Sacred Heart College (Autonomous), Tirupattur District

1.2.1 List of New Courses

M.Sc Physics

SEM	Subject	Title of the Paper	Ins.Hrs	Credits
I	MC	Mathematical Physics-I	5	4
	MC	Classical Mechanics and Statistical Mechanics	5	4
	MC	Quantum Mechanics-I	5	4
	MC	Advanced Physics Practicals	5	-
	MC	Electronic Experiments	6	-
	Elective	1. Electronic Devices and Applications 2. Energy and Environmental Physics 3. Astrophysics	4	4
II	MC	Mathematical Physics-II	5	4
	MC	Electromagnetic Theory	5	4
	MC	Quantum Mechanics-II	5	4
	MC	Advanced Physics Practicals	6	6
	MC	Electronic Experiments	5	6
	Elective	1. Microprocessor 8085 and Microcontroller 8051 2. Geophysics 3. Bio Physics	4	4
	SSP	1. Ultrasonics and its Applications	-	2*
		2. Dielectric Spectroscopy	-	2*
		3. Crystal growth techniques	-	2*
III	MC	Solid State Physics	5	4
	MC	Atomic and Molecular Spectroscopy	5	4
	MC	C Programming and Research Methodology	5	4
	MC	Modern Physics Practicals	5	-
	MC	Microprocessor and C Programming Experiments	5	-
	Elective	1. Nanoscience and Technology 2. Optical Physics 3.Computational Quantum Mechanics	4	4
	SSP	1. Shock Waves and High Pressure Physics in Material Science	-	2*
		2. Electrical Appliances	-	2*
		3. Research and Publication ethics	-	2*
	Core	Project	1	-
IV	MC	Electronic Instrumentation Techniques	5	4
	MC	Nuclear and Particle Physics	5	4
	MC	Modern Physics Practicals	5	6
	MC	Microprocessor and C Programming Experiments	5	6

	MC	Project	4	5
	Elective	1. Modern Optics 2. Reactor Physics 3. Digital Signal Processing	4	4
		Human Rights	**2**	**1**
Total			**120**	**90+4***

Sacred Heart College (Autonomous), Tirupattur District

1.2.1 List of New Courses

Department: M.Sc.Physics

S.No	Course Code	Course Name
1.	P717	Mathematical Physics-I
2.	P718	Classical Mechanics and Statistical Mechanics
3.	P719	Quantum Mechanics - I
4.	P720A	1. Electronic Devices and Applications
5.	P720B	2. Energy and Environmental Physics
6.	P720C	3. Astrophysics
7.	P820	Mathematical Physics-II
8.	P821	Electromagnetic Theory
9.	P822	Quantum Mechanics-II
10.	PP809	Advanced Physics Practicals
11.	PP810	Electronic Experiment
12.	P823A	Microprocessor 8085 and Microcontroller 8051
13.	P823B	Geophysics
14.	P823C	Bio Physics
15.	P825SSP1	Ultrasonics and its Applications
16.	P825SSP2	Dielectric Spectroscopy
17.	P825SSP3	Crystal growth techniques

Syllabus

Semester – I

Mathematical Physics-I

Mathematical Physics - I

Semester - I **Hours/week: 5**

Sub. Code: P717 **Credits: 4**

Course objectives:

1. To understand the basic concepts of matrices and complex numbers
2. To impart the knowledge of the integral transforms such as Fourier transform and Laplace transform in detail.
3. To make the students to understand and solve problems on linear differential equations and series solutions of differential equations
4. To enable the students to understand the basic principles and importance of tensor analysis,
5. To learn the basic notations, theorem and probability distribution in physics.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Revise and understand the concepts of matrices and to perform basic mathematical operations (arithmetic operations) with complex numbers in Exponential, circular functions and hyperbolic functions.	K1- K3
CO 2	Distinguish between Fourier and Laplace transform, and make them to apply the knowledge of F.T, L.T and Finite Fourier transforms in finding the solutions of differential equations, initial value problems and boundary value problems.	K1-K2
CO 3	Classify linear and partial differential equations and can solve problems of 1^{st} and 2^{nd} order linear differential equation, their solutions, also series solutions of linear differential equation.	K1-K3
CO 4	Understand tensors and their concise mathematical framework for formulating and solving physics problems in areas such as elasticity, fluid mechanics, and general relativity.	K1-K3
CO 5	Acquire the basic knowledge on probability concepts and theorems of probability	K1-K2

Mapping of COs with POs and PSOs

CO	Programme Outcomes(PO)					Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	2	2	3	3	2	3	3	2.6
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	2	3	3	2	2	3	2.6
CO4	3	3	2	3	2	3	3	2	3	2	2.6
CO5	3	3	3	3	3	3	2	2	3	3	2.8
Mean overall score											2.7
Result											High

Unit-I: Matrices and Complex numbers

Matrices: Rank of matrix-Cayley-Hamilton Theorem-Eigen values and eigenvectors

Introduction to complex number - Arithmetic of Complex Numbers-Exponential and circular functions of complex numbers – Logarithmic functions of complex variables – Separation of real and imaginary parts of circular functions - Separation of real and imaginary parts of hyperbolic functions

Unit-II: Integral Transforms

Fourier transform: Fourier sine, cosine and complex integrals – Fourier sine and cosine transform (finite and infinite) – Properties of Fourier transforms (Linear property, change of scale property, shifting property and modulation theorem) - convolution theorem

Laplace Transform: Laplace formulae – Properties of Laplace transforms (Linear property – Change of scale property, first and second shifting theorems) – special functions of Laplace transform (Gamma, Bessel, error, Heaviside's unit step and Dirac delta)

Unit-III: Ordinary Differential equations:

General form of 1^{st} order linear differential equation – solution of 1^{st} order linear differential equation – General form of 2^{nd} order linear differential equation – Homogeneous differential equation – solutions with constant coefficient – series solution of linear differential equation

Unit –IV: Tensor Analysis

Introduction to tensors – transformation of coordinates-summation convention-Tensor transformation (contravarient, covariant tensors) – Rank of a tensor – Algebra of tensor: Addition, Subtraction, Product and Division (Quotient law) – Kronecker and Livi-Civita symbol – Symmetric and Anti-symmetric tensor – Isotropic tensor – Dual tensor – metric tensor – Christoffel's symbols (Both first and second kind)-Relations-transformations–Riemann curvature tensor, Ricci tensor-Tensor fields: Gradient of tensor fields (scalar, vector) – Divergence of vector – Curl of vector – Tensorial form of Gauss's and Stoke's theorem.

Unit –V: Probability

Definition-Sample space – event – probability theorem: Additive law & generalization – Multiplicative law & generalization – Probability distribution: Average – moments – constants: binomial– Poisson – Gaussian – variation – covariation and correlation.

Text Books

1. H K Dass, Dr. Rama Verma, Mathematical Physics, Sultan Chand & Sons, New Delhi, 2019
2. P Satyaprakash, Mathematical Physics, Sultan Chand & Sons, New Delhi 2019.
3. B. D, Gupta Mathematical Physics, New Delhi, Vikas publishing house, 2018.
4. B.S.Rajput, Mathematical Physics, 30th edition, PragathiPrakashan, Meerut, 2017
5. G B Arfken, J Weber, Mathematical methods for physicists, Elsevier academic press, 2016
6. E Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt Ltd, New Delhi, 2015

Books for Reference

1. K F Riley, M P Hobson, Essential Matehmatical methods for physical sciences, Cambridge university press, USA, 2011
2. Suresh Chandra, A Text Book of Mathematical Physics, Narosa Publishing House, New Delhi, 2009.
3. Mary L.Boas, Mathematical methods in the physical sciences, Wiley India Pvt Ltd, New Delhi, 2006.
4. Tai L. Chow, Mathematical Methods for Physicists: A concise introduction, Cambridge university press, USA, 2000

Website references:

1. https://www.mathsisfun.com/algebra/matrix-introduction.html
2. https://yutsumura.com/linear-algebra/the-cayley-hamilton-theorem/
3. https://www.mathsisfun.com/numbers/complex-numbers.html
4. http://www.math.chalmers.se/Math/Grundutb/CTH/mve025/1516/Dokument/F-analys.pdf
5. https://nptel.ac.in/courses/111/102/111102129/
6. https://www.uou.ac.in/lecturenotes/science/MSCPHY-17/pdf%20ppt%20MATHEMATICAL%20PHYSICS%20tensor%20unit%207.pdf
7. https://www.math24.net/linear-differential-equations-first-order
8. http://www.sosmath.com/tables/diffeq/diffeq.html
9. https://nitsri.ac.in/Department/PHYSICS/M.Sc.__Mathematical_methods_for_Physics.pdf
10. https://www.stat.auckland.ac.nz/~fewster/325/notes/ch2.pdf
11. https://byjus.com/maths/probabilitydistribution/#:~:text=Probability%20Distribution%20Definition,outcomes%20of%20any%20random%20experiment

Semester - I

Classical Mechanics and Statistical Mechanics

Classical Mechanics and Statistical Mechanics

Semester - I **Hours/week:5**

Sub. Code: P718 **Credits: 4**

Course objectives:

1. To introduce the classical formulation approaches like Lagrangian and Hamiltonian dynamics and to study their application in mechanical systems and solving of problems.
2. To disseminate the theory and methods of Hamilton Jacobi's Formulation and small oscillation theory that can be effectively applied to solve mechanical problems.
3. To educate the students to identify, formulate and solve problems in rigid body dynamics.
4. To review the fundamental concepts of thermodynamics and to create an understanding of the principles of classical and quantum Statistical Mechanics and their applications.
5. To develop quantum simulations that bring into the statistical description using Bose-Einstein and Fermi-Dirac Statistics.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Have in-depth knowledge about Lagrangian and Hamiltonian dynamics	K1-K3
CO 2	Apply and solve problems in mechanical systems using Hamilton-Jacobi and Small Oscillations.	K1-K3
CO 3	Demonstrate and analyse principal coordinates and the principal moments of inertia for arbitrary rigid body application.	K1-K3
CO 4	Learn different statistical ensembles, their distribution functions, ranges of applicability and the corresponding thermodynamic potentials.	K1-K3
CO 5	Acquire knowledge to calculate basic thermo dynamical quantities: energy, specific heat, entropy, Helmoltz free energy, etc in classical and quantum statistical models.	K1-K2

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	3	2	3	3	2	2	2	2	2.4
CO2	2	3	2	1	3	2	2	2	3	3	2.3
CO3	3	2	2	2	2	1	3	2	3	3	2.3
CO4	3	2	2	2	2	2	3	2	3	3	2.4
CO5	2	3	2	2	2	2	1	2	3	3	2.2
Mean Overall Score											2.3
Results											High

Classical Mechanics

Unit – I: Lagrangian and Hamiltonian Formalisms

Constraints–Classification-- Lagrange equation from D'Alembert's principle-Lagrange's problems(spherical pendulum)- Hamilton's equation of motion- Variational principle- deduction of Hamiltons equation from variational principle -cyclic coordinates and conservation theorems.

Canonical transformations- generating functions- condition for a function to be canonical- examples- Poisson brackets- Properties of Poisson's brackets- Invariance of Poisson's bracket under canonical transformation.

Unit – II: Hamilton-Jacobi Theory and Small Oscillations

Hamilton-Jacobi equation- Hamilton's characteristic function - Harmonic oscillator problem by Hamilton Jacobi method-Action- angle variables- Action- angle variables in systems of one degree of freedom - Application toKepler's planetary motion.

Theory of small oscillations- Normal modes - oscillations and frequencies of free vibration - linear tri atomic molecule.

Unit – III: Rigid body dynamics

Degrees of freedom -Independent coordinates of a rigid body- orthogonal transformation-Euler's angle-Euler's theorem-Moments of inertia and Products of inertia –Moment of inertia tensor-principal axes- Angular momentum and kinetic energy- Torque and angular momentum-Euler's equation of motion-torque free motion-Symmetric top –Precession and nutation.

Statistical Mechanics

Unit – IV: Basics of statistical mechanics and Fluctuations

Introduction- Ensembles- Micro canonical, Canonical and Grand canonical ensembles- average ensemble - Liouville's theorem-Entropy-Gibbs paradox-Sackur-Tetrode equation-Partition function - Derivation of partition function (micro canonical ensemble) -correlation with thermo dynamical quantities

Fluctuations and irreversible process- Fluctuations in micro canonical ensemble- Energy and concentration fluctuations in quantum statistics- one dimensional Random walk - Brownian motion.

Unit-V: Classical and Quantum Statistics

Postulates of classical statistics-Maxwell-Boltzmann distribution-application to diatomic molecule-postulates of quantum statistics-Bose-Einstein distribution-Bose-Einstein condensation-Thermodynamic properties of Bose Einstein gas-Liquid Helium-Fermi-Dirac distribution-Degeneracy-energy of Fermi gas -thermionic emission.

Text books

1. Gupta, Kumar and Sharma, Classical Mechanics, PragatiPrakashan, Meerut, 2012.
2. Palash B. Pal, An Introductory Course of Statistical Mechanics, Narosa Publishers, New Delhi, 2008.

Books for Reference

1. Vimal Kumar Jain, Classical Mechanics, Ane Books Pvt. Ltd., 2009.
2. SrinivasaRao K. N., Classical Mechanics, Universities Press (India) Pvt. Ltd, 2003.
3. Laud B. B., Fundamentals of Statistical Mechanics, New Age International (P) Ltd. Publishers, New Delhi, 1998.
4. Kamal Sigh, Sigh S. P., Elements of Statistical Mechanics, S. Chand & Company Ltd., New Delhi, 1999.
5. Upadhyaya, Classical Mechanics, Himalaya Publishing Co., New Delhi, 1999.
6. Herbert Goldstein, Charles P. Poole Jr. and John L. Safko, Classical Mechanics 3rd Edition, Addison-Wesley, 2001.
7. Calkin M. G., Lagrangian and Hamiltonian mechanics, Allied Publishers Ltd., 2000.
8. Panat P. V., Classical Mechanics, Narosa Publishers, New Delhi, 2008.
9. Madhumangal Pal, A Course on Classical Mechanics, Narosa Publishing House, New Delhi, 2009.

10. Walter Greiner, Classical Mechanics, System of Particles and Hamiltonian Dynamics, New York, Springer, 2009.
11. Agarwal B. K., Melvin Eisner, Statistical Mechanics,New Age International (P) Ltd. Publishers, New Delhi, 2005.

Websites for Reference

1. http://astro.physics.sc.edu/selfpacedunits/unit56.html
2. http://www.phy.auckland.nz/staff/smt/453310SC.html
3. http://www.damtp.cam.ac.uk/user/tong/dynamics.htm
4. http://farside.ph.utexas.edu/teaching/301/lectures/lectures.html
5. http://www.lancs.ac.uk/depts/physics/teaching/py332/phys332.html

Semester - I

Quantum Mechanics – I

Semester – I **Hours/week: 5**

Sub. Code: **P719** **Credits: 4**

Course objectives:

1. To provide an understanding of fundamental principles of quantum mechanics and the one-dimensional applications of Schrodinger's equation.
2. To introduce the students to the basic ideas of operator formalism and also to apply Schrodinger's equation for three-dimensional quantum problems.
3. To gain knowledge on matrix formalism and to analysis the symmetries and conservation laws in unitary transformations.
4. To impart the knowledge on time independent approximations in quantum mechanics.
5. To make the students to understand the concepts of angular momenta and their commutational rules and also matrix representations.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Gain knowledge of development of quantum ideas and learn the wave nature of matter, uncertainty principle, Schrodinger's wave equation and its one-dimensional applications.	K1-K3
CO 2	Understand the operator formalism and its application for one dimensional and three-dimensional quantum problems.	K1-K3
CO 3	Gain knowledge on matrix formalism and unitary transformations.	K1-K3
CO 4	Understand the importance of few time dependent approximations and their applications.	K1-K3
CO 5	Acquire the knowledge on angular momentum, identical particles and Pauli's spin matrices.	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	3	2	2	2	3	2	2	2.4
CO2	2	3	2	1	1	2	2	2	3	3	2.1
CO3	3	2	2	2	2	2	3	2	3	3	2.4
CO4	1	2	2	2	2	2	3	2	2	3	2.1
CO5	2	3	2	2	2	2	2	2	3	3	2.3
Mean Overall Score											2.3
Results											High

Unit – I: Basic formalism

Origin of matter waves – Time dependent and independent Schrodinger wave equations for free particles – uncertainty relation – Physical interpretations of wave functions –probability current density – Continuity equation – Stationary states – Expectation value –Ehrenfest's theorem by Schrodinger method.

One dimensional applications: particles in a square well potential with rigid walls – Barrier penetration through a square potential – transmission probability– particle in a periodic potential (Qualitative study) – Bloch waves – Simple Harmonic Oscillator by Schrodinger method.

Unit – II: Three Dimensional Problems and operator formalism

Three dimensional problems: Schrodinger equation in spherical polar coordinates– system of two interactive particles – reduction – rigid rotator – particle in a spherically symmetric potential – Hydrogen atom.

Operator formalism: linear operators-significant properties–Hermitian operator- properties-simultaneous measurability of observables: commuting operators-commutationrelations of position and momentum – Hamiltonian operators –Ehrenfest'stheorem by operator method – Ladder operators – Simple Harmonic Oscillator byoperator method.

Unit – III: Matrix Formalism and Symmetry in Quantum Mechanics

Hilbert's space–operators as matrices – matrix form of wave function– unitary transformations– Representation of Co–ordinate andMomentum in Schrodinger, Heisenberg and Interaction pictures– Symmetries and conservation laws: Unitary transformations associated with translations, rotations–Parity and time reversal.

Unit – IV: Time independent **approximation Methods**

Time independent perturbation theory for non-degenerate and degenerate cases –Applications to ground state of anharmonic oscillator –Variation method – Application to ground state of Helium atom – WKB approximation method – WKB quantization rule – Application to Simple Harmonic Oscillator.

Unit – V: Angular Momentum, Identical Particles and spin

Angular momentum operators – Commutation rules – Ladder operators – Eigen valuespectrum from angular momentum algebra – Matrix representation of angular momentum –Spin angular momentum– Addition of twoangular momenta –Clebsch–Gordan coefficients for $j_1 = j_2 = ½$– Symmetry and anti–symmetry of wavefunctions – Pauli's spin matrices.

Text Books

1. SatyaPrakash, Swati Saluja, Quantum Mechanics, KedarnathRamnath, Meerut, 2012.
2. Guptha Kumar Sharma, Quantum Mechanics, Jai prakashNath publications, Meerut,2012.
3. Aruldhas.G, Quantum Mechanics, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.

Books for Reference

1. David J.Griffith, Introduction to Quantum Mechanics, Pearson EducationInternational, London, 2005.
2. Mathews P.M. andVenkatesan K., A Text book of Quantum Mechanics, Tata McGrawHill, New Delhi, 2010.
3. Chaddha G. S. Quantum Mechanics, New Age International (P) Ltd. Publishers, New Delhi,2006.
4. Thankappan V. K., Quantum Mechanics, New Age International (P) Ltd. Publishers, New Delhi, 2008.
5. Singh S. P. Bagde M. K., Kamal Singh, Quantum Mechanics, S.Chand and company Pvt. Ltd, New Delhi, 2000.
6. Devanathan.V, Quantum Mechanics, Narosa Publishing House, New Delhi, 2005.
7. Murugesan R., Modern Physics, S. Chand & Company Ltd., New Delhi, 2010.
8. Devanarayanan S. Quantum Mechanics, Scitech Publications (India) Pvt. Ltd., 2005.
9. Kamal Singh, Singh S.P., Elements of Quantum Mechanics, New Delhi, S.Chand and company Pvt. Ltd, New Delhi, 2005.

Websites for Reference

1. http://www.netsa.org.lk/OcwWeb/Physics/index.htm
2. http://www.theory.caltech.edu/people/preskill/ph229/
3. http://www.nscl.msu.edu/~pratt/phy851/lectures/lectures.html
4. http://walet.phy.umist.ac.uk/QM/LectureNotes/
5. http://www.ks.uiuc.edu/Services/Class/PHYS480/
6. http://www.mat.univie.ac.at/~gerald/ftp/book–schroe/index.html
7. http://people.deas.harvard.edu/~jones/ap216/lectures/lectures.html
8. http://www.netsa.org.lk/OcwWeb/Chemistry/5–73Introductory–Quantum MechanicsIFall2002/LectureNotes/index.htm
9. http://www.glue.umd.edu/~fivel/

Semester - I

1. Electronic Devices and Applications

Elective: Electronic Devices and Applications

Semester-I **Hours/week: 4**

Sub. Code: P720A **Credits: 4**

Course objectives:

1. To introduce structures, physical operations and circuit applications of semiconductor devices.
2. To develop the ability design electronic circuits and to grasp the basic ideas of op-amps and its applications.
3. To acquaint and demonstrate the concepts on waveform generators using Op-amp and 555 timer.
4. To understand analog and digital signals and conversion techniques .
5. To impart the fixed function of combinational and sequential logical circuits and their implementation.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Understand the characteristics and applications of special purpose diodes.	K1-K2
CO 2	Analyze input/output relations for various applications of Op-amp in analog circuits.	K1-K3
CO 3	Explain the operation of oscillators and multivibrators using op-amp and 555 timer.	K1-K2
CO 4	Recognize the relationship between digital and analog values in D/A and A/D converters.	K1-K3
CO 5	Analyze, design and implement combinational and sequential logic circuits	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	1	2	2	2	3	2	1	2.1
CO2	2	3	2	2	2	2	2	2	3	3	2.3
CO3	3	2	2	2	2	3	3	2	3	3	2.5
CO4	3	2	2	3	2	2	3	2	3	3	2.5
CO5	2	3	2	2	2	2	3	2	3	3	2.4
Mean Overall Score											2.4
Results											High

Unit-I: Special Devices

UJT– construction – working – characteristics– relaxation oscillator – Thyristors –Silicon controlled rectifier (SCR) – working – Equivalent circuit of SCR –characteristics–SCR as switch–SCR half-wave and full-wave rectifiers–LASCR–DIAC –construction–characteristics– TRIAC–construction–characteristics.

Unit-II: Op-Amp applications

Op-amp – characteristics –CMRR –Integrator – differentiator – comparator – Log and Antilog amplifiers – Instrumentation amplifier – V to I and I to V converters – Sample and Hold circuits – Analog computation: Solving Simultaneous equations and Second order differential equations – Design of Op-Amp Low pass, High pass and Band pass active filters (first order only).

Unit - III: Waveform generators

Op-amp:Phase shift oscillator– Wein bridge oscillator (no derivation) –Astablemultivibrator–Triangular wave generator –saw tooth wave generator.

555 Timer: Functional diagram – Monostablemultivibrator–Astablemultivibrator–Schmitt trigger.

Unit – IV D/A and A/D Converters

Basic DAC and ADC Techniques – D/A converters:Binary Weighted Resistor – R-2R ladder D/A converters. A/D converters: Counter type– Successive approximation type –Dual slope–parallel comparator A/D converters

Unit- V: Sequential and Combinational Circuits

Sequential circuits: Flip-Flops–JK and JK master slave flip-flops – Shift registers: Shift right shift register – Shift left shift register. Counters: Synchronous and Asynchronous decade counters – 4-bit binary up/down counters

Combinational Circuits: Multiplexer (2:1, 4:1)–Demultiplexer (1:2, 1:4)–Encoder –Decimal to BCD encoder –Decoder: 2 to 4 decoder– 3 to 8 decoder–BCD to Decimal decoder–BCD to Seven segment decoder (7447).

Books for study:

1. V. K. Mehta, Principles of Electronics, S. Chand & Co. Ltd., New Delhi, 2008.
2. Vijayendran.V, Introduction to Integrated Electronics: Digital and Analog, Third Reprint, S.Viswanathan (Printers &Publishers), PVT., Ltd, 2007.
3. Roy Choudhury.D and ShailB.Jain, Linear Integrated Circuits, 4th edition, New AgeInternational (P) Ltd, Chennai,2010.

Books for Reference

1. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Third Edition, Prentice Hall India, New Delhi,1997.
2. Donald P Leach, Albert Paul Malvino and GoutamSaha, Digital Principles and Applications, Sixth Edition, Tata McGrawHill publishing company Ltd, New Delhi,2008.
3. Allen Mottershead, Electronic devices and circuits, Prentice Hall India, New Delhi, 2000.
4. A.S.Sedra and K.C. Smith, Microelectronic Circuits, 6th edition, Oxford University Press, 2010.
5. Kenneth C. Smith, KC's Problems and Solutions for Microelectronic Circuits, 6th edition,Oxford University Press, New York 2009.

   G. Roberts and A.S. Sedra, Spice,3rd edition, Oxford University Press, 1996.

Websites for Reference

1. https://www.tutorialspoint.com/power_electronics/power_electronics_silicon_controlled_rectifier.htm#:~:text=A%20silicon%20controlled%20rectifier%20or,of%20high%20voltage%20and%20power.
2. https://www.tutorialspoint.com/power_electronics/power_electronics_triac.htm
3. https://www.electronics-tutorials.ws/power/unijunction-transistor.html
4. https://www.circuitstoday.com/lascr-light-activated-scr
5. https://www.tutorialspoint.com/linear_integrated_circuits_applications/linear_integrated_circuits_applications_basics_of_operational_amplifier.htm
6. https://www.tutorialspoint.com/linear_integrated_circuits_applications/linear_integrated_circuits_applications_log_and_anti_log_amplifiers.htm
7. https://www.tutorialspoint.com/linear_integrated_circuits_applications/linear_integrated_circuits_applications_digital_to_analog_converters.htm
8. https://www.tutorialspoint.com/linear_integrated_circuits_applications/linear_integrated_circuits_applications_waveform_generators.htm
9. https://www.tutorialspoint.com/linear_integrated_circuits_applications/linear_integrated_circuits_applications_555_timer.htm
10. http://generalengineering.sjsu.edu/docs/pdf/mse_prj_rpts/spring2010/Successive%20Approximation%20Analog%20to%20Digital%20Converter.pdf
11. http://plc.cwru.edu/tutorial/enhanced/files/lcd/intro.htm
12. http://vsagar.com/2011/12/16/how-ic-555-works-fundamentals-of-ic-555-its-basicapplications/
13. http://www.ti.com/lit/ds/symlink/lm555.pdf
14. http://www.youtube.com/watch?v=nV_AtmUS7lE

Semester - I

2. Energy and Environmental Physics

Elective: Energy and Environmental Physics

Semester-I **Hours/week: 4**

Sub. Code: P720B **Credits: 4**

Course objectives:

1. To introduce the students to energy and various types of energy conversion techniques, energy collection and laws of thermodynamics.
2. To impart the knowledge on nonrenewable energy to the students.
3. To ensure that the students gain knowledge regarding renewable energy.
4. To introduce the students regarding Bioenergy Resources and Fuel Cells
5. To enlighten the students regarding the energy crisis and environmental pollution and to inculcate various means to control pollution to safeguard environment.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Gain knowledge about energy, energy harvesting and saving.	K1-K3
CO 2	Acquire ideas about nonrenewable energy.	K1-K3
CO 3	Understand and gain knowledge about renewable energy.	K1-K3
CO 4	Gain knowledge about Biomass and various types of Fuel Cells.	K1-K3
CO 5	Be aware of environmental pollution and will know how to control them.	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	2	3	3	2	2	3	2	2.4
CO2	2	2	2	2	3	3	2	2	3	3	2.4
CO3	3	2	2	2	3	3	2	2	3	3	2.5
CO4	3	2	2	2	3	3	2	2	3	3	2.5
CO5	3	3	2	2	3	3	2	2	3	3	2.6
Mean Overall Score											2.5
Results											High

Unit - I: Energy and Thermodynamics

Energy- Concept and demand of energy - Growing energy needs - Environmental ethics - over exploitation of energy sources and associated problems - use of alternate energy sources- the first and second laws of thermodynamics - Free energy - Converting heat in to work - Reversible process –Carnot theorem - Conversion of matter in to more useful forms – Conversion of energy - Synthetic chemical fuels - Electrochemical energy conversion– Nuclear fission reactors - Fission power and environment - Role of an individual in conservation of natural resources - Conservation of the energy.

Unit - II: Nonrenewable Energy

Fossil fuels - Classification of fossil fuels, composition, physico- chemical characteristics and energy content of coal, petroleum, and natural gas - Origin and use of coal, coal –power plant - Cleaner coal combustion - Origin and uses of petroleum and natural gas - Composition and classification of petroleum and natural gas - Petroleum refinery - Gas hydrates- Environmental problems associated with petroleum.

Unit - III: Renewable energy

Introduction - Types: Solar energy, geothermal, wind energy - Principals of generation of hydroelectric power - Principals of generation of solar electric power – Solar cell fabrication - I-V characteristics- Factors limiting the efficiency of silicon solar cells - Principles of Solar Water Heating System- Natural and Forced Circulation types - Principals of generation of electric power from wind - Ocean thermal energy conversion - Waste as renewable sources of energy - types of waste, classification based on chemical nature and physical state, composition of the waste - conversion of methane in to synthetic gas - factors effecting methane formation- Management of renewable energy.

Unit - IV: Bioenergy Resources and Fuel Cells

Biomass as a source of energy: Biomass and its uses - Classification of biomass – Biodiesel from Jatropha - Advantages and disadvantages of biodiesel - Storage and use of biodiesel - Biogas as a rural energy source - Biogas production mechanism from organic wastes - Gasification and combustion of biomass- Bioethanol production. Fuel cells: Hydrogen fuel cell, metal hydrate fuel cell, microbial fuel cell.

Unit - V: Environmental Pollution

Global warming as an energy problem - Impact of climate change on energy demand – Ozone layer depletion- Climate changes - Acid rain - Sea level raises - Nature and manmade disasters - air pollution - Types and sources of air pollutants - Methods to control air pollution - water pollution - Types and sources of water Pollutants - Methods to control water pollution - soil pollution - Types and sources of soil pollutants- - Methods to control soil pollution- Biodegradable plastics- Bio fertilizers - Bio pesticides.

Books for Study

1. Taylor and Miller,Environmental Science -10th Edition, Thomson Asia Pvt. Ltd. Publications, Singapore, 2008.
2. ViswanathanB,An Introduction to Energy Sources- Indian Institute of Technology, Madras, 2006.
3. Boyle GF Renewable Energy - Power for a Sustainable Future, Second edition, Oxford University Press, 2004.
4. Singh, J.S., Singh S.P. and Gupta S. R. Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi, 2006.

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1. Glyll Henry and Gary W. Heinke Environmental Science and Engineering Pearson Education, New Delhi, 1996.
2. John Andrews and Nick Jelly ,Energy Science: Principle, Technologies, and Impacts - Oxford University Press, 2007.
3. Kurian Joseph and Nagendra R Essential of Environmental Studies, Pearson Education, New Delhi, 2004.
4. Sharma BK and Kaur SH Environmental Chemistry. GoelPublishing House, Meerut 1992.
5. Sukhatme K., Suhas P. Sukhatme, Solar Energy: Principles of Thermal Collection andStorage, Tata Mc-Graw Hill, New Delhi, 2006.
6. Nelson J., The Physics of Solar Cells, Imperial College Press, 2003.
7. Duffie J.A. and Beckman W.A., Solar Thermal Energy Engineering, John Wiley & Sons, 1990.
8. Mary D. Archer, Robert W. Hill, Clean Electricity from Photovoltaics, Imperial College Press, 2001.
9. J.N.B. Bell Air Pollution and Plant Life, 2nd Edition, John Wiley and Sons, New Delhi 2002.
10. N.P Cheremisinoff, Biotechnology for Waste and Wastewater Treatment, William Andrew Publishing, New York, 1996.
11. Kothari, D.P., Singal, K.C. and Ranjan, R., Renewable energy sources and emerging technologies, prentice hall, New Delhi, 2008.

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1. www.physicalgeography.net/fundamentals/6e.html
2. www.conserve-energy-future.com/
3. www.jatrophabiodiesel.org/
4. www.gasification.org/
5. www.corecentre.co.in/Database/Docs/DocFiles/ems.pdf
6. http://www.altenergy.org/renewables/solar.html
7. http://en.wikipedia.org/wiki/Solar_power_in_India
8. http://en.wikipedia.org/wiki/Solar_energy
9. http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/how-solarenergy-works.html

Semester - I

3. Astrophysics

Elective: Astrophysics

Semester - I **Hours/week: 4**

Sub. Code: P720C **Credits: 4**

Course objectives:

1. To understand astrophysical processes and systems, ranging from sun to stars, galaxies and Universe.
2. To Study of birth and death of stars and types of stars.
3. To know the effect of temperature on stellar spectra and basics of its quantitative analysis
4. To know the members of our solar systems and its atmosphere.
5. To understand the working principle of Astronomical Telescope.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Classify different celestial objects and understand about universe	K1-K2
CO 2	Understand the impact of astronomical bodies and formation of stars.	K1-K3
CO 3	Explain stellar evolution, including red giants, supernovas, neutron stars, pulsars, white dwarfs and black holes, using evidence and presently accepted theories.	K1-K3
CO 4	Describe the features of objects in the Solar System (Sun, planets, moons, asteroids, comets, planetary interiors, atmospheres)	K1-K3
CO 5	Demonstrate the ability to observe the celestial objects by astronomical telescopes and instrumentation.	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	3	2	2	3	3	3	2	2.6
CO2	3	3	2	3	2	2	3	3	3	2	2.6
CO3	3	3	2	3	2	3	2	3	3	2	2.6
CO4	2	2	2	2	2	3	3	3	3	2	2.4
CO5	2	3	2	3	2	2	3	2	3	3	2.5
Mean Overall Score											2.5
Result											High

Unit - I: Galaxies and The Universe

The Milky Way galaxy: The composition of galaxies, the classification of galaxies, the interstellar medium, atomic and molecular clouds, the rotation curve of galaxies, Darkmatter in galaxies

The Universe: Clusters of galaxies, Active Galactic Nuclei, The Big bang cosmology, the Cosmic Background Radiation, The expansion rate of the universe, A review of current problems and ideas.

Unit - II: Stellar Evolution, Binary and Variable Stars

Nebulae – types of nebulae - The evaluation of the Stars: Birth of a star – Death of a star – Chandrasekhar limit – white dwarfs –Neutron Stars – black holes–Supernovaeexpolsions- Binary stars – visual Binary – spectroscopic Binary – Eclipsing Binary – Origin of Binary stars - Variable stars – types – cepheid variables, pulsating variables

Unit - III: Spectral Classification of Stars

The H-R diagram and the main sequence, The equation of hydrostatic equilibrium, Viral theorem, Eddington's theory of the stars, Mass luminosity relation, the life time of the stars of different masses, the solar neutrinos.

Unit - IV: Solar System

The Sun– physical and orbital data – photosphere – chromo sphere – corona - the internal temperature of the sun, the energy generation in the centre, nuclear reactions - Members of the solar system – Mercury – Venus – Earth – Mars- Jupiter – Saturn – Uranus - Neptune - Pluto – Moon - Asteroids – comets – Meteors.

Unit - V: Astronomical Telescope

Introduction to contemporary Astronomy: Optical, Infrared, Ultraviolet, Radio, X-ray and Gamma Ray Astronomy, Observational Techniques: Optical Telescopes: Reflecting and Refracting Telescope - Radio telescopes, Detectors for X-ray and Gamma rays – Hubble's space telescope.

Text Books:

1. K.S. Krishnaswamy, 'Astro physics a modern perspective', Reprint, New Age International (P) Ltd, New Delhi, 2002.
2. BaidyanathBasu, 'An Introduction to Astro Physics', second edition, Prentice Hall of India Private limited, New Delhi, 2010.
3. Sparke&Gallagher,Galaxies in the Universe, Cambridge Univ. Press, 2000
4. Longair M, High Energy Astrophysics Vol-I &II, , Cambridge Univ. Press, 1992
5. RydenB,Introduction to Cosmology, Cambridge Univ. Press, 2002

Books for Reference:

1. R.Murugesan, 'Modern Physics', Eighteenth edition, S. Chand & Company Ltd, New Delhi, 2019.
2. S.Kumaravelu, 'Astronomy', Janki calendar corporation, Sivakasi, 1993.
3. Baker and Fredrick, 'Astronomy, ninth edition, Van NO strand Rein hold, Co, New York, 1964.
4. Illustrated World of Science Encyclopedia – Vol I and Vol VIII – creative World publications, Chicago,1971
5. RydenB ,Introduction to Cosmology,Cambridge Univ. Press, 2002
6. Shu F.H., Physical Universe, University Science Books, 1982
7. T. Padmanabhan, An Invitation to Astrophysics, World Scientific, 2006.

Websites References:

1. https://science.nasa.gov/astrophysics
2. http://solarviews.com/eng/solarsys.htm
3. http://hyperphysics.phy-astr.gsu.edu/hbase/Starlog/staspe.html
4. http://astro.unl.edu/naap/hr/hr_background1.html
5. http://www.enchantedlearning.com/subjects/astronomy/stars/startypes.shtml
6. http://hyperphysics.phy-astr.gsu.edu/hbase/geoopt/teles2.html
7. http://www.colorado.edu/physics/phys1230/phys1230_fa01/topic40.html
8. http://www.infoplease.com/cig/theories-universe/scientific-origins-universe.html
9. http://www.thebigger.com/physics/universe/explain-the-various-theories-of-the-origin-of-universe/
10. http://solarviews.com/eng/starformation.htm

Semester – II

Mathematical Physics-II

Mathematical Physics - II

Semester - II **Hours/week: 5**

Sub. Code: P820 **Credits: 4**

Course objectives:

1. To provide an insight into complex analysis and enable the students to solve problems.
2. To make the students to learn Green's function and its applications in different fields of physics.
3. To impart the knowledge to understand series solutions and special functions and enable them to apply it to solve Physics problems.
4. To make the students learn to solve various types of problems related to numerical techniques.
5. To enable the students to understand the basics of group theory, that will make them to analyze symmetries and their implications in the field of Physics.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Acquire the knowledge of complex derivatives function and operate analytic functions, and solve problems in complex integrations.	K1-K3
CO 2	Understand homogeneous and non-homogeneous equation to solve Green's functions along with boundary value problems.	K1-K3
CO 3	Gain the knowledge of series solutions and special functions and enable them to apply and solve problems in classical, statistical, quantum mechanics and electromagnetism.	K1-K3
CO 4	Distinguish numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, and solution of first order differential equations and enable them to solve problems.	K1-K3
CO 5	Recognize the basic ideas of groups, representations of groups, character table formation and application of group theory.	K1-K2

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	3	2	3	3	3	2	2	2.6
CO2	3	3	3	3	3	3	3	2	2	2	2.7
CO3	3	3	3	3	2	3	3	2	2	2	2.6
CO4	3	3	2	3	3	2	3	3	1	3	2.6
CO5	3	1	3	3	3	3	2	3	3	3	2.7
Mean Overall Score											2.6
Results											High

Unit-I: Complex Analysis

Complex function – Analytic function – Limit, Continuity – Differentiability – Cauchy-Riemann conditions-Cauchy's integral theorem (simply and multiply connected regions) – Cauchy's integral formulae – singularities of an analytic function – Residues – Cauchy's residue theorem –Evaluation of definite integrals-Contour integration.

Unit –II: Green's function

Homogeneous and non homogeneous equation (introduction only) – Green's function for one dimensional case – Wronskian's determinant – General proof and symmetry property of Green's function – Boundary value problems – Eigen function expansion of Green's function- Green's function for Poisson's and its solution – Green's function for quantum mechanical scattering problem.

Unit –III: Special Functions

Series solutions – Legendre, Bessel, Hermite and Laguerre's differential equations - generating functions-orthogonal properties-Recurrence relations.

Unit –IV: Numerical Methods

Newton-Raphson method-Finite differences- Forward difference, Backward differences-Numerical integration- Trapezoidal rule- Simpson's $1/3^{rd}$and $3/8^{th}$rule-Interpolation- Newton forward and backward interpolation formula – Lagrange's interpolation- solving first order differential equations Runge-kutta method of fourth order.

Unit –V: Group Theory

Group – basic properties – Abelian group – isomorphic group – similarity transformation and classes – group multiplication tables - Representation of Groups: symmetric elements – transformation, matrix representation – Point groups – reducible and irreducible representations – The Great OrthogonalityTheoremd-Construction of character tables for point groups C2V and C3V, structure of character tables –Mulliken's notations for irreducible representations – Applications: IR and Raman active vibrations of XY_3 type molecule – Application of group theory to chemical bonding.

Text Books

1. H K Dass, Dr. Rama Verma, Mathematical Physics, Sultan Chand & Sons, New Delhi, 2013
2. Gupta B. D, Mathematical Physics, New Delhi, Vikas publishing house, 2006.
3. P Satyaprakash, Mathematical Physics, Sultan Chand & Sons, New Delhi 2004.
4. Suresh Chandra, A Text Book of Mathematical Physics, Narosa Publishing House, New Delhi, 2006.
5. S.S.Sastry, Introductory methods of numerical analysis, Prentice hall of indiaPvt Ltd, New Delhi, 2012
6. M K.Jain, S.R.K.Iyengar, R.K.Jain, Numerical Methods : For Scientific And Engineering Computation, New agePvt Ltd, New Delhi, 2012
7. P.Kandasamy, K.Thilagavathi, K.Gunavathi,Numerical Methods, S.Chand Pvt Ltd, New Delhi, 2006

Books for Reference

1. G.B Arfken, J Weber, Mathematical methods for physicists, Elsevier academic press, 2005
2. E Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt Ltd, New Delhi, 2015
3. K F Riley, M P Hobson and S J Bence, Matehmatical methods for physics and Enginnering, Cambridge university press, USA, 2006
4. Mary L.Boas, Mathematical methods in the physical sciences, Wiley India Pvt Ltd, New Delhi, 2006.
5. Tai L. Chow, Mathematical Methods for Physicists: A concise introduction, Cambridge university press, USA, 2000
6. Chattopadhyay P. K., Mathematical Physics, , New Age International (P) Ltd, Madras

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1. https://math.mit.edu/~jorloff/18.04/notes/topic4.pdf
2. https://complex-analysis.com/
3. http://www.maths.lth.se/matematiklu/personal/olofsson/CompHT06.pdf
4. https://mathworld.wolfram.com/GreensFunction.html
5. https://brilliant.org/wiki/greens-functions-in-physics/
6. http://egyankosh.ac.in/bitstream/123456789/12543/5/Unit-3.pdf
7. http://ion.uwinnipeg.ca/~gkunstat/MathPhys2014W/Resources/math_phys_redbook/06-Special%20Functions.pdf
8. https://www.msuniv.ac.in/Download/Pdf/aa6c43e4d516475
9. https://www.vssut.ac.in/lecture_notes/lecture1428550358.pdf
10. https://medium.com/cantors-paradise/an-invitation-to-group-theory-c81e21ab739a
11. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Group_Theory/Group_Theory%3A_Theory
12. http://www.matfys.lth.se/education/FYS256/aryasetiawan.pdf
13. https://ethz.ch/content/dam/ethz/special-interest/chab/physical-chemistry/ultrafast-spectroscopy-dam/documents/ lectures/ spectroscopy FS20/ Script/PCV_Ch4.pdf

Semester – II

Electromagnetic Theory

Electromagnetic Theory

Semester - II **Hours/week: 5**

Sub. Code: P821 **Credits: 4**

Course objectives:

1. To provide a clear and logical presentation of problems in electrostatics.
2. To apply Biot-Savart law, scalar and vector potentials to measure magnetic fields.
3. To learn Maxwell's Equations and their applications.
4. To understand Fields and Radiation of Electromagnetic Sources
5. To develop an understanding of the propagation of electromagnetic waves and their properties.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Solve few electrostatics problems using Laplace equation.	K1-K3
CO 2	Use Biot-Savart law, magnetic scalar and vector potentials to deduce magnetic fields due to current carrying elements.	K1-K2
CO 3	Apply Maxwell's equations for the conservation of electromagnetic energy and momentum.	K1-K2
CO 4	Understand fields and radiation from antennas and deduce expression for power radiated from radiation sources.	K1-K3
CO 5	Describe the propagation of electromagnetic waves in various media and discuss the kinematics and dynamic properties of electromagnetic waves.	K1-K2

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	2	2	2	2	3	2	2	2.3
CO2	2	3	2	2	2	2	2	2	3	3	2.3
CO3	2	2	2	2	2	2	3	2	3	3	2.3
CO4	3	2	3	3	2	2	3	2	3	3	2.6
CO5	2	3	2	2	2	2	2	2	3	3	2.3
Mean Overall Score											2.4
Results											High

Unit – I: Electrostatics

Electric field due to a system of charges-Charge distribution-charge densities-Electrostatic Potential- Multipole expansion of charge distribution-Gauss law in integral and differential forms - Poisson's equation-Laplace's equation-Solution of Laplace's equation in spherical coordinates-Conducting sphere in a uniform field-Field at external and internal points-displacement vector-Dielectric Polarization-Dielectric sphere in a uniform field-Field at external and internal points-Electrostatic energy**.**

Unit – II: Magnetostatics

Biot-Savart law- Integral and differential form-Application to a Circular coil-Ampere's circuital law in differential and integral forms-Application to a straight wire and Force between two parallel wire-Magnetic vector potential- Characteristics of Magnetic vector potential- Application to a distant current loop-Magnetic scalar potential-Characteristics of Magnetic scalar potential-Application to a magnetic dipole(circular current loop)-Magnetostatic energy.

Unit– III: Maxwell's Equations and their applications

Faraday's laws of induction-Equation of continuity for charge-Maxwell's displacement current-Maxwell's equations in integral and differential form-significance-Non uniqueness of electromagnetic potential: Gauge invariance-Coulomb's and Lorentz gauges - Lorentz force-Lorentz force interms of electric and magnetic potentials -Energy and momentum of the field-Conservation laws for a system of charges and electromagnetic fields-Poynting's theorem-continuity equation for energy.

Unit - IV: Fields and Radiation of Electromagnetic Sources

Retarded potentials-Oscillating electric dipole: magnetic vector and scalar potentials-electromagnetic fields-poynting vector and radiated power-Radiation from a small current element: radiation power and radiation resistance-Radiation from a linear antenna-Centre fed half antenna-Antenna arrays.

Unit – V: Wave Propagation and properties

Wave equation and plane wave solution-Propagation of electromagnetic waves in free space, isotropic dielectric-Propagation in conducting media-Skin depth-Reflection and Refraction at a plane interface: kinematic properties-dynamic properties-Fresnel's formulae(oblique incidence)-Propagation between two perfectly conduction planes-Propagation of waves in a rectangular wave guide.

Text Books

1. SatyaPrakash, Electromagnetic theory and Electrodynamics, Meerut, KedarNath Ram, 2010.
2. David.J.Griffiths, Introduction to Electrodynamics, New Delhi, Addison Wesley, 2012.
3. Uma Mukherji,Electromagnetic field Theory and Wave Propagation, New Delhi, NarosaPublishing House, New Delhi, 2006.

Books for Reference

1. Agarwal G. C., Chopra K. K., Electromagnetic Theory, K Nath&Co.,Meerut 2019.
2. Edward C.Jordan, Keith G. Balmain, Electromagnetic waves and Radiating systems, Prentice Hall of India, 2005.
3. Reitz John R., Foundations of Electromagnetic Theory,Pearson Education India, New Delhi, 2009.
4. Puri S.P, Classical Electrodynamics,Tata McGraw-Hill publishing company Limited, New Delhi, 1997.
5. Prasad K.D, Antenna and Wave Propagation,Sathyaprakashan, New Delhi, 1993.
6. Meenakumari, R.,Subasri R., Electromagnetic fields, second edition,New Age International Publishers, New Delhi, 2008.
7. J.D.Jackson, Classical Electrodynamics, 3rd Edition, Wiley Eastern Ltd, New Delhi, 1998.

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1. http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html
2. https://books.physics.oregonstate.edu/GSF/maxwell1.html
3. http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html
4. https://en.wikipedia.org/wiki/Biot%E2%80%93Savart_law
5. http://odessa.phy.sdsmt.edu/~lcorwin/PHYS721EM1_2014Fall/Chap6p3_Hyun.pdf
6. https://winnerscience.com/2012/02/24/gauss-law-differential-form-derivation/
7. https://www.ece.mcmaster.ca/faculty/nikolova/antenna_dload/current_lectures/L03_RadIS.pdf
8. http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/
9. https://www.everythingrf.com/community/what-is-skin-depth
10. http://web.mit.edu/6.013_book/www/chapter13/13.4.html

Semester – II

Quantum Mechanics-II

Quantum Mechanics–II

Semester–II **Hours/week: 5**

Sub. Code: P822 **Credits: 4**

Course objectives:

1. To understand the concept of time dependent perturbation theory.
2. To provide knowledge on scattering theory in quantum mechanics.
3. To learn basic ideas of relativistic quantum mechanics of charged particles
4. To impart knowledge on Dirac equation and the transformations for Dirac equation.
5. To introduce the students to quantum field theory through the learning of relativistic Lagrangian and Hamiltonian formalisms.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Learn and understand the fundamental principle of time dependent perturbation theory and its application to physical situations.	K1-K2
CO 2	Gain knowledge on scattering phenomena occurring in quantum mechanics.	K1-K3
CO 3	Understand the fundamental principles of relativistic quantum mechanics and solution of KG equation for charged particles in electromagnetic field.	K1-K3
CO 4	Acquire knowledge of Dirac equation and matrices and their role in Lawrence transformation of Dirac equation.	K1-K3
CO 5	Understand the concept of quantum field theory by learning relativistic Lagrangian and Hamiltonian formulations.	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	2	2	2	2	3	2	2	2.3
CO2	3	3	3	1	2	2	2	2	3	3	2.4
CO3	2	2	2	2	2	2	3	2	3	3	2.3
CO4	3	2	3	3	2	2	3	2	3	3	2.6
CO5	3	3	2	1	2	2	2	2	3	3	2.3
Mean Overall Score											2.4
Results											High

Unit– I: Time Dependent Perturbation Theory

Time dependent perturbation theory – first order transitions – Constant and harmonic perturbations – Transition probabilities – Fermi–Golden rule–Semi classical treatment of an atom with electromagnetic radiation – Selection rules for dipole radiation – Adiabatic approximation – Sudden approximation – The density matrix – Spin density

Unit – II: Quantum theory of Scattering

Kinematics of scattering – Scattering cross sections – Scattering amplitude – Transformation from centre of mass system to laboratory frame – Partial wave analysis: Asymptotic behaviour – Phase shifts – Differential and total cross sections – Optical theorem – Ramsaur–Townsen effect – Born approximation and its validity – Applications: Scattering by square well potential.

Unit – III: Relativistic Quantum Mechanics – I

Schrodinger relativistic equations – Klein–Gordon equation – K.G. equation for a charged particles in electromagnetic field – Solution of K.G. equation with Coulomb potential – Difficulties in K.G. equation – Dirac's relativistic wave equation – Dirac Hamiltonian – Dirac Matrices – Equation of continuity using Dirac's equation – Plane wave solutions of Dirac equation for a free particle – negative energy states.

Unit – IV: Relativistic Quantum Mechanics – II

Covariant form of Dirac equation – Properties of gamma matrices – Traces – Relativistic invariant of Dirac equation under Lorentz transformation – T–Transformation for the Dirac equation without and

with electromagnetic field – Projection operators for energy and spin – Dirac equation under a central potential: Total angular momentum.

Unit– V: Quantization of Fields

Difference between classical and quantum fields – Relativistic Lagrangian and Hamiltonian of charged particle in an electromagnetic field –Lagrangian and Hamiltonian formulations of field – Second quantization of Klein–Gordon field – Creation and annihilation operators – Commutation relations– Quantization of non–relativistic Schrödinger's field

Text Books

1. Aruldhas.G, Quantum Mechanics,Prentice Hall of India Pvt. Ltd. NewDelhi,2007.
2. Sathyaprakash, Quantum Mechanics, KedranathRamnath , New Delhi, 2001.
3. Guptha Kumar Sharma, Quantum Mechanics, Jai prakashNath publications, 2012.

Books for Reference

1. Devanathan.V, Quantum Mechanics, Narosa Publishing House, New Delhi ,2005.
2. Devanarayanan S., Quantum Mechanics, ,Scitech Publications (India) Pvt. Ltd., New Delhi ,2005.
3. Chaddha G. S., Quantum Mechanics, , New Age International (P) Ltd. Publishers, New Delhi ,2006.
4. Thankappan V. K., Quantum Mechanics, New Age International (P) Ltd. Publishers, New Delhi ,2008.
5. Mathews P.M. andVenkatesan K., A Text book of Quantum Mechanics, , Tata McGraw–Hill, New Delhi ,2010.
6. Guptha S.L and Guptha S.D, Advanced Quantum Theory and Fields, , S.Chand and Co. Pvt. Ltd., New Delhi ,1986.
7. Sakurai J. J., Jim J. Napolitano, Modern Quantum Mechanics, 2nd Edition, , Addison Wesley, New Delhi ,2010.

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1. http://www.physics.sfsu.edu/~greensit/book.pdf
2. http://webee.technion.ac.il/labs/Quantum_Engineering/files/papers/qm_lecture_notes.pdf
3. http://physics.bgu.ac.il/~dcohen/ARCHIVE/qmc.pdf

Semester – II

Advanced Physics Practicals

Advanced Physics Practicals

(Any 15 experiments)

Semester - II **Hours/week: 6**

Sub. Code: PP809 **Credits: 6**

Course objectives:

1. **To provide the students with a broad understanding of experimental procedures, calculations of some physical parameters such as young's modulus, viscosity**
2. **To help the students towards the critical und creative thinking through few spectroscopic experiments**
3. **To make the students to evaluate the electrical resistivity and conductivity of semiconducting materials**
4. **To empower the students to demonstrate few heat experiments**
5. **To train the students towards the skill development of advanced general physics experiments**

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	**Do Young's modulus experiments and to calculate the young's modulus, poisson's ratio and viscosity for the given materials**	K1-K4
CO 2	**Set up the apparatus to get the spectra of light sources such as hydrogen, arcs of alloys/metals etc.**	K1-K3
CO 3	**Determine the electrical conductivity and resistivity of a semiconducting material using four probe apparatus**	K1-K4
CO 4	**Obtain the saturation temperature of a black body and hence they are able to calculate the stefan's constant and temperature coefficient of thermistor**	K1-K4
CO 5	**Do themselves independently few advanced general experiments such as half shade polarimeter, Planck's constant experiment**	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	

CO1	3	3	2	2	2	2	2	3	2	2	2.3
CO2	3	3	3	3	2	2	2	2	3	3	2.6
CO3	2	2	2	2	2	2	3	2	3	3	2.3
CO4	3	2	3	3	2	2	3	2	3	3	2.6
CO5	3	3	2	3	2	2	3	2	3	3	2.6
									Mean Overall Score		**2.5**
									Results		**High**

List of experiments:

1. **Cornu's method - Young's modulus and Poisson's ratio by elliptical fringes.**
2. **Cornu's method - Young's modulus by hyperbolic fringes.**
3. **Determination of Stefan's constant.**
4. **Band gap energy - Thermistor.**
5. **Hydrogen spectrum - Hartmann's Interpolation formula- Rydberg's constant.**
6. **Viscosity of liquid - Meyer's disc.**
7. **Solar spectrum - Hartmann's Interpolation formula.**
8. **F.P. Etalon using spectrometer.**
9. **Iron / Copper arc spectrum.**
10. **Lasers: Study of laser beam parameters.**
11. **Particle size determination using Laser.**
12. **Electrical resistivity and conductivity of a semiconductor by four probe method.**
13. **Spectrometer - Charge of an electron.**
14. **Spectrometer- Polarizability of liquids by finding the refractive indices at differentwavelengths.**
15. **Determination of dielectric constant of a liquid by RF oscillator method.**
16. **Determination of Planck's constant.**
17. **Fiber optic experiments – Numerical aperture, Acceptance angle and Attenuation of givenoptical fiber.**
18. **Co efficient of linear expansion –air wedge method**
19. Impedance measurement using LCR Bridge
20. Dielectric constant of Liquids and Solids by capacitance method.
21. Experiment with Silicon solar cell
22. Measurement of absorption coefficient of a material (supplied) using laser light.
23. Laurentz half shade polarimeter

Semester – II

Electronic Experiment

Electronics Experiments

(Any 20 Experiments)

Semester - II **Hours/week: 6**

Sub. Code: PP810 **Credits: 6**

Course objectives:

1. To familiarize students with various Electronic devices and their specifications.
2. To observe characteristics of electronic devices
3. To understand the design aspects of oscillator circuits
4. To familiarize the students with devices and circuit principles with special focus on applications related to instrumentations and measurements.
5. Develop skill for Design and Testing of different types of Electronic subsystems using Analog and Digital IC's.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Elucidate the basic operation of various power semiconductor devices.	K1-K4
CO 2	Describe and analyze the characteristics of different electronic devices.	K1-K3
CO 3	Measure voltage, frequency and phase of any waveform using CRO.	K1-K4
CO 4	Design and implement various digital circuits.	K1-K3
CO 5	Develop ability to diagnose faults and their rectification.	K1-K4

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)	Programme Specific Outcome (PSO)	

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean score of COs
CO1	3	3	2	2	2	2	2	3	2	2	2.3
CO2	3	3	3	2	2	2	2	2	3	3	2.5
CO3	3	2	2	2	2	2	3	2	3	3	2.4
CO4	3	2	3	3	3	2	3	2	3	3	2.7
CO5	3	3	3	3	2	2	3	3	3	3	2.8
Mean Overall Score											**2.5**
Results											**High**

List of Experiments:

1. Characteristics of SCR and Triac
2. UJT characteristics and UJT as relaxation oscillator
3. Op-amp – Applications- Log amplifier, antilog amplifier, differentiator and integrator.
4. Op-amp -Study of the attenuation characteristics and design of the phase-shift oscillator.
5. Op-amp - Study of the attenuation characteristics and design of the Wien Bridge oscillator.
6. Op-amp-Schmitt trigger
7. Op-amp - Solving simultaneous equations
8. Op-amp - Design of square wave, saw tooth wave, and Triangular wave generators.
9. Op-amp - Design of active filters –Second order- low pass, high pass, band pass and band rejecter.
10. Op-amp – D/A converter - Binary weighted method - R/2R ladder method.
11. Modulus counters using IC 7490 and seven segment display.
12. 4 - Bit Synchronous/Asynchronous Up-down counters using IC 7473/IC7476.
13. 4 - Bit Shift Registers - Ring counter, Twisted Ring counter/Johnson's counter using IC 7473/IC7476.
14. IC 7483 - Arithmetic operations.
15. IC 555 –Astablemultivibrator and Voltage Controlled Oscillator.
16. IC 555 – Monostablemultivibrator and Frequency Divider.
17. IC 555 - Schmitt Trigger and Hysteresis loss.
18. Multiplexer and Demultiplexer.
19. Photodiode characteristics
20. Op-amp 8-bit DAC
21. Characteristics of LVDT
22. V-I Characteristics of Solar cell.
23. Op-amp: I to V, V to I converter
24. A/D converter: 4 bit simultaneous A/D converter and successive approximation A/D converter using IC0801/IC0804.

Semester – II

Microprocessor 8085 and Microcontroller 8051

Elective: Microprocessor 8085 and Microcontroller 8051

Semester-II **Hours/week: 4**

Sub. Code: P823A **Credits: 4**

Course objectives:

1. To illustrate the architecture and interrupts of 8085 Microprocessor.
2. To familiarize students with instruction sets, addressing modes and programming of 8085 microprocessor.
3. To familiarize the students with interfacing of memory with 8085microprocessor.
4. To illustrate the architecture of 8051 Microcontroller.
5. To familiarize students with instruction sets, addressing modes and programming of 8051 Microprocessor.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Gain knowledge about architecture and working of 8085 Microprocessor.	K1-K3
CO 2	Develop assembly language programs using various programming tools in 8085 Microprocessor.	K1-K3
CO 3	Illustrate how the different peripherals are interfaced with 8085Microprocessor.	K1-K3
CO 4	Understand the internal design of 8051 microcontroller along with the features.	K1-K3
CO 5	Develop assembly language programming to design microcontroller-based systems.	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	2	2	2	2	2	3	2	2	2.2
CO2	3	3	3	2	2	2	2	2	3	3	2.5
CO3	3	2	2	2	2	2	3	2	3	3	2.4
CO4	2	2	3	3	3	2	3	2	3	3	2.6
CO5	3	2	3	3	2	2	3	3	3	3	2.7
Mean Overall Score											2.5
Results											High

Unit – I:Architecture and Interrupts of 8085A Microprocessor:

8085A Microprocessor: Features of 8085A Microprocessor-Pin configuration of 8085A Microprocessor- Architecture of 8085A Microprocessor.

Interrupts: Interrupt and its need - Classification of Interrupts- Priorities of Interrupts- Enabling, Disabling and Masking of interrupts: EI, DI, SIM and RIM instructions.

Unit - II:Instruction Set and programming of 8085A:

Instruction Set: Instructions-Classification of instructions based on length and function-Data TransferInstructions - Arithmetic instructions - Logical Instructions - Branch Instructions-Stack and Stack Related Instructions - I/O Instructions - Subroutines - Addressing Modes.

Programming 8085A:8-bit and 16 bit addition, 8-bit and 16 bit Subtraction, 8-bit BCD to HEX and HEX to BCD code conversions- Time delay subroutines and Delay calculations.

Unit - III:Interfacing Memory and I/O devices to 8085A

Memory Interfacing: Basic Concepts in Memory Interfacing- De-Multiplexing Address/Data bus- Interfacing memory chips: 2K×8, 4K×8 RAM interface-2K×8, 4K×8 EPROM interface.

Interfacing I/O Devices: I/O Mapped I/O-Memory Mapped I/O-Programmable Peripheral Interface (8255) - LED Interface-Flashing of LEDs-Multiplexed Seven segment display interface.

Unit –IV: Architecture of 8051 Microcontroller

Microcontroller- Difference between microprocessor and microcontroller- pin diagram of 8051 - Internal architecture of 8051 - Memory organization: Program memory and Data memory -Special function registers –Program status word- Port operation: Port 0, Port 1, Port 2, Port 3.

Unit – V: Instruction setof 8051 and Programming:

Instruction set: Data transfer instructions-Arithmetic instructions-Logic instructions-Control transfer instructions –Addressing Modes: Register addressing-Direct addressing-Register- Indirect addressing-Immediate addressing-Base register plus Index register-delay routines

Programming: 8-bit addition, subtraction, Multiplication and division.

Text Books

1. V.Vijayendran, Fundamentals of Microprocessor – 8085: Architecture, Programming and Interfacing, S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai,2009.
2. A. NagoorKani, Microprocessor and its Applications, 3rd Edition, RBA Publications, Chennai,2017.
3. Krishna Kant, Microprocessors and Microcontrollers Architecture, Programming and System Design 8085, 8086, 8051, 8096, Second edition, PHI Learning Private Limited, New Delhi, 2014.

Books for reference

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and applications with the 8085, 6th edition, New Age International Publishers Ltd., New Delhi 2013.
2. Ram.B, Fundamentals of Microprocessor and Microcontroller, Seventh Edition, DhanpatRai Publications, New Delhi, 2012.
3. N. Senthilkumar, M. Saravanan, S. Jeevananthan, Microprocessors andMicrocontrollers, Oxford University Press, 2010.
4. A.P. Godse, D.A. Godse, Microprocessor and Applications, Second Edition, Technical Publications, Pune, 2018.
5. U.S. Shah, Microprocessor and Applications, McMillan Publishers India Ltd., New Delhi, 2011.
6. AdityaMathur, Introduction to Microprocessor, 3rd Edition, Tata McGraw Hill Publishing Company Ltd., 2017.
7. Muhammed Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems, Second Edition, Pearson Pubilcations, 2007.
8. SubrataGhoshal, 8051 Microcontroller: Internals, Instructions, Programming &Interfacing, Second Edition, Pearson Publications, 2014
9. AlkaKalra, Sanjeev Kumar Kalra, Architecture and Programming of 8085 Microcontroller, University Science Press, New Delhi, 2010.
10. Kenneth J. Ayala, The 8051 MicroController, 3rd Edition, Cencage Learning, New Delhi, 2007.

Websites references:

1. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.htm
2. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_pin_configuration.htm.
3. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_addressing_modes_and_interrupts.htm
4. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_instruction_sets.htm
5. https://www.tutorialspoint.com/microprocessor/microprocessor_intel_8255a_programmable_peripheral_interface.htm
6. https://www.tutorialspoint.com/microprocessor/microprocessor_intel_8255a_pin_description.htm
7. http://aturing.umcs.maine.edu/~meadow/courses/cos335/Intel8255A.pdf
8. http://northcampus.uok.edu.in/downloads/20161125104535111.pdf
9. https://www.tutorialspoint.com/microprocessor/microcontrollers_overview.htm
10. https://www.tutorialspoint.com/microprocessor/microcontrollers_8051_architecture.htm
11. https://www.tutorialspoint.com/microprocessor/microcontrollers_8051_pin_description.htm
12. https://www.tutorialspoint.com/microprocessor/microcontrollers_8051_input_output_ports.htm

Semester – II

Geophysics

Elective: Geophysics

Semester-II **Hours/week: 4**

Sub. Code: P823B **Credits: 4**

Course objectives:

1. To explore the fundamental background of geophysics and its importance among the earth science.
2. To make them understand the geomagnetic field and Magnetic elements.
3. To provide an understanding of Laboratory measurements of the physical properties of rocks.
4. To Study Natural and Artificial seismology and its relation to other Earth System.
5. To familiarize the students with thephysical properties of minerals

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Understand the physics and geology that form the basis for geophysical observation and measurement.	K1-K2
CO 2	Explain the principles of geothermal flux distribution over continents and oceans.	K1-K2
CO 3	Explain fundamental concepts underlying common exploration of petrophysics.	K1-K3
CO 4	Acquire the knowledge of application of seismology.	K1-K2
CO 5	Obtain knowledge about classification of minerals.	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	3	2	3	2	2	3	2	3	3	2.4
CO2	2	3	2	3	2	2	3	2	3	2	2.4
CO3	3	2	3	2	2	3	2	3	3	2	2.5
CO4	3	3	2	3	2	2	3	2	3	2	2.5
CO5	3	2	3	2	3	2	3	2	3	2	2.5
Mean Overall Score											2.5
Result											High

Unit – I: Introduction to Geophysics

Geophysics and its importance among earth Sciences-Earth as a member of the solar system - Geosphere: Scope of study of various Geospheres, Atmosphere, Ionosphere, Asthenosphere, lithosphere-hydrosphere and Biosphere. Meteorology, Oceanography and Hydrology - Atmosphere:Constituent, vertical structure, weather analysis and fore casting.

Unit – II: Gravity field

Gravity field and its variations on the surface, internal and external Field – Geoid, spheroid and Ellipsoid of the earth-shape and size of the earth - Geomagnetic field, Magnetic elements-Origin and Reversals of the magnetic field- Geothermics: Heat sources, Geothermal flux distribution over continents and oceans. Geochronology: Rock dating methods, U-Th, C-14, Fission-Track and magnetic dating.

Unit – III: Petrophysics

Different physical and engineering properties of rocks - Laboratory measurements of the physical properties of rocks: Density, Seismic wave velocities, magnetic susceptibility, Electrical resistivity, thermal conductivity, porosity and permeability.

Unit–IV: Seismology

Natural and Artificial seismology and its relation to other Earth System sciences. Classification of Earth quakes, Causes and propagation of Different seismic wave and fundamental laws - Interior of the Earth and Earth quake prediction.

Introduction to Seismograph: Principle and working of mechanical type seismograph, Milnes haw, wood Andersen seismograph, electromagnetic seismograph and broadband seismograph- Various methods for determination of focal depth and epicentre location.

Unit –V: Mineralogy

Introduction- symmetry and forms in common crystal classes –physical properties of minerals – isomorphism and polymorphism, classification of minerals – structure of silicates –mineralogy of common rock – forming minerals – mode of occurrence of minerals in rock.

Text books

1. William Lowrie, Fundamentals of Geophysics,2nd edition, Cambridge UniversityPress,NewYork,2007.
2. Markus .Bath, Introduction to Seismology,Revised edition, Springer Basel AG,2014.
3. G.W.Tyrrell,The principles of Petrology,2ndedition,Surjeet Publications, New Delhi,2019.

Books for Reference

1. D.K. Jha,Textbook of Geophysics , ALP Books,2015
2. Frank D.Stacey,Physics of Earth,4th edition ,Cambridge University Press, 2008.
3. John .M.Reynolds ,An introduction to Applied and Environmental Geophysics,2ndedition,Wiley,2011.
4. John Milsom, AsgerEriksen, Field Geophysics, 4th edition,Wiley,2011.
5. Peter Styles,IntroducingGeophysics,Dunedin Academic Press, 2021.
6. C.M.R.Fowler,The solid Earth,2nd edition, Cambridge University Press, 2004.
7. Karl Seibert,AppliedGeophysics,Syrawood Publishing house,2019
8. Robert J. Charlson, Gordon H. Orians,Earth System Science,1st edition, Academic Press,2000.

Websites for reference

1. https://earthquake.usgs.gov/learn/kids/become.php
2. http://www.eegs.org/what-is-geophysics
3. http://geophysics.geoscienceworld.org/
4. http://inside.mines.edu/Geophysics-Home
5. http://library.seg.org/journal/gpysa
6. www.uio.no/studier/emner/.../ppt/.../6-introduction-to-petrophysics-august-2015.pdf
7. http://petrowiki.org/Petrophysics
8. http://www.slb.com/services/characterization/petrophysics.aspx
9. http://www.geo.mtu.edu/UPSeis/waves.html
10. http://www.environmentalscience.org/career/seismologis
11. https://earthquake.usgs.gov/learn/glossary/?term=seismology
12. http://moes.gov.in/programmes/national-centre-seismology
13. http://serc.carleton.edu/NAGTWorkshops/mineralogy/index.html
14. http://www.environmentalscience.org/career/mineralogist

Semester – II

Bio Physics

Elective: Biophysics

Semester-II **Hours/week: 4**

Sub. Code: P823C **Credits: 4**

Course objectives:

1. To explore the fundamental background of physics behind the cellular and molecular structure and its dynamics.
2. To provide an insight knowledge about the application of light and bio compatible nonmaterial in the field of bio physics.
3. To know about the applications of bio sensors.
4. To make the students to understand the application of light and non-ionizing radiation effect on biological system
5. To make the students to know about the physiochemical techniques used for the detection and treatment of various diseases.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Explain physics behind the dynamics, molecular structure of proteins, amino acids and conduction system.	K1-K2
CO 2	Acquire the knowledge on various types of proteins, enzymes and its function in the bio metabolic activities.	K1-K3
CO 3	Acquire the knowledge of application of bio Nano sensors in diagnosing.	K1-K3
CO 4	Distinguish the effect of light, ionizing and non-ionizing radiation in the biological system	K1-K2
CO 5	Differentiate the physical and chemical approach of diagnosing and application of such techniques.	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	2	2	2	3	3	3	2	2.5
CO2	3	2	3	2	3	2	3	2	2	3	2.7
CO3	2	2	2	3	3	2	2	3	3	2	2.4
CO4	3	2	2	3	3	2	2	2	3	2	2.4
CO5	2	3	3	4	3	2	3	3	2	2	2.5
Mean Overall Score											2.5
Result											High

Unit- I Cellular Structure and Dynamics

Cell -Discovery of cell and Cell Theory- Comparison between plant and animal cells- Cell wall-Kinetics of cell growth-Mitosis & Cell divisionMolecular mechanism-Synchronization of cell cycles-Cell transformation-Cell Junctions-Cell transportation and malignant tumor growth - Cell aging and death-Differentiation of cultured cells-Water and ion transport.

Unit - II: Molecular structure and functions

Intra molecular and intermolecular forces-Entropy transfer of living organisms-Structure and function of disaccharides and polysaccharide-Amino acids-Primary and secondary structures of proteins-Enzyme structure - Classification of enzymes -function relation-Semiconduction in biological macromolecules-concentration and mobility of charge carriers in proteins- cells and tissues-Determination of activation energy- Role of adsorbed water in tissues.

Unit-III: Biocompatible Nano materials and Bio sensors

Nanobiotechnology- definition and scope-Biocompatibility and cytotoxicity studies of Nanomaterials-Biological metal nanoparticle synthesis and biomedical application-Dendrimers, quantum dots-Biosensors: Ion sensors –Anion and cation sensors- Membrane electrodes, Enzyme electrodes–Biocatalyst based biosensors –ISFET for glucose, urea -Fibre optic sensors, Photo acoustic sensorsand Radiation thermometry.

Unit- IV: Photo-biophysics

Different sources of Non-Ionizing radiation-their physical- properties- Various types of optical radiations-UV- visible & IR sources- Lasers-Theory and mechanism-Optical properties of tissues-photo thermal –photochemical-photo ablation- electromechanical effect-Radiofrequency & Microwave

radiation-Biomagnetism-Effects-application-Optical properties of skin, Acute and chronic effect of sunlight on skin, Photosensitivity, Photo toxicity.

Unit -V: Physiochemical Techniques

Sedimentation Principle- Types of rotors- Preparative and Analytical Centrifuges -Sterilization-Physical and Chemical methods of sterilization-Electrodes-types Design and properties and Utility, Skin contact impedance of Electrodes -chromatography-Instrumentation, working and biological applications of Column chromatography-Electrophoresis-Disc electrophoresis: Isoelectric focusing, -Radioisotopes and their Biological Applications

Books for study

1. P. Narayanan,Essentials of Biophysics, New Age International (P) Ltd. Publishers, New Delhi, 2000.
2. VasanthaPattabhi and N. Gautham,Biophysics, Narosa Publishing House, New Delhi,2002.
3. Pranab Kumar Banargy,Introduction of Biophysics, S Chand and Co, New Delhi,2000
4. N.Arumugam and Kumaresan "Biophysics" Saraspublication,2015

Books for reference

1. Barrow C,Physical Chemistry for Life Sciences Mc-Graw Hill,2007
2. Khandpur R. S., Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing Co. Ltd, 2003.
3. David Friefelder ,Molecular Biology, Narasa Publishing House, 2008
4. Thayalan, Basics of Radiobiological Principle" Jaypee Brothers Medical Publisher, New Delhi, 2003.
5. G Cooper & R Haussman, The Cell Molecular Approach,ASM Press, 2007.
6. HG Bohr,Handbook of Molecular Biophysics (Methods & Application), Wiley India Ltd, 2009.
7. Patric F Dillon, Biophysics A Physiological Approach, Cambridge Univ. Press, 2012.
8. James C & J Q Tran, Introductory Biophysics, John &Bartlet India Pvt Ltd, 2011.
9. Roland Glaser "Bio physics: An Introduction"2nd edition, Springer, 2012.

Websites references

1. https://en.wikipedia.org/wiki/Biophysics
2. http://www.biophysics.org/
3. www.biophysics.jhu.edu/class_sites
4. https://www.cell.com/biophysj/collections/introduction-to-biophysics
5. http://www.moleculargenetics.utoronto.ca/cellular-molecular-structure-function\
6. https://en.wikipedia.org/wiki/Nanobiotechnology
7. https://www.nanowerk.com/nanobiotechnology.php
8. https://en.wikipedia.org/wiki/Biosensor
9. https://www.imamagnets.com/en/blog/what-is-biomagnetism/

Semester – II

Ultrasonics and its Applications

Self-Study Paper: Ultrasonics and its applications

Semester-II

Sub. Code: P825SSP1 **Credits: 2**

Course objectives:

1. To impart the fundamental concepts of ultrasonic waves and their sources
2. To enable the students to understand the various instruments on generation ultrasonics waves and their applications.
3. To make the students to understand the influence of ultrasonic waves on molecular interactions studies in liquid systems
4. To learn the non-destructive testing and its importance in the industrial sectors.
5. To make them understand the medical applications of ultrasounds.

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Acquire fundament knowledge of ultrasonic waves and the sources of ultrasound.	K1-K3
CO 2	Learn and understand different ultrasonic instrumentations and general applications in the field of industries and measurements.	K1-K3
CO 3	Gain the knowledge of ultrasonic waves in finding molecular interactions in multi-component liquid mixtures.	K1-K3
CO 4	Recognize different types of ultrasonic non-destructive testing and their industrial applications.	K1-K3
CO 5	Grasp the idea about clinical importance of ultrasound in Ophthalmology, obstetrics and gynecology, cardiovascular, biopsy and tissue related treatments.	K1-K2

Mapping of COs with POs and PSOs

CO	Programme Outcomes(PO)					Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	3	2	3	3	3	3	2	2.7
CO2	3	3	3	3	2	3	3	3	3	2	2.8
CO3	3	3	3	3	2	3	3	3	3	2	2.8
CO4	3	3	2	3	2	2	3	3	2	2	2.5
CO5	3	2	2	3	3	3	3	3	3	3	2.8
Mean overall score											2.7
Result											High

Unit – I Fundaments of Ultrasonic Waves and its sources

Waves - wave parameters and characteristics – Classification of sound waves – ultrasonics waves – modes of ultrasonic waves – characteristic properties of ultrasonics waves – Behavior of ultrasonic waves.

Sources of ultrasound – materials of transmission and reception - characteristics of ultrasonic beam.

Unit – II Ultrasonic instrumentation and General applications

Ultrasonic instrumentation: Sing around method – pulse superposition method- Pulse echo overlap method – cross correlation method – phase slope method – Direct method.

General applications: high intensity applications – low intensity applications.

Unit – IIIUltrasonic Studies for Molecular Interactions

Types of molecular interactions – Ultrasonic study of molecular interactions - Propagation in multicomponent liquid mixtures– Measurement techniques: continuous wave method – Pulse echo overlap method – Theories of ultrasonic velocity in mixtures and solutions– Acoustical parameter.

Unit – IV Ultrasonic Non-Destructive Testing

Classification of Ultrasonic testing– basic methods: Resonance method – pulse method – acoustic emission method – calibration of testing systems – Flaw detector and applications – advantages in ultrasonic NDT.

Unit – V Ultrasound in Medicine

Transducers for medical imaging - Types of scan: dynamic focus – compound scanning – resolution – axial, lateral – factors affecting image quality – clinical applications of scan: ophthalmology – obstetrics and gynecology – cardiovascular applications - ultrasound guided biopsy – tissue doppler mapping.

Books for study:

1. BaladevRaj, Rajendran V and Palanichamy, “Science and technology of Ultrasonics”, Narosa publications, 2009.

2. Sindhu Sadhu, “Ultrasonic studies in liquids and their correlation with the structural aspect”, GIAN publishing house, New Delhi, 1987.
3. David J Cheeke N, “Fundamental and Applications of Ultrasonic waves ", CRC Press, 2002.
4. Jack Blitz, Ultrasonic: methods and applications, Newnes-Butterworth, 1971.
5. C.R. Hill, J.C.Bamber, G.R.TerHaar. “Physical principles of Medical Ultrasonic”, John Wiley & Sons, publishing, 2004.

Books for reference

1. Robert T. Beyer and Stephen V. Letcher, “Physical Ultrasonics”, Academic Press London, 1969.
2. Karl F.Herzfeld and Thheodore A Litovitz, Absorption and Dispersion of ultrasonic waves, Academic Press, New York, 1959.
3. I. Prigogine, the Molecular theory of solutions, North Holland Publishing company, Amsterdam, 1957.
4. P. Warren Mason and R.N. Thurston (Editors), Physical Acoustics, Principles and methods. Academic Press, Elsevier, New York, 1975
5. Michel Postema, “Fundamentals of Medical Ultrasonic", Spon press, 2011.

Website for reference:

1. https://www.sonotec.com/en/column/ultrasonic.html
2. https://www.encyclopedia.com/science-and-technology/physics/physics/ultrasonics
3. https://sci-hub.se/10.1088/0022-3735/16/3/001
4. https://instrumentationtools.com/ultrasonic-testing/
5. https://www.twi-global.com/technical-knowledge/faqs/ultrasonic-testing
6. https://byjus.com/physics/applications-ultrasound/
7. https://www.mana.md/different-uses-for-ultrasound/

Semester – II

Dielectric Spectroscopy P825SSP2

Self-study Paper: DIELECTRIC SPECTROSCOPY

Semester-II **Credits:2**

Course objectives:

1. To understand polarization and its dependence on frequency and temperature
2. To comprehend impedance spectrum and modulus spectrum
3. To derive the contribution to electrical conductivity due to grains and grain boundaries
4. To apply the hands on training and to interpret the data
5. To analyze the AC and DC conductivity of the dielectric materials

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Understand the various polarization mechanisms and dependence of polarization on frequency and temperature	K1-K3
CO 2	Explain the principle and construction of instrumentation and sample preparation	K1-K2
CO 3	Separate the contribution to electrical conductivity due to grains and grain boundaries	K1-K3
CO 4	Analyse the importance of the real and imaginary part of the modulus spectrum	K1-K2
CO 5	Collect data and to interpret the data	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	2	2	2	3	2	2	2.1
CO2	3	3	3	2	2	2	2	2	3	3	2.5
CO3	3	2	1	2	2	2	3	2	3	3	2.3
CO4	2	2	3	2	3	1	3	2	3	3	2.4
CO5	3	2	3	3	2	2	3	3	3	3	2.7
Mean Overall Score											2.4
Results											High

UNIT- I INTRODUCTION

Evolution of Broadband dielectric spectroscopy-Dielectric materials-Polarization- Different types of polarization-Frequency and temperature dependence of polarization- Dielectric permittivity-Real and Imaginary part of permittivity-Dielectric loss

UNIT-II INSTRUMENTATION AND DATACOLLECTION

Principle-Basic Instrumentation-LCR meter-sample preparation and data collection.

UNIT-III IMPEDANCE SPECTRUM

Importance -Real and Imaginary part of impedance-Variation of Real and Imaginary part of impedance with frequency and temperature-Cole-Cole plot-Equivalent circuit-Ideal Debye and Non-Debye circuits-Bulk resistance-Grain boundary resistance

UNIT- IV MODULUS SPECTRUM

Importance-Real and Imaginary part of modulus-Variation of Real and Imaginary part of modulus with frequency and temperature.

UNIT-V CONDUCTIVITY STUDIES

Conductivity measurements-ac conductivity- dc conductivity– Interpretation.

Text Books:

1. J. Ross Macdonald, Impedence spectroscopy Theory, Experiment and Applications- Wiley Interscience, 2005
2. Vadim F. Lvovich, Impedence spectroscopy Applications to Electrochemical and Dielectric phenomena- Wiley Publications, 2012

Books for References:

1. W. H. Hunter Woodward, Broadband Dielectric Spectroscopy-A Practical Guide-Chapter-I, ACS Symposium Series; American Chemical Society: Washington DC, 2021.
2. Friedrich Kremer, Andreas Schonhals, Broadband Dielectric Spectroscopy, Springer, Berlin, Heidelberg, 2003.

Website references:

1. https://www.sciencedirect.com/science/article/pii/B9780323461405000108
2. https://www.novocontrol.de/php/intro_overview.php
3. https://link.springer.com/article/10.1007/BF00776148
4. https://sci-hub.se/https://doi.org/10.1016/B978-0-323-46140-5.00010-8
5. https://www.cmc.ca/wpcontent/uploads/2019/08/Basics_Of_MeasuringDielectrics_5989-2589EN.pdf

Semester – II

Crystal growth techniques P825SSP3

Self-study Paper: CRYSTAL GROWTH TECHNIQUES

Semester-II **Credits:2**

Course objectives:

1. To Understand the fundamentals of crystal growth and nucleation
2. To Analyze the low temperature method of crystal growth
3. To study fundamentals and advantages of temperature gradient/SR method
4. To acquire a qualitative idea on the Gel method for growing crystals
5. To Understand the melt growth technique of crystal growing

Course outcomes:

CO	CO Statements	Cognitive Level
CO 1	Acquire a qualitative idea on various parameters considered for growing crystals	K1-K2
CO 2	Apply and understand laboratory technique of growing crystal from solution	K1-K3
CO 3	Design the experimental setup for SR method and to grow technologically important crystals	K1-K2
CO 4	Illustrate the mechanism of gel growth and its advantages.	K1-K3
CO 5	Understand different techniques of crystal growth from melt	K1-K3

Mapping of COs with POs and PSOs

CO	Programme Outcome (PO)					Programme Specific Outcome (PSO)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	2	2	2	3	2	2	2.1
CO2	2	3	3	2	2	2	2	2	3	3	2.4
CO3	3	2	2	2	2	2	3	2	3	3	2.4
CO4	2	2	3	2	3	2	3	2	3	3	2.5
CO5	3	2	3	1	2	2	3	3	3	3	2.5
Mean Overall Score											2.4
Results											High

UNIT 1: NUCLEATION: Phase -Different kinds of nucleation – equilibrium stability and metastable state – effect of soluble impurities on nucleation – determination of solubility –supersaturation – steady state nucleation rate – nucleation parameters.

UNIT II: LOW TEMPERATURE GROWTH TECHNIQUES: Low temperature solution growth-criteria for optimizing solution growth parameters-basic apparatus for solution growth-slow evaporation method-Growth of ADP and KDP crystals--slow cooling – growth of NaCl crystal

UNIT III: SR METHOD: Introduction to temperature gradient- Sankaranarayanan-Ramasamy (SR) method - Experimental setup–Types-single coil and double coil-modification- **Growth of KDP crystal -Advantages – Applications.**

UNIT IV: **GEL GROWTH**: Principle – Various types – structure of silica gel and gelling mechanism - nucleation control - merits of gel method - experimental methods - Single and double diffusion method – Advantages of gel method.

UNIT V: HIGH TEMPERATURE GROWTH: Growth from melt – Bridgman, Czochralski, zone melting - flux growth.

Books for study

1. Ramasamy P and SanthanaRaghavan P, Crystal Growth Processes and Methods, KRU Publications, Kumbakonam, 1999.
2. James Coble Brice, Crystal growth processes, John Wiley and Sons, New York, 1986
3. John Chadwick, Brice North, The growth of crystals from liquids, Holland Pub. Co., 1973
4. Harold Eugene, Buckley, Crystal growth, John Wiley and Sons, New York, 1951
5. Heinz K. Henisch, Crystals in Gels and Liese gang Rings, Cambridge University Press, 2005.

Books for reference

1. Valentin G. Dmitriev, Gagik G. Gurzadyan, David N. Nikogosyan, Handbook of Nonlinear Optical Crystals, Springer, 2010.
2. GovindhanDhanaraj, KullaiahByrappa, Vishwanath Prasad, Springer Handbook of Crystal Growth, Springer, 2010.
3. Binay Kumar, R. P. Tandon, University of Delhi. Dept. of Physics and Astrophysics, Advances in technologically important crystals, Macmillan, 2007.

Website references

https://application.wiley-vch.de/books/sample/352732514X_c01.pdf

https://www.acadpubl.eu/hub/2018-119-12/articles/2/489.pdf

https://www.alineason.com/en/knowhow/crystal-growth/

https://www.sciencedirect.com/topics/materials-science/crystal-growth-from-melt

https://link.springer.com/chapter/10.1007/978-3-540-74761-1_1

https://pubs.acs.org/doi/10.1021/acs.cgd.7b00759