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DEPARTMENTOF PHYSICS

1st Board of Studies Meeting

19thMarch, 2018

Dr. N.S.M.P. LATHA DEVI
Head of the Department
Department of Physics
Koneru Lakshmaiah Education Foundation
(Deemed to be University)
Green Fields, Vaddeswaram-522 302,
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Koneru Lakshmaiah Education Foundation
(Deemed to be University estd. u/s. 3 of the UGC Act, 1956)
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XXII Academic Council - Annexure III

Department of Physics

Minutes of 1st Board of Studies Meeting

The Department BOS meeting is held on **19th March, 2018**, from 12:30 PM to 3:30 PM in Room No.F201

The following members were present:

1. Dr.N.S.M.P. Latha Devi, Head of the Dept. and Associate Professor, BOS-Chairperson
2. Prof. K. Krishna Reddy, Professor, Yogi Vemana University
3. Dr. Sk. Mahamuda, Assoc. Professor
4. Dr.K.Swapna, Assoc. Professor
5. Dr. M. Venkateswarlu, **Asst. Professor**
6. Dr. M V V K Srinivas Prasad, Asst. Professor

The following members were absent:

1. Dr.V.N. Mani, Scientist-E, CMET, Hyderabad

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Dr.N.S.M.P Latha devi, Chairman of BOS opened the meeting by welcoming and introducing the external members, to the internal and co-opted members and thanked them for accepting to become the member of the Board of Studies.

After due deliberations, the following resolutions have been adopted:

AGENDA and RESOLUTIONS

BOS Chairman presented a detailed M.Sc Physics curriculum for 2018 admitted batch to the all members. Upon due deliberations, the external members suggested the following courses in curriculum.

AGENDA ITEM-1

Proposed to introduce the new program M.Sc Physics for A.Y:2018-19 admitting Batch students.	Approved and Recommended to Academic council for Approval

Discussion:

Based on the identified local, regional, national and global needs a new program M.Sc Physics is suggested by the Academic peers, Faculty, with 10 Core courses, one seminar in the first year and , 3 core courses,4 Electives, One term paper and Dissertation in second year with a total of 89 credits.

Resolution:

To resolve and approve the course structure and syllabus of the M.Sc Physics course (I, II, III and IV semesters) along with labs are given in Annexure-I and Annexure-2 as suggested by BoS members and recommended to the academic council for final approval.

AGENDA ITEM-2

Request for the necessary infrastructure, and introduction of the new program, M.Sc Physics, for the upcoming academic year 2018-19.	Approved and Recommended to Academic council for Approval

To resolve and recommended necessary infrastructure, for the introduction of the new program, M.Sc Physics, for the upcoming academic year 2018-19.to Planning and monitoring

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MEMBERS ATTENDED THE BOARD OF STUDIES MEETING, DEPARTMENT OF PHYSICS

S. No:	Name	Designation	Position	Signature
1	Dr.N.S.M.P. Latha Devi	Associate Professor	BOS-Chairperson	
2	Prof. K. Krishna Reddy, Yogi Vemana University, Kadapa, Andhra Pradesh	Professor	External BOS Member	
3	Dr.V.N. Mani, CMET, Hyderabad, Telangana	Scientist-E	External BOS Member	
4	Dr. Sk. Mahamuda	Associate Professor	Internal Member	
5	Dr.K.Swapna	Associate Professor	Internal Member	
6	Dr. M V V K Srinivas Prasad	Assistant Professor	Internal Member	
7	Dr. N. Krishna Jyothi	Assistant Professor	Internal Member	
8	Dr. M. Venkateswarlu	Asst. Professor	Internal Member	

Board. It is resolved and approved in the BOS meeting the inclusion of PDD file prepared for the Y18 batch students. The same has been recommended to the Academic council for the necessary approval.

Annexure-1

Proposed M. Sc (Physics) COURSE STRUCTURE FOR Y18 REGULATION

Sl No	Course Code	Course Title	Type	L	T	P	S	Cr	Pre requisite
1	18PH5101	Mathematical Physics	Professional Core	3	2	0	0	4	NIL
2	18PH5102	Classical Mechanics	Professional Core	3	2	0	0	4	NIL
3	18PH5103	Quantum Mechanics - 1	Professional Core	3	2	0	0	4	NIL
4	18PH5104	Electronics	Professional Core	3	2	6	0	7	NIL
5	18PH5105	Modern Physics Lab-1	Professional Core	0	0	6	0	3	NIL
6	18PH5201	Statistical Mechanics	Professional Core	3	2	0	0	4	NIL
7	18PH5202	Quantum Mechanics – 2	Professional Core	3	2	0	0	4	Q M -1
8	18PH5203	Electromagnetic Theory and Modern Optics	Professional Core	3	2	6	0	7	NIL
9	18PH5204	Solid State Physics-1	Professional Core	3	2	0	0	4	NIL
10	18PH5205	Computational Methods and Programming	Professional Core	3	2	6	0	7	NIL
11	18PH5206	Seminar	Professional Core	0	0	2	0	1	NIL
12	18PH53E1	Nuclear and Particle physics	Professional Elective	2	2	0	0	3	NIL
13	18PH53E2	Radar system and satellite communication	Professional Elective	2	2	0	0	3	NIL
14	18PH53E3	Fiber optic sensor	Professional Elective	2	2	0	0	3	NIL
15	18PH5301	Atomic and Molecular Physics	Professional Core	3	2	0	0	4	NIL
16	18PH5302	Solid State Physics -2	Professional Core	3	2	6	0	7	NIL
17	18PH5303	Digital Electronics and Microprocessors	Professional Core	3	2	6	0	7	NIL
18	18PH5304	Term paper	Professional Elective	0	0	2	0	1	NIL
19	18PH54E1	Nano Science and Technology	Professional Elective	2	2	0	0	3	NIL
20	18PH54E2	Antenna theory and radio wave propagation	Professional Elective	2	2	0	0	3	NIL
21	18PH54E3	Climate change	Professional Elective	2	2	0	0	3	NIL
22	18PH54E4	Thin film technology and applications	Professional Elective	2	2	0	0	3	NIL

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23	18PH54E5	Instrumentation & measurement techniques	Professional Elective	2	2	0	0	3	NIL
24	18PH54E6	Glass science and Technology	Professional Elective	2	2	0	0	3	NIL
25	18PH54E7	Micro-electro-mechanical systems	Professional Elective	2	2	0	0	3	NIL
26	18PH54E8	Weather hazards & risk assessment	Professional Elective	2	2	0	0	3	NIL
27	18PH5401	Dissertation	Professional Core	0	0	24	0	12	NIL
				42	30	64	0	89	

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Annexure-2

18PH5101 – MATHEMATICAL PHYSICS

L-T-P-S: 3-2-0-0 Credits: 4 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Classify the analytical functions, complex integration and evaluation of definite integrals	1,2	3
CO2	Analyze Beta and Gamma functions and some special functions	1,2	3
CO3	Apply the transform technique for functions	1,2	3
CO4	Apply the numerical technique to solve functions and system of equations	1,2	3

Complex Variables

Function of complex number- definition-properties, analytic function-Cauchy –Riemann conditions-polar form-problems, Complex differentiation, complex integration –Cauchy's integral theorem- Cauchy's integral formulae-multiply connected region- problems, Infinite series-Taylor's theorem- Laurrent's theorem-Problems, Cauchy's Residue theorem-evaluation of definite integrals-problems.

Beta, Gamma functions &Special functions

Beta & Gamma functions -definition, relation between them- properties-evaluation of some integrals

Special Functions- Legendre Polynomial, Hermite Polynomial, Laguerre Polynomial-Generating finction-recurrence relations-Rodrigue's formula-orthonormal property-associated Legendre polynomial- simple recurrence relation-orthonormal property-spherical harmonics

Laplace Transforms & Fourier series, Fourier Transforms

Laplace Transforms – definition- properties – Laplace transform of elementary functions-Inverse Laplace transforms-properties- evaluation of Inverse Laplace Transforms-elementary function method-Partial fraction method-Heavy side expansion method-Convolution method-complex inversion formula method-application to differential equations Fourier series-evaluation of Fourier coefficients- Fourier integral theorem-problems-square wave-

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rectangular wave-triangular wave. Fourier Transforms- infinite Fourier Transforms-Finite Fourier Transforms-Properties-problems-application to Boundary value problem

Numerical Analysis

Solutions of algebraic and Transcendental equations-Bisection method-method of successive approximations-method of false position Iteration method-Newton Rapson method Simultaneous linear algebraic equations-Gauss elimination method-Gauss Jordan method-Matrix inversion method-jacobi method – Gauss-Siedel method. Interpolation with equal intervals-Finite differences-Newton Forward & Backward Interpolation formule Interpolation with unequal internals-Newtons divided difference formula-Lagrange interpolation formula Numerical Integration-General Quadrature formula-Trapezoidal rule -Simpson'1/3 rule & 3/8 rule

Text Books:

1. Mathematical Methods of Physics-G.Arfken,Academic Press
2. Mathematical Physics - Satya Prakash, Sultan Chand & co,New Delhi
3. Complex Variables – Murray R. Spiegel (Schaum's out line series)
4. Mathematical Physics B S Rajput

Ref. Books:

1. Special Functions - M.D.Raisinghania
2. Mathematical Methods - B.D.Gupta
3. Integral Transforms - Goyal & Gupta
4. Numerical Methods - V.N.Vedamurthy &.N.Ch.S.N.Iyengar

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18PH5102-CLASSICAL MECHANICS

L-T-P-S: 3-2-0-0 Credits: 4 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Explain the applications of Newtonian mechanics and the formulation of Lagrange's equations of motion from D'Alembert principle.	1,2	2,3
CO2	Reduction of problem of two body problem to One body problem and Classification of orbits	1,2	1,2
CO3	Explain the applications of Hamilton's equations, Canonical transformations, Poisson brackets, Invariance of Poisson bracket under canonical transformations–Principle of least action	1,2,3	1,2
CO4	Illustrate the Hamilton Jacobi equations and characteristic functions, Action and angle variable, small oscillations, applications such as linear tri-atomic molecule, two carts connected with three springs, triple pendulum, and double pendulum.	1,2,3, 4,5,6	3

Mechanics of Particles and Lagrangian Dynamics

Newton's laws of motion - Mechanics of a particle - Equation of motion of a particle - Motion of a particle under constant force and alternating force - Mechanics of systems of particles- Angular momentum of the system - Potential and kinetic energies of the system - constraints and generalized coordinates- Lagrange's equations of motion and Application - Variational calculus and Least Action principle.

Central Force Problem and Rigid Body Motion

Motion in a central force field - Motion of two particles equivalent to single particle - Equation of motion - Classification of orbits -Virial theorem-Kepler problem scattering in a central force field- Inelastic scattering in the laboratory frame - Motion of a rigid body - Orthogonal transformations - Euler angles- Coriolis effect - Angular momentum and kinetic energy – Rigid body dynamics and Moment of Inertia tensor - Euler's equation of motion – Torque Free Motion.

Hamiltonian Formulation

Legendre transformations - Hamilton's equations of motion - Applications - cyclic coordinates and conservation theoremse - Principle of least action - Canonical transformations – Poisson brackets – Properties of Poisson brackets – Constant of motion using Poisson brackets – Poisson brackets of canonical variables – Poisson's Theorem – Invariance of Poisson bracket under canonical transformation – Motion as successive canonical transformation (Infinitesimal generators) – Liouville's theorem

Hamilton Jacobi Theory and Oscillatory Motion

Hamilton Jacobi equations for Hamilton's principal and characteristic functions – Harmonic oscillator problem – Separation of variables method – Action and angle variable– Linear harmonic oscillator application- Oscillatory Motion - Stable and unstable equilibrium – Theory of small oscillations –Eigenvalue problem - frequencies of free vibrations and normal modes – Lorenz transformation relativistic kinematics – Linear triatomic molecule - Two carts connected with three springs – Triple pendulum - Double pendulum.

Text Books:

1. H. Goldstein, Classical Mechanics, 2nd Edition, Narosa, (1985).
2. Classical Mechanics by Gupta, S:L. Kumar and Sharma

Ref. Books:

1. L. Landau and E. Lifshitz, Mechanics, Oxford (1981).
2. F. Scheck, Mechanics, Springer (1994).

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18PH5103-QUANTUM MECHANICS – 1

L-T-P-S: 3-2-0-0 Credits: 4 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	**Introduction to Quantum Mechanics and its principles**	1,2	2
CO2	Derive Schrodinger's wave equation and its application to one dimensional problems	1,2	3
CO3	Introduce angular momentum and spin concept	1,2	2
CO4	Applying Schrodinger's wave equation to three dimensional problems	1,2	3

Introduction to Quantum Mechanics:

Origin of Quantum Mechanics: Wave particle duality - Matter Waves – de-Broglie's hypothesis - Photoelectric and Compton effects – Davisson and Germer's expt. – Heisenberg's uncertainty principle – complementary principle – wave packet of a particle - physical significance of the wave function - Time dependent Schrodinger's wave equation and time independent Schrodinger's wave equation.

Applications of Quantum Mechanics to One dimensional Problems

Continuity equation — stationary states – Ehrenfest Theorem – orthonormality of wave functions - Operators -Dirac's Bra and Ket formalism properties of eigen functions - Postulates of Quantum Mechanics – Dirac's delta function - Applications of time independent Schrodinger's wave equation to one-dimensional problems: free particle – potential step – potential barrier – infinite square well – linear harmonic oscillator.

Angular momentum in quantum mechanics:

Orbital angular momentum – commutation relation for orbital angular momentum – eigen values and eigen functions of L_Z and L^2. Elementary theory of spin angular momentum: spin angular momentum – spin magnetic moment and spin orbit interaction – Pauli's spin matrices.

Applications of Quantum Mechanics to three-dimensional problems:

Three-dimensional harmonic oscillator – central potentials – separation of Schrodinger's wave equation in spherical polar co-ordinates – hydrogen atom-Time independent perturbation theory: non degenerate states and degenerate states – application to linear Stark effect. Variational method – ground state energy of the hydrogen atom – helium atom.

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Text books:

1. Introduction to Quantum Mechanics - B. H. Bransden and C. J. Joachain
2. Quantum Mechanics - Gupta, Kumar and Sharma

Ref. Books:

1. Quantum Mechanics – L.I. Schiff.
2. Quantum Mechanics – A.P. Messaiah
3. Quantum Mechanics – E. Merzbacher
4. Quantum Mechanics – A.K. Ghatak and S. Lokanadhan and
5. A Text Book of Quantum Mechanics – P.M. Mathews and K. Venkatesan.

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19/2/18

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18PH5104- ELECTRONICS

L-T-P-S: 3-2-6-0 Credits: 7 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	CO	PO	BTL
CO1	**Analyze electronic circuits using various Network theorems**	1,2	2,3
CO2	Understand various semiconductor devices principles and their applications	1,2	1,2
CO3	Understand basics of transistor amplifiers through different transistor models and oscillators	1,2,3,4	1,2,3
CO4	Understand basics of operational amplifiers and their various applications	1,2,3,4,5	1,2,3

Network Analysis

Kirchoff's laws – Thevinin, Norton theorems – superposition, reciprocity, compensation theorems – source transformation – delta and star transformations – Laplace Transformation – convolution integral.

Semiconductor Devices

P-n junction diodes: tunnel diode, Schottky barrier diode – Microwave diodes: varactor diode, p-i-n diode – Optoelectronic devices: solar cell, photodetector, LED, Semiconductor laser – basic principles, biasing and characteristics of BJT and JFET – MOSFET: enhancement and depletion modes of operation – basic idea of charge coupled devices.

Amplifiers and Oscillators

Low frequency and high frequency amplifiers – power amplifiers – oscillator principle – oscillator types – frequency stability response – phase shift oscillator – Wein bridge oscillator – LC tunable oscillators – multivibrators – monostable and astable – sine wave and triangle wave generation – clamping and clipping – crystal oscillators and their applications.

Operational Amplifiers

Ideal operational amplifier: Characteristics, feedback types – Applications: basic scaling circuits – current to voltage and voltage to current conversion – sum and difference amplifiers – integrating and differentiating circuits – A.C. amplifiers – instrumentation amplifiers, comparators, filters, PLL.

Text Books:

1. *C.L.Wadhwa, Network Analysis and Synthesis, New Age International Publishers, (2007).*
2. *J. Milman and C.C. Halkias, Electronic Devices and Circuits, McGraw-Hill (1981).*
3. *R.L. Boylsted and L.Nashelsky, Electronic Device and Circuits, Pearson Education (2003).*
4. *A.P. Malvino, Electronics:Principles and Applications, Tata McGraw-Hill (1991).*
5. *G.B.Calyton, Operation Amplifiers, ELBS (1980).*

Modern Physics Lab – 1 **Course Code:18PH5104**

List of Experiments

1. Planck's constant
2. Hall magnetic fields
3. Internal series resistance of a solar cell
4. Determination of Hall coefficient
5. e/m Thomson method
6. Characteristics of a Solar cell
7. Forbidden energy band gap
8. Thickness of wire using Wedge method
9. Series and parallel combination of solar cell
10. Resolving power of a prism

Electronics Lab -1

List of Experiments

1. Transistor Characteristics
2. UJT Characteristics
3. FET Characteristics
4. Rectifiers
5. Active low pass, high pass and band pass filter
6. RC Phase Shift Oscillator
7. Wein Bridge Oscillator
8. Colpitt's Oscillator
9. Astable Multivibrator
10. Op-amp Characteristics

18PH5201-STATISTICAL MECHANICS

L-T-P-S: 3-2-0-0 Credits: 4 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Explain the Microstates and macro states of Ideal gas and Microstate and macrostate in classical systems, and derivation of Maxwell's relations, and thermodynamic laws.	1	2
CO2	Applications of these ensembles to classical ideal gas and explaining about types of oscillators.	1	2
CO3	Explanation of postulates of Quantum Statistical Mechanics and types of ensembles and energy distributions	1,2,3,4, 5	2
CO4	Explaining of Thermodynamic behavior of Ideal, Bose, Fermi gases and applications of statistical mechanics	1,2,3,4, 5	2

Thermodynamics

Equation of state for various thermodynamic systems - Laws of Thermodynamics - Consequences of equations of state and Thermodynamics laws - thermodynamics potentials - Maxwell's relations - Thermodynamic equilibrium conditions – Phase equilibrium - Gibbs' phase rule - phase transitions - Ehrenfest's classification - Microstates and macrostates – Ideal gas – Microstate and macrostate in classical systems.

Classical Statistical Mechanics

Postulates - Liouville's theorem micro-canonical - canonical and grand canonical ensembles - Virial theorem and Equipartition of Energy theorem in these ensembles - equivalence ofthese ensembles -Expressions for entropy in terms ofprobabilitity in these ensembles - Applications of these ensembles to classical ideal gas - N harmonic Oscillators - Langevin's theory of paramagnetism - problem-solving.

Quantum Statistical Mechanics

Postulates of Quantum Statistical Mechanics – Density matrix - Applications to electron in a magnetic field - free particle - harmonic oscillator - and to multi particle systems - Ideal Bose and Fermi gases in micro-canonical and Grand canonical ensembles – Bose Einstein and Fermi-Dirac distributions - equations of state.

Ideal, Bose, Fermi gases and applications of statistical mechanics

Thermodynamic behavior - Expressions for **an** equation of state - thermodynamic quantities in terms of Bose-Einstein &Fermi-Dirac functions and virial expansions - Bose-Einstein

condensation - Fermienergy and Momentum - Black body radiation - Einstein &Debye theory for heat capacity (possibly Ising model)

Text Books:

1. Statistical Mechanics by Gupta & Kumar
2. Statistical Mechanics -- R K Pathria

Ref. Books:

1. An Introductory Course of Statistical Mechanics - Palash B.
2. Elements of Statistical Mechanics - Kamal Singh & S.P. Singh
3. Statistical Mechanics An Elementary Outline – Avijit Lahiri
4. Introduction to Statistical Physics - Kerson Huang

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18PH5202-Quantum Mechanics – II

L-T-P-S: 3-2-0-0 Credits: 4 Prerequisite: QM-1

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Applying time dependent perturbation theory to solve different problems	1,2	2,3
CO2	Matrix representations of wave function, operator and the solution of harmonic oscillator using matrix mechanism	1,2	1,2
CO3	Scattering problems solutions using quantum rules	1,2	1,2
CO4	Solutions of central force problems like hydrogen atom using relativistic quantum mechanics	1,2	2,3

Perturbation Theory:

Time-dependent perturbation theory – transition to continuum – Fermi's golden rule – constant perturbation, harmonic perturbation – adiabatic and sudden approximations.

Matrix formulation of quantum mechanics:

Linear Vector Spaces – Hilbert Space, linear operators, linear transformation, matrix representation of an operator and wave function - orthonormality of wave functions - Dirac's Bra and Ket formalism. Schroedinger's equation and the Eigen value problem – energy representation - One dimensional harmonic oscillator – solution by matrix mechanics.

Scattering Theory:

Differential and total scattering cross sections - laboratory and center of Mass Reference frames, Scattering amplitude, scattering by spherically symmetric potentials – partial wave analysis – Phase shifts, scattering by a square well potential.

Relativistic Quantum Mechanics:

Klein-Gordon equation – its success and limitations – Dirac equation for a free particle - α and β matrices central forces and hydrogen atom, relativistic treatment of electron in an electro – magnetic field, spin and magnetic moment of an electron – Theory of Positron.

Prescribed Text Books:

1. *Introduction to Quantum Mechanics by B.H. Bransden& C.J. Joachain.*
2. *A text book of Quantum Mechanics – P.M. Mathews & K. Venkatesan.*
3. *Quantum Mechanics – L.I.Schiff 3rd Edition*
4. *Quantum Mechanics – Gupta, Kumar & Sharma*

Reference Books:

1. *Quantum Mechanics – MerzBacher*
2. *Quantum Mechanics– S.L. Kakani & H.M. Chandalia*

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18PH5203- ELECTROMAGNTIC THEORY AND MODERN OPTICS

L-T-P-S: 3-2-6-0 Credits: 7 Prerequisite: Nil

CO	Course Outcome	PO	BTL
CO1	Explains the wave nature of light in different mediums using Maxwell's equations and Fresnel's equations.	1,2,3	1,2,3
CO2	Explains the properties of Laser, production of Laser, different types of Laser sources and applications.	1,2,3	1,2,3
CO3	Explains the second and third harmonic generations of light and basics of Holography, recording holograms and applications.	1,2,3	1,2,3
CO4	Explains modes of optical fibers, types of fibers, signal degradation in optical fibers and lot of information regarding optical fibers.	1,2,3	1,2,3
CO5	Expertise the student in physics experiments related to light.	3	3

Electromagnetic Theory

Maxwell's equations –General wave equation-Propagation of light in isotropic dielectric medium – dispersion –Propagation of light in conducting medium –Skin depth –Reflection and refraction at the boundary of a dielectric interface-Fresenel's equations-Propagation of light in crystals – double refraction. Electromagnetic Radiation –Retarded Potentials –Radiation from an Oscillating dipole –Linear Antenna –Lienard- Wiechert Potentials.

Lasers

Lasers: Introduction – directionality- brightness- monochromacity- coherence – relation between the coherence of the field and the size of the source – absorption and emission processes - the Einstein coefficients - amplification in a medium- laser pumping Boltzman's principle and the population of energy levels – attainment of population inversion - two level – three level and four level pumping.

Optical feedback: the optical resonator laser power and threshold condition confinement of beam within the resonator – stability condition. Laser output: Absorption and emission - shape and width of broadening lines – line broadening mechanisms – natural, collision and Doppler broadening. Types of Lasers: Ruby laser, He-Ne Laser, CO_2 laser, Semiconductor GaAs laser, applications of lasers.

Non linear Optics and Holography

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Basic Principles- Harmonic generation – Second harmonic generation- Phase matching –Third Harmonic generation-Optical mixing –Parametric generation of light –Parametric light oscillator- Frequency up conversion-Self focusing of light.

Introduction to Holography-Basic theory of Holography-Recording and reconstruction of Hologram- Diffuse object illumination-Speckle pattern –Fourier transform Holography-Applications of Holography.

Fiber Optics

Fiber Optics : Introduction – total internal refraction –optical fiber modes and configurations-fiber types – rays and modes- Step index fiber structures – ray optics representation – wave representation – Mode theory for circular wave guides- wave guide equations – wave equations for step indexed fibers – modal equation – modes in step indexed fibers – power flow in step indexed fibers . Graded indexed fiber structure : Structure – Numerical aperture and modes in graded index fibers- Signal degradation in optical fibers – attenuation – losses – absorptive scattering – and radiative – core cladding – Signal distortion in optical wave guides – Information capacity determination – Group delay – Material dispersion – wave guide dispersion – inter modal dispersion – pulse broadening . Preparation of different techniques of optical fibers

Text Books:

1. Introduction to Electrodynamics, D.J.Griffiths, Prentice-Hall, India

2. Electromagnetics, B.B.Laud, Wiley –Eastern, New Delhi.

3. Modern Optics, Fowels

4. Laser and their applications, M.J.Beesly, Taylor and Francis, 1976.

5. Laser and Non-Linear Optics, B.B.Laud, Wiley Eastern Ltd.,1983.

6. Optics , E. Hecht, Addison Wiley, 1974.

7. Optical fibers communications, Gerel Keiser, McGraw Hill Book, 2000.

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Electromagnetic Theory and Modern Optics

Lab Experiments List

1. Refractive index of various liquids using Hallow prism
2. Refractive index of liquid by forming Newton's Rings
3. Double refraction of Calcite and Quartz crystals
4. Diffraction grating for Sodium doublet
5. Measurement of Numerical Aperture
6. Measurement of spectral Attenuation
7. Optical fiber loss
8. Determination of particle size using Laser diffraction
9. Determination of lattice constant using X-ray diffraction pattern.
10. Circular coil - Stewart-Gee Galvanometer

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Course Name: SOLID STATE PHYSICS-1 Course Code: 18PH5204

L-T-P-S: 3-2-6-0 Credits: 7 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Understands structure of crystalline solids, appreciates structure-property relationship in crystals, crystal diffraction and the concepts of reciprocal lattice	1,2 ,7	2,3
CO2	Understand the motion of electron in gas and metal and heat capacity of metal	1,7	2
CO3	Understand the Periodic Zone schemes, Fermi surfaces and different types of orbits and quantization of orbits in a magnetic field	1,2 ,7	2
CO4	Understand the concept of energy bands and effect of the same on electrical properties.	1,2 ,7	2

CRYSTAL STRUCTURE:

Periodic array of atoms—Lattice translation vectors and lattices, symmetry operations, The Basis and the Crystal Structure, Primitive Lattice cell, Fundamental types of lattices—Two-Dimensional lattice types, three-Dimensional lattice types, Index system for crystal planes, simple crystal structures-- sodium chloride, cesium chloride and diamond structures.

CRYSTAL DIFFRACTION AND RECIPROCAL LATTICE:

Bragg's law, Experimental diffraction methods-- Laue method and powder method, Derivation of scattered wave amplitude, indexing pattern of cubic crystals and non-cubic crystals (analytical methods). Geometrical Structure Factor, Determination of number of atoms in a cell and position of atoms. Reciprocal lattice, Brillouin Zone, Reciprocal lattice to bcc and fcc Lattices.

FREE ELECTRON FERMI GAS:

Energy levels and density of orbitals in one dimension, Free electron gas in 3 dimensions, Heat capacity of the electron gas, Experimental heat capacity of metals, Motion in Magnetic Fields- Hall effect, Ratio of thermal to electrical conductivity.

FERMI SURFACES OF METALS:

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Reduced zone scheme, Periodic Zone schemes, Construction of Fermi surfaces, Electron orbits, hole orbits and open orbits, Experimental methods in Fermi surface studies--Quantization of orbits in a magnetic field, De-Hass-van Alphen Effect, extremal orbits, Fermi surface of Copper.

THE BAND THEORY OF SOLIDS:

Nearly free electron model, Origin of the energy gap, The Block Theorem, Kronig-Penny Model, wave equation of electron in a periodic potential, Crystal momentum of an electron- Approximate solution near a zone boundary, Number of orbitals in a band--metals and isolators. The distinction between metals, insulators and semiconductors.

TEXT BOOKS:

1. Introdcution to Solid State Physics, C.Kittel, 5th edition,

2. Solid State Physics, A.J.DEKKER.

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18PH5205-COMPUTATIONAL METHODS AND PROGRAMMING

L-T-P-S: 3-2-6-0 Credits: 7 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	**Analyze the C characters, operators, analytic expression, arrays, functions and simple programs**	1,2	3
CO2	Describe and apply the basics of MATLAB to solve linear systems and interpolation	1,2	3
CO3	Apply MATLAB to solve linear equation, non-linear equation and simultaneous equations	1,2	3
CO4	Describe and Apply C language and MATLAB to solve interpolations, numerical differentiation and integration	1,2	3

Fundamentals of C Language:

C character set-Identifiers and Keywords-Constants-Variables-Data types-Declarations of variables

Declaration of storage class-Defining symbolic constants –Assignment statement. Operators - Increment and decrement operators –Conditional operators. Arithmetic expressions – Precedence of arithmetic operators – Type converters in expressions – Mathematical (Library) functions – data input and output – The get char and put char functions-Scanf - Printf-simple programs.

a) Control statements and Arrays: If-Else statements –Switch statement-The operator –GO TO

While, Do-While, FOR statements-BREAK and CONTINUE statements.

b)Arrays: One dimensional and two dimensional arrays –Initialization –Type declaration-Inputting and outputting of data for arrays –Programs of matrices addition, subtraction and multiplication

c)User Define functions: The form of C functions –Return values and their types –calling a function

Category of functions. Nesting of functions. Recursion. ANSI C functions-Function declaration. Scope and life time of variables in functions.

MATLAB and Applications

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C character Basics of Mat lab- Mat lab windows – On-line help- Input-Output-File types-Platform Dependence-Creating and working with Arrays of Numbers – Creating, saving, plots printing Matrices and Vectors – Input – Indexing – matrix Manipulation-Creating Vectors Matrix and Array Operations Arithmetic operations-Relational operations – Logical Operations – Elementary math functions, Matrix functions – Character Strings Applications-Linear Algebra,-solving a linear system, Gaussian elimination, Finding Eigen values and eigenvectors, Matrix factorizations Curve Fitting and

Interpolation – Polynomial curve-fitting on the fly, Least squares curve fitting, General nonlinear fits,

Interpolations.

Linear and Non –linear equations, Simultaneous equations:

Solution of Algebra and transcendental equations-Bisection, Falsi position and Newton-Rhapson methods-Basic principles-Formulae-algorithms. Solutions of simultaneous linear equations-Guass elimination and Gauss Seidel iterative methods-Basic principles- Formulae-Algorithms.

Interpolations, Numerical differentiation and integration:

Concept of linear interpolation-Finite differences-Newton's and Lagrange's interpolation formulae-principles and Algorithms Numerical differentiation-algorithm for evaluation of first order derivatives using formulae based on Taylor's series-Numerical integration-Trapezoidal and Simpson's 1/3 rule-Formulae- Algorithms

Text books:

1.Numerical Methods, E. Balaguruswamy, Tata McGraw Hill

2.Computer oriented numerical methods-Rajaraman

3. Y.Kirani Singh and B.B.Chaudhuri, MATLAB Programming, Prentice-Hall India,2007

4. Rudra Pratap, Getting Started with Matlab 7, Oxford, Indian University Edition,2006

5. Stormy Attaway: A Practical introduction to programming and problem solving, Elsevier, 2012.

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18PH5206 – SEMINAR

L-T-P-S: 0-0-2-0 **Credits: 1** **Prerequisite: Nil**

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO#	Course Outcome (CO)	PO	BTL
CO1	Students will be able to work effectively as individuals and as team members.	PO1	2
CO2	Student will be able to improve their body language and self confidence	PO1	2
CO3	Student will be able to improve presentation skills	PO1	2
CO4	Student will be able to improve communication and overcome fear	PO1	2

18PH5301-ATOMIC AND MOLECULAR PHYSICS

L-T-P-S: 3-2-0-0 Credits: 4 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Detailed discussion about the electronic structure in atoms using different spectra	1,2,7	1,2,3
CO2	Study of molecular energy levels using rotational and vibrational spectroscopy	1,2,4, 6,7	1,2,3
CO3	Study of Raman effect of rotational, vibrational and polyatomic molecules	1,2,4, 6,7	1,2,3
CO4	Detailed discussion about the electronic spectra and resonance spectroscopy like NMR and ESR.	1,2,4, 6,7	1,2,3

Atomic Spectra

Quantum states of electron in atoms – hydrogen atom spectrum – electron spin – Stern Gerlach experiment – spin orbit interaction – Lande interval rule – two electron systems – LS-JJ coupling schemes – fine structure – spectroscopic terms and selection rules – hyperfine structure – exchange symmetry of wave function – Pauli's exclusion principle – periodic table – alkali type spectra – equivalent electrons. Zeeman and Paschen Back effect of one and two electron systems – selection rules – Stark effect.

Microwave Spectroscopy and IR Spectroscopy

Rotational spectra of diatomic molecules – rigid rotator – effect of isotropic substitution – non rigid rotator – rotation spectra of polyatomic molecules – linear, symmetric top and asymmetric top molecules – experimental techniques – diatomic vibrating rotator – linear,

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symmetric top molecule – analysis by infrared techniques – characteristic and group frequencies.

Raman Spectroscopy

Raman effect – quantum theory of Raman effect – rotational Raman spectra – vibrational Raman spectra – Raman spectra of polyatomic molecules – Raman spectrometer – hyper-Raman effect – experimental techniques.

Electronic Spectroscopy and Resonance Spectroscopy

Electronic spectra of diatomic molecules – Frank-Condon principle – dissociation energy and dissociation products – rotational fine structure of electronic vibration transitions – Fortrat Diagram – predissociation. Inner shell vacancy – X-ray –Auger transitions – Compton Effect – NMR – basic principles – classical and quantum mechanical description – spin-spin and spin lattice relaxation times – magnetic dipole coupling – chemical shift – Knight shift – ESR – basic principles – nuclear interaction and hyperfine structure – g-factor – Zero field splitting.

Text Books:

1. *C.N. Banwell, Fundamentals of Molecular Spectroscopy, 4th edition, McGraw-Hill, New York (2004).*
2. *Arthur Beiser, Concepts of Modern Physics, 6th edition, Tata McGraw-Hill, New Delhi (2003).*
3. *G. Aruldhas, Molecular Structure and Spectroscopy, Prientice Hall of India, New Delhi (2002).*
4. *B.P. Straughan & S. Walker, Spectroscopy: Vol. I, Chapmen and Hall (1976).*
5. *Manas Chandra, Atomic Structure and Chemical Bond, Tata McGraw-Hill, New Delhi (2003).*
6. *G.M. Barrow, Introduction to Molecular Spectroscopy, Mc Graw Hill Ltd., Singapore (1986).*

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18PH5302- SOLID STATE PHYSICS-II

L-T-P-S: 3-2-6-0 Credits: 7 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Understands structure of crystalline solids, kinds of crystal imperfections and appreciates structure-property relationship in crystals.	1,2,7	2,3
CO2	understand the source of a materials magnetic behavior and be able to distinguish types of magnetism and their properties	1,2,7	1,2,3
CO3	understand semiconductor physics: direct and indirect band-gaps, the effects of doping a semiconductor and Drift and Diffusion – Einstein relation	1,2,3,7	1,2,3
CO4	understand the phenomenon of superconductivity: key experiments, some attempts to explain superconductivity, the BCS model	1,2,3,7	1,2,3
CO5	Expertise the student in physics experiments related to materials characterization	3,7	3

Lattice Energies and Lattice Vibrations

Origin of chemical binding in ionic and van der Waals crystals – Elastic properties – Stress and strain – Elastic moduli - Lattice energy calculations for ionic and van der Waals crystals – Lattice vibrations: Mono and diatomic one dimensional infinitely long lattices – Vibrational spectra – Infrared absorption in ionic crystals – Vibrational spectra of finite lattice – Quantization of lattice vibrations – Phonons – Properties – Experimental measurement of dispersion relation.

Magnetic Materials

Types- Dia, para, ferro, anti-ferro & Ferri magnetic materials-Hysteresis curve- susceptibility measurement: Guoy balance, Quincke's Method- Quantum theories of para and ferro magnetism – Curie point and exchange integral – Curie temperature and Neel Temperature (Definitions) - Magnons – Domain Theory - Applications of Magnetic materials.

Semiconductor Physics

Intrinsic and extrinsic semiconductors – Expression for position of Fermi levels and carrier concentrations – Variation of Fermi level with temperature – np product – Carrier mobility, conductivity and their variation with temperature – Direct and indirect band gap

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semiconductors – Differences and examples – Hall effect - Continuity equation – Drift and Diffusion – Einstein relation – Generation, Recombination and life time of non-equilibrium carriers – Heyness-Schockley experiment – Determination of life time, diffusion length of minority charge carriers.

Superconductivity

Concept of zero resistance – Magnetic behavior – Distinction between a perfect conductor and superconductor – Meissner effect – Isotope effect – Specific heat behavior – Two-fluid model – Expression for entropy difference between normal and superconducting states – London's equations – Penetration depth – BCS theory –Josephson junctions – SQUIDS and its applications - Applications of superconductors – High TC superconductors – Preparation – Properties.

Prescribed Text Books

1. Solid State Physics, C. Kittel, John Wiley & Sons.
2. Solid State Physics, A.J. Dekkar, Macmillan India Ltd.
3. Elementary Solid State Physics, M. Ali Omar, Addison-Wesley.
4. Solid State Physics, M.A. Wahab, Narosa Publishing House.
5. Solid State Electronic Devices, B.G. Streetman.
6. High TC Superconductivity, C.N.R. Rao and S.V. Subramanyam.
7. Solid State Physics, S.O. Pillai.
8. Solid State Physics, S.L. Kakani and C. Hemarajan.
9. Electrons in Solids, Richard H. Bube.

SOLID STATE PHYSICS-II LAB EXPERIMENTS LIST

1. B-H Curve
2. Dielectric constant of a solid
3. Specific heat of a solid (Graphite)
4. Specific heat of a metal (Brass) using Lee's Method
5. Synthesis of nano particles
6. Photoluminescence properties of Materials
7. Refractive index by Abbe refractometer
8. Resistivity measurement of any composite material
9. Density,Viscosity, Surface tension measurement by using Ultrasonic interferometer
10. Lattice dynamics

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18PH5303- DIGITAL ELECTRONICS & MICROPROCESSORS

L-T-P-S: 3-2-6-0 Credits: 7 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Understand numerical and character representations in digital logic, number system, Logic gates, Logical expressions and Boolean algebra.	1,2	2,3
CO2	Combinational and sequential systems design using standard gates and filp-flops and minimization methods	1,2,3	1,2
CO3	Understanding logic gates, combinational and sequential Logic Functions.	1,2,3	1,2
CO4	Able to understand and analyze the architectural features of Intel 8085 Microprocessor	1,2,3, 4,5,6	2
CO5	Applying Microprocessor 8085 programming to solve the mathematical problems and ability to design circuits by digital electronics	1,2,3	1,2,3

NUMBER SYSTEMS AND BOOLEAN ALGEBRA:

one number system (decimal, binary, octal, hexadecimal) - octal and hexadecimal number systems - decimal numbers to BCD code - difference between BCD and straight binary - AND, OR, NOT gate operations - Truth Tables (AND, NAND, OR, NOR, NOT gates) - Boolean expressions – universal logic gates - Boolean algebra to simplify complex logic circuits - logical expression into a sum-of-products expression - Exclusive-OR and Exclusive-NOR gates - Design simple logic circuits - ADD and SUB two HEXADECIMAL numbers - HALF-Adder and FULL-Adder.

FLIP-FLOPS, COUNTERS:

Latches - flip-flops – flip flops by NAND or NOR gates - synchronous and asynchronous systems – types of flip flops – RS, JK, D, T- Flip-Flops - conversion of Flip-Flops - triggering mechanisms in flip-flops - Parallel- and Serial- data transfers - Asynchronous (ripple)

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counters, Modulo N counters, Synchronous (Parallel) counters, Synchronous Down and Up/Down counters.

REGISTERS, MSI LOGIC CIRCUITS

X Parallel in/Parallel out shift registers - Serial in/serial out shift registers - parallel in/serial out shift registers - Serial in/parallel out shift registers –Analog to digital and Digital to analog converter - Decoders and Encoders - Multiplexers and Demultiplexers.

MICROPROCESSOR 8085:

Microprocessor and its architecture – addressing modes – data movement instructions – Arithmetic and logic instructions – Program control instructions – conditional loop instructions – Memory inter phacings – Algorithem technique – Program and technique.

Text Books:

1. Ronald J. Tocci, Neal S. Widmer and Gregory L. Moss, Digital Systems : Principles and Applications, Pearson Education. Ninth Edition

2. Barry B. Brey and C.R. Sarma, The Intel Microprocessors : Architecture, Programming and Interfacing, Pearson Education.

3. M. Morris Mano, Computer System Architecture 3rd Edition

Digital Electronics and Microprocessor Lab Experiments

1. Verification of Logic Gates and Universal Logic Gates
2. Logic Gates using Universal Gate (NAND)
3. Combinational Circuits (half adder, full adder, half subtractor)
4. A/D and D/A conversion
5. Encoder – Decoder
6. Multiplexer and Demultiplexer
7. Verification of Flip-Flops
8. Counters
9. Registers
10. Microprocessor 8085 programs

Professional Electives

18PH53E1-Nuclear and Particle Physics

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Will apply the models describing the basic nucleon and nuclear properties and establish the basic fundamentals necessary for further course outcomes.	1,2,7	1,2
CO2	Properties and decay principles of Beta and Gamma rays will be reviewed, their selection rules will be understood.	2,3,4,7	1,2, 3
CO3	**The** history of different techniques to detect various kinds of radiation will be learned. Detection and importance of radiation detection using Hyper Pure Germanium Detectors to study various basic science principles and their applications in various fields will be reviewed.	1,2,3, 4,5,7	1,2, 3,4
CO4	**The basics** of particle physics and their classification will be discussed. Their fundamental properties and functions along with basic particle physics models leading to GUT will be discussed.	1,2,7	2,3

General Properties of nuclei:

Size of the nuclei, nuclear binding energy, nuclear angular momentum, parity and statistics, nuclear magnetic dipole moments and its experimental measurement, Schmidt limits, nuclear quadrupole moment.

Beta Decay:

Energy release in beta decay, Fermi theory of beta decay, shape of the beta spectra, angular momentum and parity selection rules, comparative half-lives, non-conservation of parity, beta spectroscopy. **Gamma Decay:** Energetics of gamma decay, angular momentum and parity selection rules, internal conversion, lifetimes for gamma emission, gamma ray spectroscopy.

Radiation Detection:

Introduction: Principle of detection of photons, charged particles and neutrons. Gas counters: Ionization chambers, Proportional counters, Neutron detectors and G.M. counters. Scintillation detectors: Organic and inorganic Scintillators – theory, characteristics and detection efficiency. BGO detectors – advantages of BGO over Scintillation detectors. Solid State Detectors: Silicon Surface Barrier detectors, E - E detection for charged particles, Si (Li) detectors for X-rays and electrons, HP Ge detectors for photon detection. Energy resolution, efficiency and timing considerations.

Particle Physics:

Particle interactions and families, symmetries and conservation laws--- energy and momentum, angular momentum, parity, Baryon number, lepton number, isospin, strangeness and charm, the quark model, colored quarks and gluons, Grand unified theories (preliminaries only)

Prescribed Text Books:

1. Introductory Nuclear Physics - Kenneth S Krane.
2. Nuclear Radiation Detectors - S.S. Kapoor & V.S. Ramamurthy
3. Radiation Detection and Measurement - G.F. Knoll

Reference Books:

1. The Atomic Nucleus - R.D. Evans.
2. Nuclear and Particle Physics - E.B.Paul.
3. Techniques for Nuclear and Particle Physics experiments - William. R. Leo

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18PH53E2- RADAR SYSTEMS AND SATELLITE COMMUNICATION

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	To learn the Radar operations, types of radar and applications	1,2,4	1,2
CO2	To learn the signal and data processing for radars, antenna characteristics	1,2,4	1,2
CO3	To learn the satellite communications, orbital constitutions and Telemetry, Tracking	1,2,3	1,2,3
CO4	To learn the coding techniques for INMARSAT VSAT, GPS, RADARSAT, INTELST applications	1,2,3,4	2,3

Radar Systems:

Fundamental – A simple RADAR – overview of frequencies – Antenna gain Radar Equation – Accuracy and Resolution – Integration time and the Doppler shift (Ch 1 of Text Book 1) Designing a surveillance radar – Rader and surveillance – Antenna beam – width consideration – pulse repetition frequency – unambiguous range and velocity – pulse length and sampling – radar cross section – clutter noise (Ch 2 of Text Book 1) Tracking Radar – Sequential lobbing – conial scanning – Monopoles Radar – Tracking accuracy and Process – Frequency Agility – Radar guidance (Ch3 of Text Book 1)

Signal and Data Processing:

Properties of clutter – Moving Target Indicator Processing Shareholding – Plot extraction – Tract Association, Initiation and Tracking (Ch 5 of Text Book 1) Radar Antenna – Antenna parameters – Antenna Radiation Pattern and aperture distribution – Parabolic reflector – cosecant squared antenna pattern – effect of errors on radiation pattern – Stabilization of antennas (Ch7 of Text Book 2).

Satellite Communication:

Satellite System – Historical development of satellites – communication satellite systems – communication satellites – orbiting satellites – satellite frequency bands – satellite multiple access formats (Ch1 of Text Book 3).

Satellite orbits and inclination – Look angles, orbital perturbations, space craft and its subsystems – attitude and orbit control system – Telemetry, Tracking and Command – Power system – Transponder – Reliability and space qualification – launch vehicles. (Ch2 & 3 of Text Book 4)

Multiple Access Techniques:

Time division multiple access – Frequency division multiple access – Code division multiple access – Space domain multiple access. (Ch 7 of Text Book 4).

Earth Station technology – Subsystem of an earth station – Transmitter – Receiver Tracking and pointing – Small earth station – different types of earth stations – Frequency coordination – Basic principles of special communication satellites – INMARSAT VSAT, GPS, RADARSAT, INTELST. (Ch 10 & 11 of Text Book 4).

Text Books:

1. *Understanding Radar Systems – Simon Kingsley and Shaun Quegan.*
2. *Introduction to Radar Systems – MI Skolnik*
3. *Satellite Communication – Robert M. Gagliardi*
4. *Satellite Communication – Manojit Mitra*

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18PH53E3-FIBER OPTIC SENSORS

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Explains the light properties like total internal reflection and interference	1	2
CO2	Fundamental properties of optical fibers, types of optical fibers and their related information	1,2	2,3
CO3	Different concepts of light and information related to interferometers and sensors	1,2	2,3
CO4	Explains the fiber optics in modulation sensors and different effects of light	1,2	2,3

Introduction:

Plane polarized wave – propagation of a light through a quarter wave plate – reflections at a plane interface – Brewster angle – total internal reflection – interference – refraction – concept of coherence – diffraction of Gaussian beam.

Fundamentals of Fiber Optics:

Numerical aperture – attenuation in optical fibers – pulsed dispersion in step index optical fiber – loss mechanisms – absorptive loss – radiative loss – principle of optical waveguides – characteristics of fibers – pulsed dispersion in planar optical waveguide – modes in planar waveguides – TE, TM modes – propagation characteristics of step index and graded index optical fibers.

Intensity-modulated Sensors:

Transmission concept – reflective concept – micro-bending concept – intrinsic concepts – transmission and reflection with other optical effects - source of error and compensation schemes – phase modulation mechanisms in optical fibers – optical fiber interferometers –

optical fiber phase sensors for mechanical variables – the optical fiber signal interferometer – optical fiber interferometric sensors.

Frequency modulation in Optical fiber sensors:

Introduction – optical fiber Doppler system – development of the basic concepts. Polarization modulation in fiber sensors – introduction – optical activity – Faraday rotation – electro-gyration – electro –optic effect – kerr effect – photo elastic effect – polarization modulation sensors.

Text Books:

1. D.A. Krohn, Fiber Optic Sensors: Fundamentals and Applications, 2nd edition, Instrument Society of America (1992).
2. B. Culshaw, Optical Fiber Sensing and Signal Processing, Peter Peregrinus Ltd. (1984).
3. Djafar K. Mynbaev and Lowell L. Scheiner, Fiber Optic Communications Technology, Peason Education Asia (2001).

18PH5304 – TERM PAPER

L-T-P-S: 0-0-2-0 **Credits: 1** **Prerequisite: Nil**

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO#	Course Outcome (CO)	PO	BTL
CO5	The term paper has to be taken up by the III Semester students. It is based on independent research in one of the areas opted by the student. In a term paper, a student should demonstrate his/her ability in finding out the relevant sources, selection, an illustration of materials, and in organizing the information on the topic, gathering the data, processing, analyzing, and summarizing.	PO6	4

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18PH54E1- NANOSCIENCE AND TECHNOLOGY

Course Code:

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Understand the basics of nanomaterials, parameters which get effected by scaling down the size of the material, Major approaches and synthesis procedure	1,2,7	1,2
CO2	Explain the basics of principles associated with characterization techniques and usage of the techniques	1,2,7	2,3
CO3	Identifying the change in properties of the nanomaterial in case of metals, semiconductors, insulators, ceramics and polymers and make use of nanomaterials in those devices	1,2,3,7	1,2
CO4	Understand synthesis of carbon nanotubes and explore their applications.	1,2,3,4, 5,6,7	2,3

Introduction to Nanoscience and synthesis of Nanomaterials

Overview of the Nano science and technology, Introduction to Physics of the solid state-structure, Insulators, S.C's, conductors-their energy bands. Size determination. Metal nanoclusters, semi conducting nano particles-photo fragmentation. Types of Nano materials -Nano structured crystals, Metals and ceramics, Top down Approach & Bottom up Approach I: Physical methods-Thermal spraying, Electrodeposition method, RF-plasma method, Ball milling method-Applications. Chemical methods-Thermolysis, Pulser laser ablation method, Spray pyrolysis, CVD, and sol-Gel technique.

Characterization of Nano materials

Introduction to Microscope, optical microscope, Optical absorption spectrometer, Infrared, Ramanspectroscopy, UV-Visible and XRD techniques-their applications in nano technology. Microscopic techniques: Scanning electron microscopy (SEM) and Transmission Electron microscopy.

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Mechanical, Optical & Electrical Properties of Nano materials

Introduction-Nano structured materials, Mechanical behavior of Nano crystalline Metals, semiconductors and ceramics. Mechanical behavior of Two phase nano structured materials and Nano structured multilayer's. Optical properties of nano Particles- Optical direct and indirect band gap studies. Conduction mechanism- Electrical conductivity of nano structured materials-. Semi conducting nano particles, ceramics, conducting polymers, Composites. Metal nanostructured particles-and device applications

Carbon Nano Structures& CNTs:

Introduction-Carbon molecules, New carbon structures, Small carbon clusters, Discovery of C_{60}, Fullerenes. Carbon Nano Tubes: Introduction-Types of CNTs- SWCNT and MWCNT-. Fabrication-Synthesis methods of CNTs. Electrical Properties, conductivity studies, soft lithography, Lithography using particle beams, Applications of CNTs- Carbon nano tubes in Computers, In Fuel cells and Batteries.. CNTs as Chemical Sensors, Drug delivery system. Nano Devices- CNTs as Microelectromechanical systems (MEMS), -Applications.

Text Books:

1. The Physics and Chemistry of Solids - Stephen Elliott & S. R. Elliott, John Wiley & Sons, 1998.

2. Hari Singh Nalwa – Handbook of nanostructured materials and nanotechnology: Synthesis and processing, ASP,2004

3. Zhong Lin Wang, *"Characterization of Nanophase Materials"*, Wiley-VCH, 2001

3. Carl.C.Koch, "Nanostructured materials, processing, properties and applications, NFL publications, 2007.

4. T.J.Chung, P.M. Anderson, M.K.Wu and S.Hsieh, "Nanomechanics of materials and structures, Springer, 2006.

Recommended Reference:

1. Jackie Ying. Ed "*Nanostructured Materials"*, Academic Press, 2001. A small edited volume with some good articles on some specialized topics such as adsorption in nanoporous materials
2 J. Bozzola and Lonnie D. Russel, "Electron Microscopy", Jones and Bartlett Publishers Inc., USA, 1999.

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18PH54E2-ANTENNA THEORY AND RADIOWAVE PROPAGATION

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	To be learn the antenna characteristics, radiation and applications	1,2	1,2
CO2	To be learn antenna arrays, advantages; impedance measurements	1,2	1,2
CO3	To be learn types of antennas, excitation techniques for designing the antennas	1,2, 3,6	1,2
CO4	To be learn ground wave space wave and sky wave propagation for wireless communications	1,2, 3,5	1,3

Radiation and Antenna Fundamentals

Potential functions of electro-magnetic fields. Potential function for sinusoidal oscillations. Fields radiated by an alternating current element. Power radiated by a current element and radiation resistance. Radiation from a quarter wave monopole or a half wave dipole. EM field close to an antenna and far field approximation. *(Chapter 10 in Jordan and Balmain)*

Definition of an antenna. Antenna properties – radiation pattern, gain, directive gain and directivity.

Effective area. Antenna beam width and band width. Directional properties of dipole antennas.

(Chapter 11 in Jordan and Balmain and Chapter 2 in Kraus)

Antenna Arrays and Impedance

Two element array. Linear arrays. Multiplication of patterns and binomial array. Effect of Earth on vertical patterns. Mathematical theory of linear arrays. Antenna synthesis – Tchebycheff polynomial method. Wave polarization. *(Chapter 11 and 12 in Jordan and Balmain and Chapter 4 in Kraus)*

Antenna terminal impedance. Mutual impedance between two antennas. Computation of mutual impedance. Radiation resistance by induced emf method. Reactance of an antenna. Biconcal antenna and its impedance.

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(Chapter 14 in Jordan and Balmain and Chapters 8.1 –8.5 in Kraus)

Frequency Independent (FI) Antennas and Methods of excitation and Practical Antennas

Frequency Independence concept. Equiangular spiral. Log Periodic (LP) antennas. Array theory of LP and FI structures. *(Chapter 15 in Jordan and Balmain and Chapter 15 in Kraus)*

Methods of excitation and stub matching and baluns. Folded dipole, loop antennas. Parasitic elements and Yagi-Uda arrays and Helical antenna. Complementary screens and slot antennas. Radiation from a rectangular horn antenna.

(Chapter11.15 in Jordan and Balmain and Chapters 6.1 – 6.4 ,7.1 – 7.8 and 13 in Kraus)

Radio Wave Propagation

Elements of Ground wave and Space wave propagation. Tropospheric propagation and Troposcatter. Fundamentals of Ionosphere. Sky wave propagation – critical frequency, MUF and skip distance.

(Chapter 16 and 17 in Jordan and Balmain)

BOOKS

1. *"Electromagnetic waves and Radiating Systems" by E.C.Jordan and K.G.Balmain*
2. *"Antennas" by J.D.Kraus. (Second Edition)*

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18PH54E3-CLIMATE CHANGE

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	energy balance of the earth-atmosphere and inter-glacial and insterstadial events	1	2
CO2	Anthropogenic climate change and Greenhouse gases (GHG) and global warming	1	2
CO3	Future Emissions and Energy Resources and Biological sources of Nitrous oxide, societal resilience.	1,3	2,3
CO4	Teleconnections of the world climate system, Climate in relation to sunspot and cosmic activity. Climate phenomena and their relevance for future regional climate change.	1,3	2,3

The Climate system

Energy balance of the earth-atmosphere. History of climate change – glacial cycle, inter-glacial and insterstadial events, year to decadal variations, natural variability.

Global warming

Anthropogenic climate change. Greenhouse gases (GHG) and global warming – GHGs trend, global temperature trend, global distribution of emissions, Sources of CO2 in the Land, Ocean and atmosphere.

Future Emissions and Energy Resources, Current and Future sources of Methane, Biological sources of Nitrous oxide, societal resilience. Mitigation strategies: Reducing Carbon Emissions, Energy use and Emission trading,

Climate trends:

Teleconnections of the world climate system, consequences of global warming; Ozone hole; Volcanic eruptions and aerosols, Nuclear winter; Climate in relation to sunspot and cosmic activity.

IPCC Assessment of climate change:

Detection and Attribution of Climate Change: from Global to Regional scales. Short term climate change: Projections and Predictability. Long- term climate change: Projections, commitments and irreversibility. Climate phenomena and their relevance for future regional climate change.

The measurement of climate change. Climate change and extreme weather events. Climate change impacts on ecosystems, agriculture.

TEXT BOOKS:

1. Earth's Climate: Past and Future - Ruddiman, William F.2001.
2. Climate Change 2001 - Houghton, J.T., 2001, (ed). The Scientific Basis. 881pp.
3. Climate Change: A Multidisciplinary Approach - William James Burroughs
4. Current trends in Global Environment - A.L. Bhatia (2005).

REFERENCE BOOKS:

1. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC 2013 report. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
2. Causes of Climate - J.G. Lockwood

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18PH54E4- THIN FILM TECHNOLOGY AND APPLICATIONS

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Explain the concept of thin film technology and the preparation and techniques	1,2,7	2,3
CO2	Explaining the growth and techniques and kinetics	1,2,7	1,2
CO3	Explaining about XRD, TEM and other techniques for Thin film characterization	1,2,3,7	1,2
CO4	Explaining the various properties of thin films.	1,2,3,4,5,6,7	2,3

Preparation of Thin film Techniques:

Preparation of Thin-films Kinetic aspects of Gases in a vacuum chamber - Classifications of vacuum ranges Production of vacuum - Pressure measurement in vacuum systems - Physical vapour deposition - Evaporation Techniques - Sputtering (RF & DC) - Pulsed Laser deposition-Liquid Phase Epitaxy- Vapour Phase Epitaxy- Molecular Beam Epitaxy.

Film growth technique and Kinetics:

Film growth and measurement of thickness, Thermodynamics and Kinetics of thin film formation - Film growth – five stages - In corporation of defects and impurities in films - Deposition parameters and grain size - structure of thin films - Microbalance technique - quartz crystal monitor photometric - Ellipsometry and interferometers - Measurement of rate of deposition using ratemeter - cleaning of substrate.

Thin film Characterization Techniques:

Characterization, X-ray Diffraction(XRD) - SEM, Photoluminescence(PL) - Raman Sepectroscopy, UV-Vis-IR Spectrophotometer – AFM - Hall effect – SIMS - X-ray Photoemission Spectroscopy (XPS) - Vibrational Sample Magnetometers, Rutherford Back Scattering (RBS).

Various Properties of Thin films:

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Properties of thin films Dielectric properties - Experimental techniques for dielectric film - annealing effect, effect of film thickness on dielectric properties – determination of optical constants – Experimental techniques for determination of optical parameters - Magnetic and mechanical properties - Hall effect compilations - Adhesion, stress, strength, Raleigh surface waves - Ferromagnetic properties of Thin films - Experimental methods for measurement of mechanical properties of thin films.

Reference Text Books:

1. K.L. Chopra, Thin film phenomena, McGraw- Hill book company New York, 1969

2. Ludminla Eckertova, 'Physics of thin films', Plenum press, New York 1977.

3. A. Goswami, Thin Film Fundamentals, New Age international (P) Ltd. Publishers, New Delhi (1996).

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18PH54E5-Instrumentation & Measurement Techniques

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Various basic fundamentals of measurements along with techniques to measure them will be taught.	1,2	2,3
CO2	Passive Electric Transducers will be introduced and various kinds of them used for various measurements will be briefed.	1,2,3,4	1,2,3
CO3	Active Electric Transducers will be introduced and various kinds of them used for various measurements will be reviewed.	1,2;3,4	1,2,3
CO4	An important feature to measure the accuracy of any measurement is its error. Errors will be described; ways and means to measure them in various measurement techniques will be learnt. Different ways to reduce errors will also be introduced using graphical methods.	1,2,3, 4,5,6	1,2, 3,4

Characteristics of instruments:

Measurements of frequency, phase, time interval, impedance, measurement of power, energy and distortion, accuracy, precision, tolerance, hysteresis, loading effect, repeatability, reproducibility, resolution, sensitivity, linearity, drift, range, **and** response time. Measurement of temperature (thermodynamic scale, bimetallic method, fluid expansion method), pressure (manometer, bell type, ring type, Burdon tube), flow, force, level. Concept of calibration

Passive Electrical transducer:

Resistive: Resistance Thermometers, Resistive displacement Transducers, Resistive strain Transducers, Resistive Pressure Transducers. Inductive: Inductive thickness transducers, Inductive displacement transducers, Eddy current type Inductive transducers. Capacitive: Capacitive thickness Transducers, Capacitive displacement Transducers.

Active Electrical Transducers:

Thermo electric Transducers. Piezo-electric Transducers: Force transducers, strain transducers, Torque and pressure transducers, and photoelectric transducers. Digital Transducers: Digital displacement transducers, Digital tachometers.

Error analysis: Types of error, systematic and random errors, Significant figures and round - off, Uncertainties and probable error, Random variable – Mean, variance and standard deviation – Normal distribution – sampling technique – propagation of errors – Estimates of mean and errors – Instrumental uncertainties – statistical fluctuations – Chi square test – Goodness of fit. Graphical representation of data, curve fitting.

Prescribed Text Books:

1. Instrumentation devices and systems - Rangan, Mani, Sharma - Tata McGraw Hill
2. Instrumentation Measurement and Analysis – Nakara, Chaudhari - Tata McGraw Hill
3. Advanced Engineering Mathematics - H K Daas – S. Chand & Co

Ref. Books:

1. Modern Electronic Instrumentation and Measurements – Alberd D Helfrick, W D Cooper
2. Mathematical Methods for Physicists – George Brown Arfken, Hans-Jurgen Weber

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18PH54E6-GLASS SCIENCE AND TECHNOLOGY

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Interpret free ion d2 and f2 configurations; Spin-orbit coupling; Ground states for fn configurations; Coulomb and spin-orbit energies; Intermediate coupling.	1,2,7	2,3
CO2	Explain basic Absorption characteristics of Rare Earth ions	1,2,7	1,2
CO3	Explain the basic formulae related to the luminescence characteristics of Rare earth ions.	1,2,3,7	1,2
CO4	To understand energy transfer between the different rare earth ions.	1,2,3,4, 5,6,7	2,3

1. ATOMIC SPECTROSCOPY:

The free ion: Free ion terms for d2 and f2 configurations; Spin-orbit coupling; Ground states for fn configurations; Coulomb and spin-orbit energies; Intermediate coupling.

2. ABSORPTION CHARACTERISTICS OF RARE EARTH IONS:

Intra-configurational f-f transitions; magnetic dipole, electric dipole and induced electric dipole transitions; Intensity of absorption bands; Judd-Ofelt theory for induced electric dipole transitions and evaluation of Judd-Ofelt parameters.

3. LUMINESCENCE CHARACTERISTICS OF RARE EARTH IONS:

Radiative transition rates, Emission cross-sections and Branching ratios, relaxiation process: Non-radiative relaxiation: Multi-phonon, Radiative quantum efficiencies of rare earth ion energy levels.

4. ENERGY TRANSFER IN RARE EARTHS:

Possible mechanisms of energy transfer: Resonance energy transfer; Process of IR to Visible upconversion; Energy transfer from lanthanides to other species.

5. RARE EARTH DOPED LASERS:

Principle of laser action: typical rare earth lasers- Nd: YAG: Energy level diagram of Nd(III) ion in YAG laser.

TEXT BOOKS:

1. Introduction to Ligand Fields, B N Figcgis, Wiely Eastern Ltd, New Delhi.

2. Optical Spectra of Transparent Rare Earth Compounds. S Hufner, Academic Press, London.

3. Lasers and excited states of Rare Earths, R Reisfield and C K Jorgensen, Springer-Verlag, New York.

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18PH54E7-MICRO-ELECTRO-MECHANICAL SYSTEMS

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Understand the basic concepts of MEMS technology and relates to the scaling laws that are used extensively in the conceptual design of devices and systems. Also explains the materials and microfabrication processes used for common micro components and devices.	1,2,7	1,2
CO2	Understanding the concepts of bulk manufacturing process	1,27	1,2
CO3	Understanding the concepts of surface manufacturing process	1,2,3,7	1,2
CO4	Study and analyze the various micro sterio methods in the manufacturing of MEMS Devices. And explains the use of CAD and finite elements method in selected case studies and examples in the design and applications of MEMS devices.	1,2,3,4, 5,6,7	1,2

Introduction

Emergence- devices and application – scaling issues – materials for MEMS – thin film deposition – lithography and etching.

Bulk micro Machining:

Introduction - etch-stop techniques – dry etching – buried oxide process – silicon fusion bonding and anodic bonding.

Surface micro Machining:

Introduction – sacrificial layer technology – material systems in sacrificial layer technology – plasma etching – combined IC technology and anisotropic wet etching.

Microstereo lithography and MEMS Devices:

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Introduction – scanning method – projection method – applications – LIGA process:introduction, basic process and application. Electronic interfaces – design, simulation and layout of MEMS devices using CAD tools.

Reference Books:

1. *S.M. Sze, Semiconductor Sensors, John Wiley & Sons (1994).*
2. *M. Elwenspoek and R. Wiegerink, Mechanical Microsensors, Springer-Verlag (2001)*
3. *Masood Tabib-Azar, Microactuators – Electrical, Magnetic, Thermal, Optical, Mechanical, Chemical and Smart structures, Kluwer Academic Publishers (1997)*
4. *Eric Udd, Fiber Optic Smart structures, John Wiley & Sons (1995).*

18PH54E8- WEATHER HAZARDS & RISK ASSESSMENT

L-T-P-S: 2-2-0-0 Credits: 3 Prerequisite: Nil

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO	Course Outcome	PO	BTL
CO1	Types of weather hazards	1,2	1,2
CO2	Hydrological Modeling - water quality modeling.	1,2	1,2
CO3	Disaster Impact and Damage Analysis	1,2	1,2
CO4	Pre-Disaster Risk Assessment and Risk Information for Risk Reduction Planning	1,2	2,3

Weather hazards:

Types of weather hazards, vulnerability to weather elements, tropical cyclones, severe local storms, heavy precipitation, flash floods, fog, heat and cold waves, tornadoes.

GIS based Modelling:

Hydrological Modeling - water quality modeling, watershed management and modeling, saltwater intrusion models. Land-surface-subsurface Process Modeling - pipeline alignment studies, solid and hazardous waste disposal site selection, zoning atlas for industrial silting, environmental information system development. Ecosystem modeling, risk and hazard modelling.

Disaster Impact and Damage Analysis:

The use of satellite imagery for disaster relief and recovery; Impact analysis and preliminary damage assessment.

Pre-Disaster Risk Assessment

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Hazard Assessment; Elements at risk and vulnerability assessment; Types and methods of risk assessment, risk evaluation, cost-benefit analysis.

Risk Information for Risk Reduction Planning:

Risk evaluation, Visualization of risk information; Risk information and spatial planning.

TEXT BOOKS:

1. Weather Risk Management: A guide for Corporations, Hedge Funds and Investors - Tang, K., Ed., Risk Books, 2010.

2. The transfer of weather risk faced with the challenges of the future - Finas, B., SCOR, 2012.

3. Climate Risk and the Weather Market: Financial Risk Management with Weather - Hedges, Robert S. Dischel Ed., Risk Books, 2002.

4. Weather Derivatives: Modeling and Pricing Weather-Related Risk - Antonis Alexandridis K. and Achilleas D. Zapranis , Springer, 2012.

REFERENCE BOOKS:

1. Climate risk assessment and management in agriculture - Ramasamy Selvaraju; http://www.fao.org/docrep/017/i3084e/i3084e06.pdf

2. Severe and hazardous weather: An introduction to high impact meteorology - Rauber Robert M, Walsh John E, Charlevoix Donna J, Kendall Hunt Publishing, 2013.

3. Meteorology Today - C. Donald Ahrens, Brooks Cole Pub., 2004.

OC-D-1&2 and AC-D-1 &2:

M.Sc. student must submit a dissertation work on a topic of his interest at the end of the 2nd year for fulfilment of his degree. The content of the dissertation has to yield a good Scopus indexed Journal publication.

18PH5401 – DISSERTATION

L-T-P-S: 0-0-24-0 **Credits: 12** **Prerequisite: Nil**

Course Outcomes (COs) – Program Outcomes (POs) – Blooms Taxonomy Levels (BTL) Mapping Table:

CO#	Course Outcome (CO)	PO	BTL
CO5	Prepare new materials and conduct characterization studies and analysis of obtained results followed by the conclusions	PO6	4

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