electrical characteristics of IC741
8. Study of attenuation characteristics of Wien's bridge network and design of Wein's bridge oscillator using Op- Amp
9. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator Using Op- Amp
11. Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
12. Study of R-S, clocked R-S and D-Flip flop using NAND gates
13. Study of J-K, D and T flip flops using IC 7476/7473
14. Study of Arithmetic logic unit using IC 74181
15. Construction of Encoder and Decoder circuits using ICs.
16. Arc spectrum – Iron.

Text Book

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. S. Poornachandra *Electronic Laboratory Primer a design approach*, B. Sasikala, Wheeler Publishing, New Delhi.
4. *Electronic lab manual Vol I*, K A Navas, Rajath Publishing

Reference Book

1. Jones, B.K., (1986). *Electronics for Experimentation and Research*. Prentice-Hall.
2. Zbar, P.B., Malvino, A.P., & Miller, M.A., (1994). *Basic Electronics: A Text-Lab Manual. Tata Mc-Graw Hill*, New Delhi.
3. *Advanced Practical Physics*, S.P Singh, Pragati Prakasan.
4. *An advanced course in Practical Physics*, D. Chattopadhaya, C.R Rakshit, New Central Book Agency Pvt. Ltd
5. *Op-Amp and linear integrated circuit*, Ramakanth A Gaykwad, Eastern Economy Edition.

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**
23PPH1DSE1A	**PHYSICS OF NANOSCIENCE AND TECHNOLOGY**	**DSE-I**	**6**	**3**

Course Objectives

- To understand the material physics on the nano scale and the application aspects of nanoscience and technology
- To provide the basic knowledge about nanoscience and technology.
- To learn the structures and properties of nanomaterials.
- To acquire the knowledge about synthesis methods and characterization techniques and its applications.
- To understand the Technology with the characterization studyand applications at nanometer scale.

Pre-Requisites

- Basic knowledge in Solid State Physics.
- Physics of Nanoscience and Technology is concerned with the study, creation, manipulation and applications at nanometer scale.
- Understand the material physics on the nano scale.
- Understand the application aspects of nanoscience and technology.

Course Outcome

CO Number	CO Statement On the successful completion of the Course, the Student will be able to,	Cognitive Level
CO 1	Understand the basic of nanoscience and explore the different types of nanomaterials and should comprehend the surface effects of the nanomaterials.	K1, K2
CO 2	To learn the structures and properties of nanomaterials.	K2
CO 3	Apply the process and mechanism of synthesis and fabrication of nanomaterials.	K3
CO 4	Analyze the various characterization of Nano-products through diffraction, spectroscopic, microscopic and other techniques.	K4
CO 5	Evaluate and apply the concepts of nanoscience and technology in the field of sensors, robotics, purification of air and water and in the energy devices.	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	**FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY** Fundamentals of NANO–Historical Perspective on Nanomaterial and Nanotechnology-Classification of Nanomaterials–Metal and Semiconductor Nanomaterials-2D, 1D, 0D nanostructured materials- Quantum dots–Quantum wires –Quantum wells-Surface effects of nanomaterials.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**PROPERTIES OF NANOMATERIALS** Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant - Mechanical behavior: Elastic properties – strength - ductility - superplastic behavior - Optical properties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS).	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**SYNTHESIS AND FABRICATION** Physical vapour deposition - Chemical vapour deposition - sol-gel-Wet deposition techniques - electrochemical deposition method – Plasma arching - Electrospinning method - ball milling technique - pulsed laser deposition - Nanolithography: photolithography –Nanomanipulator.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**CHARACTERIZATION TECHNIQUES** Powder X-ray diffraction - X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**APPLICATIONS OF NANOMATERIALS** Sensors: Nano sensors based on optical and physical properties - Electrochemical sensors –Nano-biosensors. Nano Electronics: Nanobots - display screens - GMR read/write heads - Carbon Nanotube Emitters –Photocatalytic application: Air purification, water purification -Medicine: Imaging of cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: fuel cells - rechargeable batteries -supercapacitors-photovoltaics.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**SELF STUDY FOR ENRICHMENT** **(Not to be included for External Examination)** Nanomachines and Devices-Nanocomposites-Catalytic properties-Cytochemical synthesis along with suitable examples-Cyclic Voltammetry (CV)-Miscellaneous applications of nanotechnology-Dental implants, consumer products, biomimetic nanomaterials for tissue engineering, biopolymer tagging, semiconductor quantum dots.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Pradeep T, (2012), *A textbook of Nanoscience and Nanotechnology*, Tata McGraw-Hill Publishing.
2. Shah M A, Tokeer Ahmad (2010), *Principles of Nanoscience and Nanotechnology*, Narosa Publishing House Pvt Ltd.,
3. Chattopadhyay K K and Banerjee A N, (2012), *Introduction to Nanoscience and Nanotechnology*, PHI Learning Pvt. Ltd., New Delhi.
4. Hari Singh Nalwa, (2002), *Nanostructured Materials and Nanotechnology*, Academic Press.
5. Kothari D P, Velmurugan V and Rajit Ram Singh, (2018), *Nanotechnology and Nanoelectronics*, Narosa Publishing House Pvt. Ltd, New Delhi.
6. Poole C P and Ownes F J, (2003), *Introduction to Nanotechnology*, Wiley Reprint (2014).

Reference Books

1. Huozhong Gao, (2004), *Nanostructures and Nanomaterials*, Imperial College Press.
2. Richard Booker and Earl Boysen, (2005), *Nanotechnology*, Wiley Publishing Inc. USA
3. Fendler John Wiley and Sons. J H, (2007), *Nano particles and Nano structured films*; Preparation, Characterization and Applications.
4. Murty B S, et al., (2012), *Textbook of Nanoscience and Nanotechnology*, Universities Press.
5. Dr. Parag Diwan and Ashish Bharadwaj, (2005), *The Nanoscope*, Vol. IV-Nanoelectronics Pentagon Press, New Delhi.

Web References

1. www.its.caltec.edu/feyman/plenty.html
2. http://www.library.ualberta.ca/subject/nanoscience/guide/index.cfm
3. http://www.understandingnano.com
4. http://www.nano.gov
5. http://www.nanotechnology.com

Pedagogy

Chalk and Talk, Seminars on Industrial Interactions, Power Point Presentation, Quiz, Assignment and Group discussion.

Course Designer

Dr. R. Mekala

SEMESTER- I	INTERNAL MARKS: 25			EXTERNAL MARKS: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PPH1DSE1B	**ENERGY PHYSICS**	**DSE-1B**	**6**	**3**

Course Objectives

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

Pre-requisites

- Knowledge of conventional energy resources.
- Basics of Tidal Energy and Bio gas Energy.
- Understandings of Wind Energy.
- Basic Idea on Solar Energy.

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	To identify various forms of renewable and non-renewable energy sources	**K1**
CO 2	Understand the principle of utilizing the oceanic energy and apply it for practical applications.	**K2**
CO 3	Discuss the working of a windmill and analyze the advantages of wind energy.	**K3**
CO 4	Distinguish aerobic digestion process from anaerobic digestion.	**K3,K4**
CO 5	Understand the components of solar radiation, their measurement and apply them to utilize solar energy.	**K2,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	2	2	1	2	2	3	3	2	2
CO 2	2	2	2	1	2	3	3	3	2	2
CO 3	2	2	2	1	2	3	3	3	2	2
CO 4	2	2	2	1	2	3	3	3	2	2
CO 5	2	2	2	1	2	3	3	3	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	**INTRODUCTION TO ENERGY SOURCES** Conventional and non-conventional energy sources and their availability–prospects of Renewable energy sources– Energy from other sources– chemical energy–Nuclear energy– Energy storage and distribution.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
II	**ENERGY FROM THE OCEANS** Energy utilization–Energy from tides–Basic principle of tidal power–utilization of tidal energy – Principle of ocean thermal energy conversion systems.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
III	**WIND ENERGY SOURCES** Basic principles of wind energy conversion–power in the wind–forces in the Blades– Wind energy conversion–Advantages and disadvantages of wind energy conversion systems (WECS) - Energy storage–Applications of wind energy.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
IV	**ENERGY FROM BIOMASS** Biomass conversion Technologies– wet and dry process– Photosynthesis -Biogas Generation: Introduction–basic process: Aerobic and anaerobic digestion – Advantages of anaerobic digestion–factors affecting bio digestion and generation of gas- bio gas from waste fuel– properties of biogas-utilization of biogas.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
V	**SOLAR ENERGY SOURCES** Solar radiation and its measurements–solar cells: Solar cells for direct conversion of solar energy to electric powers–solar cell parameter–solar cell electrical characteristics– Efficiency–solar water Heater –solar distillation– solar cooking–solar greenhouse – Solar Pond and its applications.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
VI	**SELF STUDY FOR ENRICHMENT** **(Not to be included for External Examination)** Thermo electric power – Small scale Hydro electrics – Inter connected systems-Alternative liquid fuels (Alcohol fuels)-Sun shine Recorder.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,

Text Books

1. G.D. Rai, 1996, *Non – Conventional Energy sources,* 4th edition, Khanna publishers, New Delhi.
2. S. Rao and Dr. ParuLekar, *Energy technology.*
3. M.P. Agarwal, *Solar Energy,* S. Chand and Co., New Delhi (1983).
4. S. P. Sukhatme, *Solar energy, principles of thermal collection and storage*,2nd edition, Tata McGraw-Hill Publishing Co. Lt., New Delhi (1997).
5. S. Rao and Dr. Parulekar, *Energy Technology*

Reference Books

1.*Renewable energy resources*, John Twidell and Tonyweir, Taylor and Francis group, London and New York.

2.*Applied solar energy,* A. B. Meinel and A. P. Meinal

3.John Twidell and Tony Weir, *Renewable energy resources*, Taylor and Francis group, London and New York.

4.*Renewal Energy Technologies: A Practical Guide for Beginners* C.S. Solanki-PHI Learning

5.*Introduction to Non-Conventional Energy Resources* -Raja et. al., Sci. Tech Publications

Web References

1. https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=2411&printable=1
2. https://www.nationalgeographic.org/encyclopedia/tidal-energy/
3. https://www.ge.com/renewableenergy/wind-energy/what-is-wind-energy
4. https://www.reenergyholdings.com/renewable-energy/what-is-biomass/
5. https://www.acciona.com/renewable-energy/solar-energy/

Pedagogy

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

Course Designer

Dr. T.Noorunnisha

Semester- I	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PPH1DSE1C	**DIGITAL COMMUNICATION**	**DSE-1C**	**6**	**3**

Course Objectives

- To understand the use of Fourier, transform in analyzing the signals
- To learn about the quanta of transmission of information
- To make students familiar with different types of pulse modulation
- To have an in-depth knowledge about the various methods of error controlling codes
- To acquire knowledge about spread spectrum techniques in getting secured communication

Pre-requisites

- Exposure to Fourier transform, multiplexing.
- Basics knowledge on Pulse Modulation.
- Understanding of coding.
- Knowledge on noises in communication signals.

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	Apply the techniques of Fourier transform, convolution and sampling theorems in signal processing	K1, K3
CO 2	Apply different information theories in the process of study of coding of information, storage and communication	K3
CO 3	Explain and compare the various methods of pulse modulation techniques	K4
CO 4	Apply the error control coding techniques in detecting and correcting errors- able to discuss, analyze and compare the different error control coding	K3, K4
CO 5	Apply, discuss and compare the spread spectrum techniques for secure communications	K3, 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	3	2	3	1	2	3	3	2	1	3
CO 2	2	2	2	1	2	3	3	2	2	3
CO 3	3	3	2	1	2	2	2	2	1	2
CO 4	3	2	2	1	3	3	2	2	1	3
CO 5	2	2	2	1	3	3	2	2	1	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	**SIGNAL ANALYSIS** Fourier transforms of gate functions, delta functions at the origin – Two delta function and periodic delta function – Properties of Fourier transform – Frequency shifting – Time shifting - Convolution –Graphical representation – Convolution theorem – Time Convolution theorem – Frequency Convolution theorem –Sampling theorem.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
II	**INFORMATION THEORY** Communication system – Measurement of information - Coding – Bandot Code CCITT Code –Hartley Law – Noise in an information Carrying Channel- Effects of noise- Capacity of noise in a channel – Shannon Hartley theorem –Redundancy.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
III	**PULSE MODULATION** Pulse amplitude modulation - natural sampling – Instantaneous sampling - Transmission of PAM Signals - Pulse width modulation – Time division multiplexing – Band width requirements for PAM Signals. Pulse Code Modulation –Principles of PCM –Quantizing noise – Generation and demodulation of PCM -Effects of noise – Companding – Advantages and application.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
IV	**ERROR CONTROL CODING** Introduction to Linear Block Codes, Hamming Codes, BCH Coding, RS Coding, Convolutional Coding, Coding Grain Viterbi Coding.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
V	**SPREAD SPECTRUM SYSTEMS** Pseudo Noise sequences, generation and Correlation properties, direct sequence spread spectrum systems, frequency HOP Systems, processing gain, anti-jam and multipath performance.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
VI	**SELF STUDY FOR ENRICHMENT** **(Not to be included for External Examination)** Dual-Tone Multi frequency Signal Detection, Digital Filters, Multirate DSP, Linear Prediction &Optimum Linear Filters, Power spectrum estimation Bartlett and Welch methods	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,

Text Books

1. B.P. Lathi, *Communication system*, Wiley Eastern.
2. George Kennedy, *Electronic Communication Systems*, 3rdEdition, McGraw Hill.
3. Simon Haykin, *Communication System*, 3rd Edition, John Wiley & Sons.
4. George Kennedy and Davis, 1988, *Electronic Communication System*, Tata McGraw Hill.
5. Taub and Schilling, 1991, *"Principles of Communication System"*, Tata McGraw Hill.

Reference Books

1. John Proakis, 1995, *Digital Communication*, 3rd Edition, McGraw Hill, Malaysia.
2. M. K. Simen, 1999, *Digital Communication Techniques, Signal Design and Detection*, Prentice Hall of India.
3. Dennis Roddy and Coolen, 1995, *Electronics communications,* Prentice Hall of India IV Edition.
4. Wave Tomasi, 1998, *"Advanced Electronics communication System"* Prentice Hall, Inc.
5. M.Kulkarni, 1988, *"Microwave and Radar Engineering",* Umesh Publications.

Web References

1. http://nptel.iitm.ac.in/
2. http://web.ewu.edu/
3. http://www.ece.umd.edu/class/enee630.F2012.html
4. http://www.aticourses.com/Advanced%20Topics%20in%20Digital%20Signals
5. http://nptel.iitm.ac.in/courses/117101051.html

Pedagogy

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

Course Designer

Dr. T. Noorunnisha

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 of field equations, conservation laws and Gauge transformations

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 inElectrostatics	K3
CO 3	Evaluate the magnetic and electric field using various laws ofmagnetostatics 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	Evaluate electromagnetic wave equations in electro-magnetostatics	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	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
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
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, K1, K2, K3, K4, K5
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
V	**ELECTROMAGNETIC WAVES AND WAVE PROPAGATION** Electromagnetic waves in free space - 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 - Cavity resonator.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
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

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* 3rdeditionK.Nath &Co.,Meerut
3. Jordan . E.C. and K.G.Balmain,(2015), *Electromagnetic Waves and RadiatingSystems*,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/
4. https://www.sciencedirect.com/topics/computer-science/electromagnetic-theory
5. https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/

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**
23PPH2CC5	**QUANTUM MECHANICS**	**CC-V**	**6**	**5**

Course Objectives

- To provide the basic concepts of quantum mechanics and various formalism of quantum mechanics
- To impart knowledge of advanced quantum mechanics for solving relevant physical problems
- To introduce the role of Quantum Mechanics on evolution of the physical systems in our Universe
- To deepen the understanding of the theoretical and practical principles of Quantum Mechanics
- To familiarize students with advanced quantum mechanics

Pre-requisites

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

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the Course, the Student will be ableto	Cognitive Level
CO 1	Analyze the advanced techniques in Physics to gain insights towards quantum mechanics	K1, K2
CO 2	Apply principles of Quantum Mechanics to calculate observables for given wave functions	K3
CO 3	Apply knowledge about fundamental quantum mechanical processes in Nature	K4
CO 4	Ascertain the mathematical concepts behind fundamentals of quantum mechanics.	K5
CO 5	Develop the concepts in quantum mechanics and apply the development of mathematical skills and problem solving in quantum mechanics	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	2	3	3	2	2	2	3
CO 2	3	2	3	3	2	3	2	2	2	2
CO 3	2	3	2	3	3	2	2	3	2	3
CO 4	3	3	3	2	3	3	3	3	2	2
CO 5	3	3	3	3	2	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	COGNITIVE LEVEL
I	**SCHRÖDINGER EQUATION APPROACH** Time dependent Schrödinger equation - Time independent Schrödinger equation - Normalization and probability interpretation- Expectation values: Ehrenfest theorem - Conditions on the wave function **APPLICATIONS** Particle in a square well potential - Quantum mechanical tunnelling - Reflection at potential barrier and walls - Linear harmonic oscillator (Schrödinger method) - The free particle - Hydrogen atom - Deuteron	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**FORMALISM IN QUANTUM MECHANICS** Linear vector space - Linear operator - Eigenfunctions - Eigenvalues - Hermitian operator- Postulates of quantum mechanics - Simultaneous Measurability of Observables - General uncertainty Relation - Dirac's notation - Equation of motion - Momentum representation - Heisenberg Method - Matrix representation of Wavefunction - Matrix representation of operator - Schrodinger Equation in Matrix form- Unitary Transformations	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**SIMPLE HARMONIC OSCILLATOR** Harmonic oscillator in Schrodinger representation - Properties of stationery states - Formulation of Harmonic oscillator problem in abstract notation - Eigen states and Eigenvalues of the Harmonic oscillator (Abstract operator approach) - Creation, Annihilation and Number operators **ANGULAR MOMENTUM** Angular momentum operator - Commutations relations of Angular momentum - Eigenvalue and eigenfunction of L^2 and L_z - Eigenvalues of J^2 and J_z - Angular momentum matrices -Spin angular momentum - Addition of angular momentum- Clebsch Gordon Coefficients	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**TIME-INDEPENDENT PERTURBATION THEORY** Perturbation theory for discrete levels - Equation in various orders- non-degenerate levels -Degenerate levels - First excited state of Hydrogen atom - Two electron atoms-Variational method: Upper bound on ground state energy - Application to excited states Hydrogen molecule - WKB approximation: One	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

	dimensional Schrödinger equation with asymptotic solution **TIME-DEPENDENT PERTURBATION THEORY** Introduction - First order perturbation - Harmonic Perturbation -Transition to continuum states (Fermi'sGolden Rule) - Absorption and Emission of Radiation- Einstein's A and B coefficients - Selection Rule			
V	**SCATTERING THEORY** The Born approximation - Validity of Born approximation - Partial wave analysis: Asymptotic behavior of partial waves - Scattering amplitude in terms of phase shifts - Scattering by a square well potential- scattering by Coulomb potential **RELATIVISTIC QUANTUM MECHANICS** Generalization of the Schrodinger equation- Hydrogen like atom- The Klein - Gordon equation - Dirac Equation - Negative energy states - Spin of the Dirac particle - Spin Orbit Energy -The hydrogen Atom	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**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 - Dirac's matrices	-	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 McGraw Hill, New Delhi.
2. Aruldhas G, (2009), *Quantum Mechanics*, Second edition, Prentice Hall of India.
3. Ghatak A & Lokanathan S (1987) *A Text Book of Quantum Mechanics*, Tata McGraw Hill, New Delhi
4. 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*, 4 th edition, Tata McGraw Hill, New Delhi,
3. Shankar R, (2007), *Principles of Quantum Mechanics*, 2 nd edition, Springer, New Delhi.
4. Thankappan V.K, (2014), *Quantum Mechanics*, 4th Edition Wiley Eastern Ltd, New Delhi.

Web References

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, Assignment, Group discussion and quiz

Course Designer

Dr.R.Meenakshi

SEMESTER-II	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSECODE	**COURSE TITLE**	**CATEGORY**	**HRS / WEEK**	**CREDITS**
23PPH2CCC1A	**MICROPROCESSOR AND MICROCONTROLLER**	**CCC-I**	**6**	**4**

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
- Concepts of programming languages

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 of microprocessor/microcontroller and impart the knowledge aboutthe instruction set	K1,K2
CO 2	Demonstrate programming proficiency using the various addressing modes and data transfer instructions of microprocessor/micro controller	K3
CO 3	Explain the data transfer schemes of microprocessor/microcontroller and interfacing devices	K4
CO 4	Distinguish the instruction set of microprocessor / micro controller and Create program with microprocessor/microcontroller	K5
CO 5	Develop programming skill using interfacing and peripheral devices of microprocessor/microcontroller	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
II	**MICROPROCESSOR PROGRAMING** Assembly language - Stacks - Subroutines. Simple programs: Addition and subtraction two 8-bit and 16-bit numbers – Shift an 8-bit number left by one bit- Mask off Least Significant 4 bitsof 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 SCHEMES AND 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 SynchronousAsynchronous Receiver Transmitter (USART- 8251))- Programmable DMA controller (8257) –Programmable Interrupt Controller (PIC 8259) – Special Purpose Interfacing Devices – Programmable CRT Controller (8275H) – Programmable Keyboard / Display Interface (8279)	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**MICROCONTROLLER-8051** Introduction to micro controller- Difference between microprocessor and microcontroller. 8051 microcontroller: Pin configuration- Architecture and Key features 8051- Data types and directives Instruction set: Data transferinstructions - 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 – Conversion of 8 –bit number to BCD	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

V	**MICROPROCESSOR AND MICROCONTROLLER APPLICATIONS** Microprocessor Applications: Interfacing 7 segment LED display-Measurement of temperature-Microprocessor based traffic control. Microcontroller Applications: Temperature controller – Stepper motor.	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 4 bits 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.8th Edition
2. Godse A. P Godse D.A. (2017) *Microprocessors and microcontrollers*. TechnicalPublications, Pune 4th Revised Edition

Reference Books

1. uhammad Ali Mazidi, Jinice Gillispie Mazidi (2004) *The 8051 microcontroller and embedded systems.* Pearson Education, Delhi.2nd Edition.
2. Nagoorkani A. (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**.**
3. https://kanchiuniv.ac.in/coursematerials/VIJAYARAGHAVAN_mp%20_mc

Pedagogy

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

Course Designer

Dr.T.Noorunnisha

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 introduce 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 – Conidial and solitary waves - The Scott Russel phenomenon and derivation of Korte Weg - 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 KdV equation–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 NonlinearScience*, Springer.
5. Robert C. Hilborn. (2004). *Chaos and Nonlinear Dynamics*, 2nd Edition, India: OxfordUniversity 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**
23PPH2CCC1C	**PHYSICS OF SENSOR AND TRANSDUCER**	**CCC-I**	**6**	**4**

Course Objectives

- To acquire the knowledge of Sensing and transducer devices.
- To understand the structural and functional principles of sensors and transducers.
- To make familiar with the working of different types of sensors and transducers.
- To differentiate between the types of transducers available
- To gain information about the function of sensor and transducers.

Pre-requisites

- Fundamental knowledge of physical parameters.
- Basic idea 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 semiconductor sensors	K3
CO 3	Evaluate the working principles of sensor and transducers for measurement of displacement, strain, velocity, acceleration etc.	K4
CO 4	Apply the function of the sensor, transducer construction, principle of operation and characteristics in proper applications.	K5
CO 5	Determine the technologies in sensing and transducing devices.	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	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	COGNITIV ELEVEL
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
II	**SEMICONDUCTOR SENSOR** Introduction-Sensor Output Characteristics-Wheatstone's Bridge- Piezo resistivity in Silicon-Semiconductor Strain Gauges - Inductive Sensors: Sensitivity and Linearity of the Sensor –Types-Capacitive Sensors: Electrostatic Transducer - Force/Stress Sensors Using Quartz Resonators - Ultrasonic Sensors	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
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
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
V	**TEMPERATURE SENSORS AND THERMAL TRANSDUCERS** Heat and temperature, The bimetallic strip, Liquid and gas expansion, Thermocouples, Metal – resistance sensors, Thermistors, Radiant heat energy sensing, Pyroelectric detectors, Thermal transducers, Thermal to electrical transducers.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

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

Text Books

1. Patranabis. D, *Sensors and Transducers,* Wheeler publisher.
2. Randy Frank, (1995) *Understanding 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

Dr. K. KANNAGI

Semester -II	Internal marks: 40		External marks: 60	
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 of doing experiments in Programmed and formula skills.
- Develop the knowledge of 8085 Programme
- Formulate the idea of numerical problem in Python programing.

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 analyze 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 systemof 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 3/8rule -Taylor's series method–First order differential equation: Euler's method - Modified Euler'smethod – 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-Hallof 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: AGuide 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 DesignerMs.

S. PRIYA

SEMESTER - II	INTERNAL MARKS: 25			EXTERNAL MARKS: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PPH2DSE2B	**BIOMECHANICS AND BIOPHYSICS**	**DSE - II**	**6**	**3**

Course Objectives

- To give exposure and orientation of different aspects of biophysics
- To impart the knowledge about the links between physical and biological sciences
- To understand the applications of physics, chemistry to biological sciences
- To provide knowledge about bioenergetics.
- To gain keen understanding of Biomolecular mechanics.

Pre-requisites

- Strong foundation of biophysics
- Commendable Knowledge of macromolecular mechanics

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 Atomic & Molecular structures and thermodynamics	K1, K2
CO 2	Analyze the principles of physical sciences to understand and solve biological complexities	K3
CO 3	Recognize the biomechanics of human body.	K4
CO 4	Apply the concepts of dynamics to analysis the metabolism of human body.	K5
CO 5	Evaluate the intramolecular processes and interactions.	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	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	**ATOMIC & MOLECULAR STRUCTURES** Structure of Atom - Schrodinger's theory - Quantum numbers- Pauli's exclusion principle - Hund's rule - Bonds between atom & molecules – Ionic – Covalent – Hydrogen- Electrostatic – Disulphide & Peptide bonds - Vander Waals forces - Bond energies - Bond angles - Bayer's strain - Weakinteractions	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
II	**THERMODYNAMICS & BIOENERGETICS** Laws of Thermodynamics - Concept of free energy- Unavailable energy & Entropy, change in entropy of living system - Heat content of food - Bomb calorimeter- Energy generation & energy transfer processes in biochemical reactions - Metabolism of glucose & formation of ATP - Energy requirements in cell metabolism - Role & Structure of mitochondria - High-energy phosphate bond.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
III	**MOLECULAR ALPHABETS OF LIFE** Amino acid - Nucleic acid bases & Lipids - Classification & Properties of Amino acid - Peptides & Polypeptides- Nucleosides - Nucleotides - Polynucleotides - Pentose & Hexose Polysaccharides - Amino acid to Peptides- Polypeptides.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
IV	**PRINCIPLES OF PROTEINS** Basics aspects of protein structure - Polypeptide chain geometrics - estimates of potential energy - results of potential energy calculations - hydrogen bonding - hydrophobic & hydrophilic interactions and water as universal solvent in biological systems - Disruption of hydrophobic interactions by urea - ionic interactions - hydrophobic versus ionic interactions - prediction of proteinstructure.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.
V	**MACROMOLECULAR MECHANICS** Ligand interaction at equilibrium - Identical independent sites - Scatchard plot - Multiple classes of independent sites - Interaction between binding sites – Allosterism- MWC model - Sequential model - Oxygen Hemoglobin binding - Binding of two different ligands - Energetics and dynamics of binding - Structures of protein - ligand complexes	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.

VI	**SELF STUDY FOR ENRICHMENT:** **(Not to be included for External Examination)** Molecular orbital theories, Hybridization of orbitals, σ and π bonds - Electron transfer phenomenon & biological energy transfer - Different types of linkages - Concept of protein evolution, Cytochrome & Hemoglobin evolutionary studies Free - radicals in biology and medicine.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.

Text Books:

1. Ackerman E.A. Ellis, L.E.E. & Williams L.E. (1979), *Biophysical Science*, Prentice-Hall Inc.
2. Barrow. C. (1974), *Physical Chemistry for Life Sciences*, McGraw-Hill.
3. Berns M.W. (1982), *Cells*, Holt Sounders International Editors.
4. Bloomfield V.A. and Harrington R.E. (1975), *Biophysical chemistry*, W.A.Freeman and CO.
5. Bulter l.A.V. And Noble D.Eds. (1976), *Progress in Biophysics and Molecular Biology*, Oxford.
6. Cantor C.R. and Schimmel P.R. (1980), *Biophysical chemistry*, W.A.Fremman and Co.
7. Casey E.J. (1967), *Biophysics, concepts and mechanisms*, Affiliated East west press.

Reference Books:

1. Schule G.E. and schirmer R.H. (1984), *Principles of protein structure*, Springer-Verlag.
2. Segel F.H. (1975), *Enzyme Kinetics*, John willey and sons.
3. Setlow R.B. and pollard E.L. (1962), *Molecular Biophysics*, Pergamon Press.
4. Sheelk P. and Birch D.E. (1983), *Cell Biology Structure, Biochemistry and function*, John willey and sons.
5. Spragg S.E. (1980), *Physical Behavior of macromolecules with biological functions*, John willey and sons.

Web References

1. https://www.studocu.com/in/document/gujarattechnologicaluniversity/engineering-chemistry/engineering-chemistry-atomic-and- molecular-structure/20534347.
2. https://www.studocu.com/in/document/university-ofcalcutta/chemistry/chemical-thermodynamics-energetics-i-notes/27031492.
3. https://chem.libretexts.org/Bookshelves/BiologicalChemistry/ConceptsinBiophysicalChemistry(Tokmakoff)/02%3AMacromolecules/09%3AMacromolecularMechanics

Pedagogy

Lecture, Seminar, Assignments 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**
22PPH2DSE2C	**MATERIAL CHARACTERIZATION AND MEASUREMENT TECHNIQUES**	**DSE-II**	**6**	**3**

Course Objectives

- To illustrate the basic knowledge ofoptical 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