15AVP201 /	**AMRITA VALUES PROGRAMME I /**	**1 0 0 1**
15AVP211	**AMRITA VALUES PROGRAMME II**	**1 0 0 1**

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World
Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana
Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata
Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads
Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, Satyakama Jabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita
Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda
Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

Life and Teachings of Spiritual Masters India
Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature
The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation
The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting
Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability
Organic farming is emerging as an important segment of human sustainability and

healthy life. 'Haritamritam' is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature".

Benefits of Indian Medicinal Systems

Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Únity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

15CHY102 CHEMISTRY I 3 0 0 3

Unit 1 Chemical Bonding

Review of orbital concept and electronic configuration, electrovalency and ionic bond formation, ionic compounds and their properties, lattice energy, solvation enthalpy and solubility of ionic compounds, covalent bond, covalency, orbital theory of covalency - sigma and pi bonds - formation of covalent compounds and their properties Hybridization and geometry of covalent molecules - VSEPR theory - polar and non-polar covalent bonds, polarization of covalent bond - polarizing power, polarisability of ions and Fajan's rule, dipole moment, percentage ionic character from dipole moment, dipole moment and structure of molecules, co-

ordinate covalent compounds and their characteristics, molecular orbital theory for H2, N2, O2 and CO, metallic bond - free electron, valence bond and band theories, weak chemical bonds – inter and intra molecular hydrogen bond - van der Waals forces.

Unit 2 Thermodynamic Parameters

Stoichiometry - mole concept, significance of balanced chemical equation - simple calculations - Conditions for occurrence of chemical reactions - enthalpy, entropy and free changes – spontaneity – Thermochemistry - heats of reactions - (formation, combustion, neutralization) - specific heats - variation of enthalpy change with temperature - Kirchhoff' relation (integrated form) - bond enthalpy and bond order - Problems based on the above.

Unit 3 Kinetics

Review of molecularity and order of a reaction, rate law expression and rate constant - first, second, third and zero order reactions, pseudo-first order reactions (pseudo-unimolecular reactions) - complex reactions - equilibrium and steady state approximations -mechanism of these reactions - effect of temperature on reaction rates - Arrhenius equation and its significance, Michaelis Menden kinetics-enzyme catalysis.

Unit 4 Electrochemistry

Electrolytes - strong and weak, dilution law, Debye-Huckel theory, faraday's laws, origin of potential, single electrode potential, electrochemical series, electrochemical cells, Nernst equation and its application, reference electrodes - SHE, Ag/AgCl, Calomel.

Unit 5 Photochemistry

Photochemistry, laws of photochemistry - Stark-Eistein law, Beer-Lamberts law, quantum efficiency-determination, photochemical processes - Jablonsky diagram, internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo sensitization, photopolymerization.

REFERENCE BOOKS:

1. *Principles of Physical Chemistry, B.R. Puri, L.R. Sharma & M.S. Pathania, Vishal Publications, 46th, 2013.*
2. *Principles of Inorganic Chemistry, B R. Puri, L.R. Sharma, Vishal Publications, 2008*

15CHY112 CHEMISTRY II 3 0 0 3

Unit 1 Ionic equilibria

Electrolytes, strong and weak - specific, equivalent and molar conductances, equivalent conductance at infinite dilution and their measurement - Kohlrausch's

law and its applications - calculation of equivalent conductance at infinite dilution for weak Electrolytes and solubility of sparingly soluble salts - applications of conductivity measurement - conductometric titrations - acid-base precipitation and complexometric titrations, Common ion effect and its application, concept of pH, indicators, theories of indicators – buffers and their pH - Henderson equation.

Unit 2 Chemical equilibria

Law of mass action - equilibrium constant – Relation between Kp and Kc - Temperature dependence – The van't Hoffs equation – Pressure dependence of the equilibrium constant Kp and Kc – Factors that change the state of equilibrium - Le-Chatelier's principle and its application to chemical equilibria.

Unit 3 Basic concepts in Organic Chemistry

Composition of organic compounds – detection and estimation of elements- carbon – hydrogen -nitrogen, oxygen, sulphur, phosphorous, halogens – Calculation of empirical and molecular formula - determination of molecular weights – physical and chemical methods - empirical formula and molecular formula – Classification and Nomenclature of organic compounds. Organic reactions and their mechanisms: Electron displacement effects – inductive, electromeric, mesomeric and hyperconjugative. Reactive intermediates – carbocations, carbanions, free radicals and carbenes.

Unit 4 Acids, Bases and Non-aqueous solvents

Concepts of acids and bases – hard and soft acids and bases - Pearson's concept, HSAB principle and its application - basis for hard-hard and soft-soft interactions - non-aqueous solvents - general characteristics of non-aqueous solvent - melting point, boiling point, latent heat of fusion and vaporization, and dielectric constant - reactions such as complex formation, redox, precipitation and acid-base type in non-aqueous solvents like liquid ammonia, liquid SO2 and liquid HF.

Unit 5 Coordination Chemistry

Werner's theory – Electronic interpretation of co-ordination compounds - EAN rule – types of ligands – Nomenclature, isomerism – stability of complexes – factors influencing stability – Application of coordination compounds in qualitative and quantitative analysis. Theories of bonding in coordination.

TEXTBOOKS:

1. *Puri, Sharma & Pathania, 'Principles of Physical Chemistry', 42nd edition, Vishal Publishing Co, Delhi, 2007.*
2. *Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition, Prentice Hall, 1992.*
3. *Puri B R, Sharma L R, Kalia K K., 'Principles of Inorganic Chemistry', 23rd edition, Shoban Lal Nagin Chand & Co, New Delhi, 1993.*

REFERENCES:

1. *S.F.A. Kettle, 'Physical Inorganic Chemistry', Spectrum, 1996*
2. *J. Clayden, N. Greeves, S. Warren and P. Wothers, 'Organic Chemistry', 2nd edition, Oxford University Press, 2012.*
3. *R.Stephen Berry, Stuart A. Rice & John Ross, 'Physical Chemistry', 2nd edition, Oxford University press, 2000.*

15CHY182 CHEMISTRY LAB. 0 0 2 1

1. Acid base titration (double titration).
2. Complexometric titration (double titration).
3. Redox (permanganimetry) titration (double titration).
4. Conductometric titration.
5. Potentiometric titration.
6. Colorimetric titration.

15CHY185 CHEMISTRY LAB. – INSTRUMENTAL 0 0 2 1

1. Determination equivalent conductance at infinite dilution of a strong electrolyte.
2. Conductometric titration of a mixture of strong and weak electrolytes.
3. Kinetics of acid catalysed ester hydrolysis.
4. Determination of solubility of sparingly soluble salt conductometrically.
5 Determination of molecular weight of a polymer through viscometry
6. Determination of concentration of ions by Spectrophotometer.

15CHY203 ELECTROCHEMISTRY 3 1 0 4

Unit 1 Background Theory

Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

Unit 2 Batteries

Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries. Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; lithium primary cells - liquid and solid cathodes cells.

Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultra-

thin lithium polymer cells (comparative account). Reserve batteries and their applications.

Unit 3 Fuel Cells

Working principle, fabrication and performance aspects of the following: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, molten carbonate, and direct methanol fuel cells. Membranes: Nafion – Polymer blends and composite membranes; assessment of performance. Fuels: Hydrogen, methane, methanol - Sources and preparation, reformation processes for hydrogen – clean up and storage of the fuels – use in cells, advantages and disadvantages of using hydrogen as fuel.

Unit 4 Electrochemical Processes

Electrochemical Processes: Principle, process description, operating conditions, process sequence and applications of Electroforming – production of waveguide and plated through hole (PTH) printed circuit boards by electrodeposition; Electroless plating of nickel, copper and gold; Electropolishing of metals; Anodizing of aluminium; Electrochemical machining of metals and alloys.

Unit 5 Corrosion Studies

Corrosion and control:Free energy concept of corrosion - different forms of corrosion. Mechanism of Electrochemical corrosion - Galvanic and Electrochemical series and their significance. Corrosion Control:Corrosion Inhibitors: Passivators - Vapour phase inhibitor.

Anodic and cathodic protection methods - Coatings - metallic and other inorganic coatings - organic coatings - stray current corrosion - cost of corrosion control methods.

TEXTBOOKS:

1. *Dell, Ronald M Rand, David A J, 'Understanding Batteries', Royal Society of Chemistry, (2001).*
2. *M. Aulice Scibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India (2006).*
3. *Uhlig H H and Reviees R W, 'Corrosion and its Control', Wiley, (1985).*

REFERENCES:

1. *Christopher M A, Brett, 'Electrochemistry – Principles, Methods and Applications', Oxford University, (2004).*
2. *G. Hoogers, 'Fuel cell handbook', CRC, Boca Raton, FL, (2003).*
3. *ASM Metals Handbook, 'Corrosion', Vol. 13, ASM Metals Park, Ohio, USA, (1994).*

15CHY214 CHEMISTRY OF MATERIALS 3 1 0 4

Unit 1 Electro-active Polymers

Conjugated polymers - synthesis, processing and doping of conjugated polymers:

polyacetylene, polyaniline, polythiophene, poly (p-(phenylenevinylene) - ionically conducting polymers - applications of conjugated polymers. Semi-conducting, poly-ferrocene - photo resist optical fibers and sensors, photochromic & thermochromic materials. Preparation, properties and applications of ABS, polycarbonates, epoxy resins - polyamides - Nylon and Kevlar.

Unit 2 Photochemistry in Electronics

Photochemical reactions - laws of absorption (Grothers-Draper law - Stark-Einstein's law) - Quantum efficiency - photochemical decomposition of HI and HBr - Quantum yield florescence and phosphorescence - photosensitization.

Unit 3 Biomaterials

Classification and nomenclature. Preparation, properties. Glucose – structure and configuration of mono saccharide, interconversion, mutarotation, epimerization, cyclic structure. Polysaccharide – starch, cellulose, glycogen – structure and utility. Reducing and non-reducing sugars.

Unit 4 Amino acids, Proteins, vitamins and Nucleic acids

Amino acids: Classification, structure and stereochemistry of amino acids, preparation and reactions of β, γ - amino acids. Essential and non-essential amino acids, zwitter ion, isoelectric point. Peptides: structure and synthesis (Carbo-benzoxy method, Sheehan method only). Proteins: Structure of proteins, denaturation and colour reactions. Nucleic acids: Classification and structure of DNA and RNA. Replication of DNA, Genetic Codes. Vitamins – Classification and important sources, physiological action and deficiency symptoms of vitamin A, B1, B2, and B12. C, D, E and K.

Unit 5 High energy and Toxic materials

High Energy materials: Preparation, properties and application of ammonium nitrate (AN), NH_4NO_3, ammonium perchlorate (AP), NH_4ClO_4, ammonium dinitramide (AND), $NH_4N(NO_2)_2$, hydrazinium nitroformate (HNF), $N_2H_5C(NO_2)_3$.

Toxic Materials: Principles of Toxicology - Volatile poisons - Gases CO, hydrocyanic acid - H_2S - PH_3 - CO_2- SO_x - NO_x - Heavy metals - lead, arsenic, mercury, antimony, barium, bismuth, selenium, zinc, thallium - Pesticides - Food poisoning - Drug poisoning - barbiturates - narcotics - ergot - LSD - alkaloids - Radioactive Toxicology - Radiation hazards.

TEXTBOOKS:

1. *Chawla S, 'A Textbook of Engineering Chemistry', Dhanpat Rai & Co, Delhi, (2001).*
2. *Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition, Prentice Hall, 1992*

REFERENCES:

1. *Mark Ratner and Daniel Ratner, 'Nanotechnology - A gently introduction to the next big idea', Pearson Education, (2003).*

2. *Interrante L.V. and Hampden Smith M.J, 'Chemistry of Advanced Materials', Wiley-VCH, (1988).*
3. *Van Vlack, Lawrence H, 'Elements of Material Science and Engineering', 6th edition, New York Addison, Wesley, (1989).*

15CSA100 PROBLEM SOLVING AND COMPUTER PROGRAMMING 3 0 0 3

Unit 1

Introduction to problem solving: algorithm development and flowchart. Introduction to Computer terminologies and computer languages. Number systems: binary, octal and hexadecimal. Bitwise operators and enumeration.

Unit 2

C Fundamentals: structure of C program: directives, functions, statements, printing strings, comments; compilation and execution, Programming errors and debugging. Variables and assignment, reading input; data types, constants, identifiers, keywords, operators - arithmetic, logical, relational, assignment; expressions - precedence and associativity, type cast-implicit and explicit

Unit 3

Selection statements - if, if else, nested if, if else ladder, switch. Case. Iterative structures: entry controlled and exit controlled loop, exiting from a loop: break, continue, goto; nested loops.

Unit 4

Functions: library functions user defined functions: defining and calling functions, function declaration, passing arguments to a function, returning values from function. Storage classes - auto, extern, static, register variables, scope of a variable. Recursion.

Unit 5

Arrays: one dimensional numeric arrays, initialization, accessing and usage, two dimensional numeric arrays, initialization, accessing and usage. Introduction to multidimensional arrays. Strings: literal, variables: initialization, reading, writing and accessing. String handling functions. Array of strings. Passing arrays and strings to functions.

TEXTBOOK:

Jeri Hanly and Elliot Koffman, "Problem solving and program design in C", Fifth Edition, Addison Wesley (Pearson), 2007.

REFERENCE:

Reema Thareja, "Computer Fundamentals and programming in C", Oxford University Press, 2012.

15CSA116 ADVANCED COMPUTER PROGRAMMING 3 0 0 3

Unit 1

Structures: structures variables - declaration, bit fields, initialization and operation on structures, typedef, nested arrays and structures: arrays in structures, nested structures, arrays of structures.

Unit 2

Pointers– Declarations, Passing arguments by call by reference, Functions returning pointer, Pointer Arithmetic. Pointer to pointer, Pointers and Arrays – pointer to array, array of pointers, Dynamic memory allocation – malloc(), calloc(), deallocation: free(), dangling pointers.

Unit 3

Pointers and structures, structures and functions: passing structure as argument and returning structure from functions, self-referential structure, unions.

Unit 4

Files - file pointers, standard streams and redirection, text files, binary files, file operations: open, mode, close; Input and output - character I/O, line I/O, formatted I/O. Random file access, Command line arguments.

Unit 5

Preprocessor – Macros. User defined libraries and headers, introduction to the graphics library.

TEXTBOOK:

Jeri Hanly and Elliot Koffman, "Problem solving and program design in C", 5th Edition, Addison Wesley (Pearson), 2007.

REFERENCE:

Reema Thareja, "Computer Fundamentals and programming in C", Oxford University Press, 2012.

15CSA180 PROBLEM SOLVING AND COMPUTER PROGRAMMING LAB. 0 0 2 1

Basic Linux commands, programs using input/output statements, operators, control structures and loops. Programs using functions and recursions. Programs using numeric one-dimensional array, two-dimensional array. Programs using strings, string handling functions and string arrays. Programs using passing arrays and strings to functions.

15CSA187 ADVANCED COMPUTER PROGRAMMING LAB. 0 0 2 1

Programs to demonstrate functions call by reference and returning values by reference.Programs using pointer arithmetic operations and handling pointers. Programs to demonstrate dynamic memory allocation and de-allocation. Programs to show structure and union operations. Programs using files, command line arguments and macros. Programs using user defined libraries and graphics library.

15CUL101 CULTURAL EDUCATION I 2 0 0 2

Unit 1

Introduction to Indian Culture - Introduction to Amma's life and Teachings - Symbols of Indian Culture.

Unit 2

Science and Technology in Ancient India - Education in Ancient India - Goals of Life – Purusharthas - Introduction to Vedanta and Bhagavad Gita.

Unit 3

Introduction to Yoga - Nature and Indian Culture - Values from Indian History - Life and work of Great Seers of India.

TEXTBOOKS:

1. *The Glory of India (in-house publication)*
2. *The Mother of Sweet Bliss, (Amma's Life & Teachings)*

15CUL111 CULTURAL EDUCATION II 2 0 0 2

Unit 1

1. Relevance of Sri Rama and Sri Krishna in this Scientific Age.
2. Lessons from the Epics of India.
3. Ramayana & Mahabharata.

Unit 2

4. Who is a Wise Man?
5. A Ruler's Dharma.
6. The Story of King Shibi.

Unit 3

7. Introduction to the Bhagavad Gita.
8. Bhagavad Gita – Action without Desire.

Unit 4

9. Role and Position of Women in India.
10. The Awakening of Universal Motherhood.

Unit 5

11. Patanjali's Astanga - Yoga System for Personality Refinement.
12. Examples of Heroism and Patriotism in Modern India.

TEXTBOOKS:

Common Resource Material II (in-house publication)

Sanatana Dharma - The Eternal Truth (A compilation of Amma's teachings on Indian Culture)

15ENG101 COMMUNICATIVE ENGLISH 2 0 2 3

Objectives: *To help the student to obtain ability to communicate in English; to impart an aesthetic sense and enhance creativity*

Unit 1

Parts of Speech, Tenses, Prepositions, Determiners - Agreement (Subject – Verb, Pronoun - Antecedent), Phrasal Verbs, Modifiers, Linkers/ Discourse Markers, Question Tags.

Unit 2

Paragraph writing – Cohesion - Development: definition, comparison, classification, contrast, cause and effect - Essay writing: Descriptive and Narrative.

Unit 3

Letter Writing - Personal (congratulation, invitation, felicitation, gratitude, condolence etc.) Official (Principal/ Head of the department/ College authorities, Bank Manager, Editors of newspapers and magazines).

Unit 4

Reading Comprehension – Skimming and scanning - inference and deduction – Reading different kinds of material – Graphical Representation – Speaking: Narration of incidents / stories/ anecdotes - Current News Awareness.

Unit 5

Prose: R.K. Narayan's Fifteen Years - A.P.J. Abdul Kalam's Wings of Fire (Part I - 3)

Short Stories: Katherine Mansfield's A Cup of Tea – Kishori Charan Das's Death of an Indian,

Poems:Maya Angelou's I Know Why the Caged Bird Sings - Sri Aurobindo's The Tiger and the Deer

REFERENCES:

1. *A P J Abdul Kalam, Wings of Fire, Universities Press (India) Ltd., Hyderabad, 2004.*
2. *Khushwant Singh & Neelam Kumar, Our Favourite Indian Short Stories, Seventh Imp., Jaico Publishers, 2007.*
3. *Jatin Mohanty (Ed.), Ten Short Stories, Universities Press (India) Ltd., Hyderabad, 1983.*
4. *Martinet, Thomson, A Practical English Grammar, IV Ed. OUP, 1986.*
5. *Murphy, Raymond, Murphy's English Grammar, CUP, 2004*
6. *R. K. Narayan, A Writer's Nightmare: Selected Essays 1958-1988, Penguin Books India Pvt. Ltd., New Delhi, 1988.*
7. *Seely, John, Writing and Speaking, OUP, 1998*
8. *Sri Aurobindo, Collected Poems, Sri Aurobindo Ashram, Pondicherry.*
9. *Syamala, V. Speak English in Four Easy Steps, Improve English Foundation Trivandrum: 2006*

15ENG121 PROFESSIONAL COMMUNICATION 1 0 2 2

Objectives: *To convey and document information in a formal environment; to acquire the skill of self-projection in professional circles; to inculcate critical thinking and to improve aesthetic sense.*

Unit 1

Vocabulary Building: Prefixes and Suffixes; One-word substitutes, Modal auxiliaries, Error Analysis: Position of Adverbs, Redundancy, Dangling modifiers – Reported Speech.

Unit 2

Instruction, Suggestion & Recommendation - Graphical Interpretation: Extracting data from charts and graphs - Essay writing: Analytical and Argumentative.

Unit 3

Circulars, Memos – Business Letters - e–mails.

Unit 4

Reports: Trip report, incident report, event report - Sounds of English – Stress, Intonation - Situational Dialogue - Group discussion.

Unit 5

Listening and Reading Practice - Book Review.

REFERENCES:

1. *Felixa Eskey Tech Talk, University of Michigan. 2005*
2. *Michael Swan. Practical English Usage, Oxford University Press. 2005*
3. *Anderson, Paul. Technical Communication: A Reader Centered Approach, V Edition, Hercourt, 2003.*

4. *Raymond V. Lesikar and Marie E. Flatley. Basic Business Communication, Tata McGraw Hill Pub. Co. New Delhi 2005. 10th Edition.*

15ENV300 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY 3 0 0 3

Unit 1

State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties and Conventions, Overview of Legal and Regulatory Frameworks.

Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.

Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People's action.

Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil/ land degradation/ pollution

Unit 2

Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.

Discuss the interrelation of environmental issues with social issues such as: Population, Illiteracy, Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people's movements and activism, Indigenous knowledge systems and traditions of conservation.

Unit 3

Common goods and public goods, natural capital/ tragedy of commons, Cost benefit analysis of development projects, Environment Impact Assessment (EIA),

Environment Management Plan (EMP), Green business, Eco-labeling, Problems and solutions with case studies.

Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco-homes/ Green buildings, Sustainable communities, Sustainable Cities.

Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

TEXTBOOKS/ REFERENCES:

1. *R. Rajagopalan, Environmental Studies: From Crisis to Cure. Oxford University Press, 2011, 358 pages. ISBN: 9780198072089.*
2. *Daniel D. Chiras, Environmental Science. Jones & Bartlett Publishers, 01-Feb-2012, 669 pages. ISBN: 9781449645311.*
3. *Andy Jones, Michel Pimbert and Janice Jiggins, 2011. Virtuous Circles: Values, Systems, Sustainability. IIED and IUCN CEESP, London. URL:http://pubs.iied.org/pdfs/G03177.pdf*
4. *Annenberg Learner, The Habitable Planet, Annenberg Foundation 2015. URL: http:// www.learner.org/courses/envsci/unit/pdfs/textbook.pdf.*

15HIN101 HINDI I 1 0 2 2

Objectives: *To teach Hindi for effective communication in different spheres of life: Social context, Education, governance, Media, Business, Profession and Mass communication.*

Unit 1

Introduction to Hindi Language - National Language, Official Language, link Language etc. Introduction to Hindi language, Devanagari script and Hindi alphabet.
Shabda Bhed, Roopanthar ki Drishti se - Bhasha – Paribhasha aur Bhed - Sangya - Paribhasha Aur Bhed - Sangya ke Roopanthar - kriya.

Unit 2

Common errors and error corrections in Parts of Speech with emphasis on use of pronouns, Adjective and verb in different tenses – Special usage of adverbs, changing voice and conjunctions in sentences, gender & number - General vocabulary for conversations in given context – understanding proper pronunciation – Conversations, Interviews, Short speeches.

Unit 3

Poems – Kabir 1st8 Dohas, Surdas 1st 1 Pada; Tulsidas 1st 1 Pada; Meera 1st 1 Pada.

Unit 4

Letter writing – personal and Formal – Translation from English to Hindi.

Unit 5

Kahani – Premchand: Kafan, Abhilasha, Vidroh, Poos ki rath, Juloos.

TEXTBOOKS:

1. *Prem Chand Ki Srvashrestha Kahaniyam: Prem Chand; Diamond Pub Ltd. New Delhi*
2. *Vyavaharik Hindi Vyakaran, Anuvad thaha Rachana: Dr. H. Parameswaran, Radhakrishna publishing House, New Delhi*
3. *Kamtha Prasad Guru: Hindi Vyakaran, Best Book pub House, New Delhi*
4. *Poetry: Kavya Ras - Ed: T.V. Basker - Pachouri Press; Mathura*

15HIN111 HINDI II 1 0 2 2

Objectives: *Appreciation and assimilation of Hindi Literature both drisya & shravya using the best specimens provided as anthology.*

Unit 1

Kavya Tarang; Dhumil ke Anthim Kavitha [Poet - Dhumil], Dhabba [Poet - Kedarnath Singh], Proxy [Poet - Venugopal] Vakth [Poet - Arun Kamal], Maachis [Poet - Suneeta Jain].

Unit 2

Communicative Hindi - Moukhik Abhivyakthi.

Unit 3

Audio-Visual – Media in Hindi – Movies like Tare Zameen par, Paa, Black etc., appreciation and evaluation. News reading and presentations in Radio and TV channels in Hindi.

Unit 4

Gadya Manjusha – Budhapa, Kheesa, Sadachar ka Thavis.

Unit 5

Translation: Theory and Practice - Letter writing: Formal and Personal – Introduction to Hindi Software.

TEXTBOOKS:

Kavay Tarang: Dr. Niranjan, Jawahar Pusthakalay, Mathura.
Gadya Manjusha: Editor: Govind, Jawahar Pusthakalay, Mathura

15KAN101 KANNADA I 1 0 2 2

Objectives: *To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech.*

Unit 1

Adalitha Kannada: bhashe, swaroopa, belavanigeya kiru parichaya
Paaribhaashika padagalu
Vocabulary Building

Unit 2

Prabhandha – Vyaaghra Geethe - A. N. Murthy Rao
Prabhandha – Baredidi…baredidi, Baduku mugiyuvudilla allige... - Nemi Chandra
Paragraph writing – Development: comparison, definition, cause & effect
Essay – Descriptive & Narrative

Unit 3

Mochi – Bharateepriya
Mosarina Mangamma – Maasti Venkatesh Iyengar
Kamalaapurada Hotelnalli – Panje Mangesh Rao
Kaanike – B. M. Shree
Geleyanobbanige bareda Kaagada – Dr. G. S. Shivarudrappa
Moodala Mane – Da. Ra. Bendre
Swathantryada Hanate – K. S. Nissaar Ahmed

Unit 4

Letter Writing - Personal: Congratulation, thanks giving, invitation, condolence

Unit 5

Reading Comprehension; nudigattu, gaadegalu

Speaking Skills: Prepared speech, pick and speak

REFERENCES:

1. *H.S. Krishna Swami Iyangar – Adalitha Kannada – Chetana Publication, Mysuru*
2. *A.N. Murthy Rao – Aleyuva Mana – Kuvempu Kannada Adyayana Samste*
3. *Nemi Chandra – Badhuku Badalisabahudu – Navakarnataka Publication*
4. *Sanna Kathegalu - Prasaranga, Mysuru University , Mysuru*
5. *B.M. Shree – Kannadada Bavuta – Kannada Sahitya Parishattu*
6. *K.S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna Book House (P) Ltd.*
7. *Dr. G.S. Shivarudrappa – Samagra Kavya – Kamadhenu Pustaka Bhavana*

15KAN111 KANNADA II 1 0 2 2

Objectives: *To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to develop functional and creative skills in language; to enable the students to plan, draft, edit & present a piece of writing.*

Unit 1

Official Correspondence: Adhikrutha patra, prakatane, manavi patra, vanijya patra

Unit 2

Nanna Hanate - Dr. G. S. Shivarudrappa
Mankuthimmana Kaggada Ayda bhagagalu – D. V. Gundappa (Padya Sankhye 5, 20, 22, 23, 25, 44, 344, 345, 346, 601)
Ella Marethiruvaga - K. S. Nissaar Ahmed
Saviraru Nadigalu – S Siddalingayya

Unit 3

Sayo Aata – Da. Ra. Bendre

Unit 4

Sarva Sollegala turtu Maha Samelana - Beechi
Swarthakkaagi Tyaga - Beechi

Unit 5

Essay writing: Argumentative & Analytical
Précis writing

REFERENCES:

1. *H. S. Krishnaswami Iyangar – Adalitha Kannada – Chetan Publication, Mysuru*
2. *Dr. G. S. Shivarudrappa – Samagra Kavya. - Kamadhenu Pustaka Bhavana*
3. *Shrikanth - Mankuthimmana Kagga – Taatparya – Sri Ranga Printers & Binders*
4. *K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna book house*
5. *Dr. Da. Ra. Bendre – Saayo Aata – Shri Maata Publication*
6. *Beechi – Sahukara Subbamma – Sahitya Prakashana*

15MAL101 MALAYALAM I 1 0 2 2

Objectives: *To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother-tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.*

Unit 1

Ancient poet trio: Adhyatmaramayanam,
Lakshmana Swanthanam (valsa soumitre… mungikidakayal), Ezhuthachan- Medieval period classics – Jnanappana (kalaminnu… vilasangalingane), Poonthanam.

Unit 2

Modern Poet trio: Ente Gurunathan, Vallathol Narayana Menon - Critical analysis of the poem.

Unit 3

Short stories from period 1/2/3, Poovanpazham - Vaikaom Muhammed Basheer - Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4

Literary Criticism: Ithihasa studies - Bharatha Paryadanam - Vyasante Chiri - Kuttikrishna Mararu - Outline of literary Criticism in Malayalam Literature - Introduction to Kutti Krishna Mararu & his outlook towards literature & life.

Unit 5

Error-free Malayalam: 1. Language; 2. Clarity of expression; 3. Punctuation.

Thettillatha Malayalam – Writing - a. Expansion of ideas; b. Precis Writing; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script/ Feature/ Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. *P. K. Balakrishnanan, Thunjan padhanangal, D.C. Books, 2007.*
2. *G. Balakrishnan Nair, Jnanappanayum Harinama Keerthanavum, N.B.S, 2005.*
3. *M. N. Karasseri, Basheerinte Poonkavanam, D.C. Books, 2008.*
4 *M. N. Vijayan, Marubhoomikal Pookkumbol, D.C. Books, 2010.*
5. *M. Thomas Mathew, Lavanyanubhavathinte Yukthisasthram, National Book Stall, 2009.*
6. *M. Leelavathy, Kavitha Sahityacharitram, National Book Stall, 1998.*
7. *Thayattu Sankaran, Vallathol Kavithapadhanam, D.C. Books, 2004.*

15MAL111 MALAYALAM II 1 0 2 2

Objectives: *To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother-tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.*

Unit 1

Ancient poet trio: Kalayanasougandhikam, (kallum marangalun… namukkennarika vrikodara) Kunjan Nambiar - Critical analysis of his poetry - Ancient Drama: Kerala Sakunthalam (Act 1), Kalidasan (Transilated by Attor Krishna Pisharody).

Unit 2

Modern/ romantic/ contemporary poetry: Manaswini, Changampuzha Krishna Pillai – Romanticism – modernism.

Unit 3

Anthology of short stories from period 3/4/5: Ninte Ormmayku, M. T. Vasudevan Nair - literary contributions of his time.

Unit 4

Part of an autobiography/ travelogue: Kannerum Kinavum, V. T. Bhattathirippadu - Socio-cultural literature - historical importance.

Unit 5

Error-free Malayalam: 1. Language; 2. Clarity of expression; 3. Punctuation.

Thettillatha Malayalam – Writing - a. Expansion of ideas; b. Precis Writing; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script/ Feature/ Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. *Narayana Pillai. P.K, Sahitya Panchanan. Vimarsanathrayam, Kerala Sahitya Academy, 2000*
2. *Sankunni Nair. M.P, Chathravum Chamaravum, D.C. Books, 2010.*
3. *Gupthan Nair. S, Asthiyude Pookkal, D.C Books.2005*
4. *Panmana Ramachandran Nair, Thettillatha Malayalam, Sariyum thettum etc., D.C. Book, 2006.*
5. *M. Achuthan, Cherukatha-Innale, innu, National Book Stall, 1998.*
6. *N. Krishna Pillai, Kairaliyude Katha, National Book Stall, 2001.*

15MAT106 TRIGNOMETRY AND DIFFERENTIAL EQUATIONS 3 1 0 4

Unit 1

Trigonometry: *(Mathematics for Degree students, P.K.Mittal)*
Expansions of sin nθ, cosθ, tan nθ in powers of Sinθ, Cosθ, Tanθ. Expansion of $Sin^n\theta$, $Cos^n\theta$, $Sin^m\theta$, $Cos^m\theta$ in terms of Sines and Cosines of Multiplies of θ – Power series for Sinθ, Cosθ, Tanθ - Hyperbolic Functions - Inverse Hyperbolic Functions - Logarithm of complex numbers - Summation of Trigonometric Series - Gregory Series - Euler Series.

Unit 2

Differentiation *(Calculus, Thomas)*

Applications of Derivative: Mean Value theory – Concavity and Curve Sketching – Maxima and Minima.

Unit 3

Differential Equations of First Order: *(Advanced Engineering Mathematics, E.Kreyszig)* Formation of Differential Equations. Solutions of Differential Equations (Variable Separable, Homogeneous Equations and Equations reducible to Homogeneous Form, Linear and Equations reducible to Linear Form, Exact Differential Equations and Equations reducible to Exact form). Differential Equations not of the first degree (solvable for 'p', solvable for 'y', solvable for 'x', Clairaut's Equation). Applications.

Unit 4

Differential Equations of Higher Order: *(Advanced Engineering Mathematics, E.Kreyszig)* Homogeneous Linear Differential Equations with Constant Coefficient and Euler-Cauchy Differential Equations, Basis of Solutions and Wronskian. Non Homogeneous Equations - Method of Undetermined Coefficients and Method of Variation of Parameters.

Unit 5

Boundary Value Problems for Second Order Equations: Green's function, Sturm Comparison Theorems and Oscillations, Eigenvalue Problems. Applications.

TEXTBOOKS:

1. *'Calculus', G.B.Thomas Pearson Education, 2009, 11th Edition.*
2. *'Advanced Engineering Mathematics', E.Kreyszig, John Wiley and Sons, 2002, 8th Edition.*
3. *'Mathematics for Degree students', P.K.Mittal, S.Chand & Co, New Delhi.*
4. *"Mathematics for B.Sc.", Branch I Vol. I, Vol. II, P.Kandasamy and K.Thilagavathy, S.Chand & Co.*

15MAT116 MATRICES AND VECTOR CALCULUS 3 1 0 4

Unit 1

Matrices: Matrix, Algebraic operations, Transpose of a matrix, Inverse of a matrix, Properties of matrices, Kinds of matrices: Symmetric and skew symmetric matrices, Hermitian and skew Hermitian matrices, Orthogonal and unitary matrices, Determinant of a matrix, Properties of determinants.

Unit 2

Systems of Linear Equations: Linear System of Equations, Gauss Elimination, Consistency of a linear system of equations.

Unit 3

Eigen value problems: Eigen values, Eigen vectors, Properties of Eigen values and Eigen vectors, Cayley-Hamilton theorem, Some Applications of Eigen value Problems, Similarity of Matrices, Diagonalization of a matrix, Quadratic forms and Canonical form of a quadratic form.

Unit 4

Vector differentiation: Limit of a vector function – continuity and derivative of vector function - Geometrical and Physical significance of vector differentiation - Partial derivative of vector function – gradient and directional derivative of scalar point functions – Equations of tangent plane and normal line to a level surface. Divergence and curl of a vector point function – solenoid and irrational functions – physical interpretation of divergence and curl of a vector point function.

Unit 5

Integration of vector functions – Line, surface and volume integrals. Guass - Divergence Theorem – Green's Theorem – Stoke's Theorem (Statements only). Verification of theorems and simple problems.

TEXTBOOKS:

1. *'Advanced Engineering Mathematics', Erwin Kreyszig, John Wiley and Sons, 2002, 8th Edition.*
2. *Textbook of Matrix Algebra, Suddhendu Biswas, PHI, 2012.*
3. *Vector Calculus with Applications to Physics, Shaw James Byrnie - 2009*
4. *T.K.Manickavasakam Pillay, Vector Calculus, 2004.*

15MAT226 FOURIER ANALYSIS, LAPLACE TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS 3 1 0 4

Fourier Analysis:

Unit 1

Periodic Functions, Trigonometric Series, Fourier Series, Functions of any Period p=2L, Even and Odd Functions, Half Range Expansions (theorem statement only), Complex Fourier Series, Applications of Parseval's Identity.

Unit 2

Fourier Integrals, Sine and Cosine Integrals, Fourier Transforms - Sine and Cosine Transforms, Properties, Convolution Theorem.

Laplace Transforms:

Unit 3

Laplace Transforms, Inverse Transforms, Properties, Transforms of Derivatives and Integrals, Second Shifting Theorem, Unit Step Function and Dirac-Delta Function, Differentiation and Integration of Transforms.

Unit 4

Convolution, Initial and Final Value Theorems, Periodic Functions, Solving Linear Ordinary Differential Equations with Constant Coefficients, System of Differential Equations and Integral Equations.

Partial Differential Equations:

Unit 5

Basic Concepts, Modeling; Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series, D'Alembert's Solution of The Wave Equation, Heat Equation; Solution by Fourier Series.

TEXTBOOKS:

1. *Advanced Engineering Mathematics, E.Kreyszig, John Wiley and Sons, 2002, 8th Edition.*
2. *An Introduction to Laplace Transforms and Fourier Series, P.P.G.Dyke, Springer, 2004.*
3. *The Integral Transforms for Engineers, Larry C.Andrews and Bhimson K.Shivamoggi, Spie Press, Washington, 1999.*

15MAT237 MATHEMATICAL STATISTICS AND NUMERICAL METHODS 3 1 0 4

Unit 1

Probability

Introduction to Probability – theorems on probability – Independent and conditional events and probabilities – Bayes theorem – related problems.

Unit 2

Random Variable and Distributions

Introduction to random variable – discrete and continuous distribution functions – marginal and joint distributions - mathematical expectations – moment generating functions and characteristic functions – related problems.

Unit 3

Standard distribution functions and applications

Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Normal distribution functions – moment generating functions, means and variances of the distributions – related problems.

Unit 4

Numerical Methods:

Solution of Equations by Iterative methods, Interpolation. Numerical Integration and Differentiation, Solution of linear systems by Iterative methods, Eigen values of Matrices by Iterative methods.

Unit 5

Numerical Solutions for Ordinary Differential Equations and Partial Differential Equations.

TEXTBOOKS:

1. *Ravichandran,J. Probability and Statistics for Engineers, 1st Edition (Reprint 2012), Wiley India.*
2. *Douglas C.Montgomery and George C.Runger, Applied Statistics and Probability for Engineers, (2005) John Wiley and Sons Inc.*
3. *Jain,M.K., Iyengar,S.R.K. and Jain,R.K., Numerical Methods for Engineering and Scientific Computation', New Age International (P), New Delhi, 1995, 3rd Edition.*
4. *M.K.Venkataraman – Numerical Methods in Science and Engineering, The National Publishing Company, Chennai.*

15OEL231 – 2xx OPEN ELECTIVES 3 0 0 3

Open electives syllabi – see at the end of the booklet.

15PHY101 MECHANICS AND PROPERTIES OF MATTER 3 1 0 4

Unit 1

Physical quantities, dimensional analysis, significant figures. Vectors: basics, vector derivatives, elementary vector operations, time derivatives, angles, expansion in series, vectors and spherical polar coordinates, cylindrical coordinate system. Useful vector identities.

Unit 2

Instantaneous velocity and acceleration. Kinematics in 2D: Projectile Motion, Uniform Circular Motion and centripetal acceleration. Relative Velocity and Relative Acceleration.

Unit 3

Forces and equations of motion. Concepts of momentum, energy, angular momentum, work and potential energy. Motion of a particle in uniform gravitational field, Newton's law of universal gravitation. Some applications of Newton's law. Forces of Friction.

Unit 4

Conservation of momentum-derivation by use of Newton's third law, internal forces and momentum conservation, centre of mass, systems with variable mass. Conservation of angular momentum.

Unit 5

Conditions for equilibrium, Elastic Properties of Solids, Hooke's law and elastic

constants of isotropic solid, stress energy. Kinematics of moving fluids, equation of continuity, Euler's equation, Bernoulli's theorem, viscous fluids, surface tension and surface energy, capillarity.

TEXTBOOK:

David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics 9th Edition,John Wiley (2012)

REFERENCE BOOKS:

1. *Kittel et al, Mechanics, Berkeley Physics Course Vol. 1, 2nd edition, Tata McGraw Hill 2011.*
2. *Raymond. A. Serway and Jerry. S. Faughn, College Physics 7th Ed., Thomson Brooks/Cole, USA, 2009.*
3. *Francis. W. Sears, Mark. W. Zemanski and Hugh. D. Young, University Physics, Narosa Publishing House, 2011.*
4. *Richard P. Feynman, Robert. P. Leighton and Matthew Sands, Feynman Lectures on Physics Vol. 1, Narosa, 2003.*
5. *D.S. Mathur, Mechanics, S. Chand and C, India, 2000.*

15PHY111 BASICS OF ELECTRICITY AND MAGNETISM 3 1 0 4

Unit 1

Essential vector calculus-conservation and quantization of charges. Coulomb's law, energy of a system of charges; Electrical energy in a crystal lattice, electric field charge distribution, flux, Gauss law and applications. Spherical charge, line charge, infinite flat sheet, force on a layer of charge, Electric potentials- potential difference and potential functions, Gradient of Scalar functions. Field derivation from potential, Potentials of charge distribution.

Unit 2

Uniformly charged disk, divergence of vector function, Gauss theorem and differential form of first law, Laplacian, Laplace equation- physical concept, Stokes theorem, Curl in Cartesian coordinates, physical meaning of curl; curl of E.

Unit 3

Conductors in electrostatic fields, Uniqueness theorem, capacitance and capacitor, potentials and charges on several conductors, boundary value problem. Electric current and current density-steady current and charge conservation, electrical conductivity and ohms law. Energy dissipation in current flow-emf and voltaic cell, networks with voltage sources, variable currents in capacitor and resistors.

Unit 4

Faraday's law of electromagnetic induction, Lenz's law. Self and mutual inductance, eddy currents, RL, LC and RLC circuits, alternating currents: simple average and rms value. AC circuits series resonance, parallel circuits, and transformer.

Unit 5

Field of moving charge; magnetic forces, measurement of charge in motion, invariance of charge, electric field measured in different frames of reference, field at a point of charge moving with constant velocity. Magnetic field: Definition of magnetic field, vector potential, field of any current carrying wire, rings, coils, Amperes law and its applications. Magnetic materials and hysteresis.

TEXTBOOKS:

1. *David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics, 9th Edition,John Wiley, 2012*
2. *Edward M Purcell. Electricity and Magnetism, 2nd Ed., Berkeley Physics Series, Tata McGraw-Hill, 2011.*

REFERENCE BOOKS:

1. *Hugh. D. Young and Freedman, Sears& Zemansky's University Physics, 12th Ed, Pearson, 2011.*
2. *Richard P. Feynman, Robert. P. Leighton and Matthew Sands, Feynman Lectures on Physics Vol.1, 1E, Narosa,2008*
3. *Raymond. A. Serway and Jerry. S. Faughn, College Physics, 7th Ed, Thomson Brooks/Cole, USA, 2009*
4. *David. J, Griffith, Introduction to electrodynamics ,4th Ed, John Wiley, 1999*

15PHY182 PHYSICS LAB. - MECHANICS AND PROPERTIES OF MATTER 0 0 2 1

1. Compound pendulum measurement of 'g' symmetric oscillation.
2. Studies with Rigid pendulum.
3. Young' Modulus Uniform bending.
4. Young' Modulus Cantilever.
5. Torsion pendulum.
6. Studying the flow of liquid through capillary tube.
7. Studying the liquid flow through series and parallel combinations of capillaries.
8. Studying the laws of vibration on a non-metallic string with Melde's apparatus.
9. Studies on exciting the different modes of sonometer wire.
10. Studying the mass on a spring.
11. Velocity of sound in air-Kundt's tube (Ultra sonic).
12. Determination of surface tension on a mercury drop.
13. Study of collisions in two dimensions.

15PHY201 BASIC EXPERIMENTAL TECHNIQUES IN PHYSICS 3 1 0 4

Unit 1

Data and error analysis: Uncertainties, reporting errors, probability distributions, error analysis, curve fitting, least square fit, testing the fit, reporting data.

Unit 2

Extraction of Signal from Noise: Signal to noise ratio, different kinds of noise, addition of noisy waveforms, and optimizing signal to Noise ratio, signal averaging, waveform recovery.

Unit 3

Data Acquisition: Data rates, analog to digital conversion, instrument control and acquisition, PC controlled experiments.

Unit 4

Grounding and Shielding: Grounding, electronic Interference, vibration Isolation, cables-twisted pairs and coaxial cables, ground loops.

Unit 5

Analog to Digital conversion, Dynamic Range Measurement Techniques: Modulation, Lock-in detection, Time constants, Grounding, Shielding, Electronic Interference Environmental Fluctuations, Microphonic Noise, Vibration Isolation, Cables-Twisted pairs and coaxial cables, instrument control.

TEXT/REFERENCE BOOKS:

1. *John R. Taylor, An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, 2nd Ed., University Science Books, 1996.*
2. *John H. Moore, Christopher C. Davis, Michael A. Coplan, Sandra C. Greer, Building Scientific Apparatus, Cambridge University Press, 4th Ed., 2009*

15PHY202 OPTICS AND WAVE MOTION 3 1 0 4

Unit 1

Geometrical optics: Fermat's principle- Laws of reflection and refraction. Images formed by plane mirror, Spherical mirror, Spherical refracting surfaces, Thin lens, system of thin lens - Lens aberrations, Microscopes, Telescopes-reflecting type.

Unit 2

Wave Motion: One dimensional wave equation, Differential wave equation, Simple Harmonic motion (SHM), super position of two or more SHMs. Lissajous figures. Damped and forced oscillators, standing wave and resonance. Group velocity and phase velocity, Energy density and energy transmission in waves-Sound waves-Doppler effect in Sound.

Unit 3

Interference: Wave nature of light, Spatial and temporal coherence (qualitative treatments), Wave division interference - Young's experiment, Interference pattern from double slit- Intensity distribution, Fresnel's double mirror, Fresnel's biprism,

Amplitude division interference: fringes from equal thickness films, unequal thickness film, phase change on reflection, Michelson's Interferometer.

Unit 4

Diffraction: Fraunhoffer diffraction - single, double and multiple slits, circular aperture, Resolution of imaging system, diffraction grating, resolving power of grating. Bragg's Law, Fresnel diffraction: straight edge, circular aperture.

Unit 5

Polarization: Introduction, Polarization sheets, Polarization by reflection, double refraction, Angular momentum of light, Polarization by scattering, linear, circular and elliptic polarization, optical rotation.

TEXTBOOKS:

1. *David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics, 9th Edition,John Wiley, 2012*
2. *A.K. Ghatak, Introduction to Modern optics, Tata McGraw Hill, 1972.*

REFERENCE BOOKS:

1. *Bahaa E.A. Salesh, Fundamentals of photonics, 2nd Ed., Wiley Interscience, 2007.*
2. *Richard P. Feynman, Robert. P. Leighton and Matthew Sands, Feynmann Lectures on PhysicsVol.1, Narosa, 2003.*
3. *G.B. Fowls, Introduction to Modern Optics, 2nd Ed., Dover Publications, Inc., USA, 1989.*
4. *M. Born and E. Wolf, Principles of Optics, 7th Ed., Cambridge University Press, 2002.*
5. *S.C. Lipson and H. Lipson, Optical Physics, Cambridge University Press, 1969.*

15PHY211 ANALOG ELECTRONICS 3 1 0 4

Unit 1

Network Analysis: Basic circuit analysis methods: nodal, mesh and modified nodal-analysis. Transient analysis of RL, RC and RLC circuits.

Network Theorems: superposition theorem, Thevenin-Norton theorem, substitution theorem, maximum power-transfer theorem, star-delta-transformation.

Unit 2

Diodes theory, Equation and characteristic, load line analysis, half wave, full wave and bridge rectifier circuits and ripple factor, Peak detector.

Filter circuits - Capacitor Filter Diode clippers and limiters, combination of clippers, clampers, voltage doublers.

Zener diode - specification and operations, Voltage regulator circuits and design -Photo diode.

Unit 3

Transistor - CB, CE and CC configuration, characteristic, operating point,α,β and γ, relations, transistor switch. Basic of amplifiers and its parameters, Frequency response, Decibels computations. Thermal instability in CE amplifier, stability factor, self-biasing (base biasing), emitter biasing, Voltage divider bias, collector base biasing (all biasing circuits-comparison), calculation of transistor dissipation, Significance of Q point in thermal runway,

Unit 4

Low frequency response of transistor amplifier: Effect of emitter bypasses capacitor, effect of coupling capacitor and cascading of CE stages, feedback fundamentals.

Transistor power amplifier: Class A & class B amplifiers - Theory and design, Harmonic distortion, Variation of power output with load, Push - Pull Amplifier-description, theory and operation.

Unit 5

Field Effect transistors - Advantages and disadvantages, basic construction of JFET, Principles of operation, characteristic and parameters, biasing of MOSFETs. Common Source amplifier, Common drain or source follower (comparison), Depletion and Enhancement MOSFET, difference between FETs and MOSFETs, one application of MOSFET.

Operational Amplifiers - inverting and non-inverting amplifiers, Gain, input and output impedance of inverting amplifier, differential Amplifier, Summing amplifier, Op-amp as integrator, differentiator, Oscillators.

TEXTBOOKS:

1. *Allen Mottershead, Electronic devices and circuits – An Introduction, 1sted, PHI, Eastern Economy Editions, 2005.*
2. *Albert Malvino, David J Bates, Electronic Principles, 7th Edition, Tata McGraw Hill, 2007.*

REFERENCE BOOKS:

1. *Donald A. Neamen, Microelectronics: Circuit Analysis & Design, 4thedition,Tata McGraw-Hill, 2009.*
2. *John D. Ryder, Electronic Fundamentals and Applications, Prentice Hall of India Pvt. Ltd. New Delhi 1983.*
3. *Horowitz and Hill,The art of Electronics, 2nd Ed., Cambridge University Press, 1989.*

15PHY213 THERMAL PHYSICS 3 1 0 4

Unit 1

Basic concepts and definitions: Systems and surroundings, state variables and thermodynamic properties. Thermodynamic equilibrium and equation of state. Extensive and intensive variables. Homogeneous and heterogeneous systems. Phases, work, Reversible, Quasi - static process, Adiabatic, isothermal, isobaric and isochoric process. Thermal contact and thermal equilibrium.

Unit 2

Zeroth law of thermodynamics: Concept of temperature & its measurement, Triple point of water, Thermometers, Celsius, Rankine and Fahrenheit scales, Thermometry - platinum resistance thermometry, Radiation and vapour pressure. Thermal expansion.

Unit 3

Work and heat, First law of thermodynamics: Internal energy and work, Heat and Enthalpy, Special cases of First law of thermodynamics; Differential form of first law, Heat Capacity and its measurement, Heat transfer mechanisms: Conduction, Convection, Radiation. Kirchoff's laws, kinetic Theory of gases, Avogadro number, Work done by an ideal gas, Molecular Speed distribution, Molar specific heat, Adiabatic, Isothermal, Constant volume Constant Pressure process for an ideal gas.

Unit 4

Second law of thermodynamics: Kelvin Planck statements, Entropy and its variation, State function, Engines - external and internal combustion engines - Carnot engine: Steam engine, Gasoline engine, Diesel Engine, Stirling engine, Clausius statement of second law, Refrigerator, Equivalence of Kelvin-Planck and Clausius statement, Reversibility and irreversibility, Conditions for irreversibility, Entropy of an ideal gas TS diagram. Irreversibility of second law of thermodynamics,

Unit 5

Heat and entropy in irreversible process. PV, PT, TS diagram for pure substance, PVT surface, enthalpy, Helmholtz and Gibbs function. Maxwell's relations - TdS equation, Heat capacity equations, Joule Thomson expansion, Phase transition, Phase diagram and its applications. Third law of Thermodynamics-Applications of fundamental concepts, Mean free path, Equipartition of energy, Equilibrium distribution.

TEXTBOOKS:

1. *David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics, 9th Edition, John Wiley, 2012*
2. *M.W. Zemansky and R.H. Dittman Amit K. Chattopadhyay, Heat and Thermodynamics, 8th edition, Tata McGraw-Hill,2011*

REFERENCE BOOKS:

1. *Bruno Linder, Thermodynamics and Introductory Statistical Mechanics John Wiley & Sons, 2004*

2. *Walter Greiner, Ludwig Neise, Horst Stöcker, Thermodynamics and statistical mechanics, 2ndEd, Springer, 1995.*
3. *Hugh. D. Young and Freedman, Sears & Zemansky's University Physics, 12th Ed, Pearson, 2011.*
4. *Richard P. Feynman, Robert. P. Leighton and Matthew Sands, Feynman Lectures on Physics Vol.1, 1E, Narosa, 2008*
5. *BrijLal, N.Subrahmanyam and P.S.Hemne, Heat, Thermodynamics and Statistical Physics (multicolour Edition), 1st Ed, S.Chand & Co, 2007*

15PHY248 PHYSICS OF LASERS AND APPLICATIONS 3 0 0 3

Unit 1

Review of some basic concepts and principle of laser

Introduction to light and its properties: Reflection, Refraction, Interference, Diffraction and Polarization. Photometry – calculation of solid angle. Brewster's law. Snell's law and, its analysis.

Introduction to LASERS: Interaction of radiation with matter - Induced absorption, spontaneous emission, stimulated emission. Einstein's co-efficient (derivation). Active material. Population inversion – concept and discussion about different techniques. Resonant cavity.

Unit 2

Properties of LASERS

Gain mechanism, Threshold condition for PI (Derivation), Emission broadening-line width, derivation of $\Delta\omega$ FWHM. Natural emission line width as deduced by quantum mechanics - Additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadening in gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity.

Properties – Coherence, Intensity, directionality, monochromaticity and Focussibility. LASER transition – Role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

Unit 3

Types of LASERS

Solid State LASER: (i) Ruby LASER – Principle, Construction, working and application. (ii) Neodymium (Nd) LASERS. Gas LASER: (i) He-Ne LASER - Principle, Construction, working and application. (i) CO_2 LASER - Principle, Construction, working and application.

Liquid Chemical and Dye LASERS. Semiconductor LASER: Principle, Characteristics, Semiconductor diode LASERS, homo-junction and hetero-junction LASERS, high power semi-conductor diode LASERS.

Unit 4

Applications in Communication field

LASER Communications: Principle, construction, types, modes of propagation, degradation of signal, Analogue communication system, digital transmission, fiberoptic communication.

Unit 5

Applications of LASERS in other fields

Holography: Principle, types, intensity distribution, applications. Laser induced fusion. Harmonic generation. LASER spectroscopy. LASERS in industry: Drilling, cutting and welding. Lasers in medicine: Dermatology, cardiology, dentistry and ophthalmology.

REFERENCES:

1. *William T Silfvast, "Laser Fundamentals", Cambridge University Press, UK (2003).*
2. *BB Laud, "Lasers and Non-linear Optics", New Age International (P) Ltd., New Delhi.*
3. *Andrews, "An Introduction to Laser Spectroscopy (2e)", Ane Books India (Distributors).*
4. *KR Nambiar, "Lasers: Principles, Types and Applications", New Age International (P) Ltd., New Delhi.*
5. *T Suhara, "Semiconductor Laser Fundamentals", Marcel Dekker (2004).*

15PHY281 PHYSICS LAB. - ELECTRICITY AND MAGNETISM 0 0 2 1

1. Thermal conductivity of a bad conductor – Lee's disc method
2. Spherical calorimeter – specific heat capacity thermal conductivity of good conductor – Forbe's method
3. Studying the current and voltage and sensitivity of - BG
4. Potentiometer calibration, potential drop Calibration of Ammeter and volt meter
5. Calibration of thermocouple using potentiometer
6. Specific resistance carry forester bridge
7. Studying the variation of total thermal radiation with temperature.
8. Verification of Joule's Law of Heating.
9. Studying the field along the axis of the coil
10. Deducing the magnetic properties of a sample from its Hysteresis curve on CRO
11. Studying the charging and discharging and Energy dissipation of capacitor in RC circuits.
12. Studying the amplitude response and phase relation of VR VC and VL in LCR series resonance circuit.
13. Studying the mechanism of Eddy current

15PHY285 PHYSICS LAB. - OPTICS 0 0 2 1

1. Determination of focal length of combination of lenses and nodal distance using nodal slide Assembly.
2. Studying the resolving limit of Telescope.
3. Studying the dispersive power of prism.
4. Studies on Newton's ring experiment.
5. Studying the Interference fringes in Wedge shaped films.
6. Studying the diffraction by grating – Using Spectrometer at minimum deviation condition.
7. Studying the degree of polarization of light reflected at various incident angles & verifying the Law of Malus.
8. Studying the dependence of optical rotation on wavelength and concentration of solutions.
9. Studying the absorption spectrum of iodine vapour.
10. Studies on absorption of light by salt solutions.
11. Studies on various characteristic of photonic detectors.
12. Studying the characteristic of LASER light using optical fibres and Grating.
13. Optical communication kit – Optical signal transmission reception.

15PHY301 DIGITAL ELECTRONICS 3 1 0 4

Unit 1

Introduction to Logic Circuits, Logic Families: Review of Number Systems, Variables and functions, inversion, Truth tables, Logic Gates and Networks, Boolean algebra, Synthesis gates using NAND and NOR gates. Introduction to Logic families such as ECL, TTL.

Implementation Technology: Transistor Switches, NMOS Logic Gates, CMOS Logic Gates, Negative Logic System, tri-state logic.

Unit 2

Optimized Implementation of Logic Functions: Karnaugh map, Strategy for minimization, Minimization of Sum of Products and Product of Sums Forms, Incompletely specified Functions.

Number Representation and Arithmetic Circuits: Addition of unsigned Numbers, Signed numbers, Fast Adders.

Unit 3

Combinational Circuit Building Blocks: Multiplexers, Decoders, Encoders, Priority Encoders, Code Converters and Arithmetic Comparison Circuits.

Unit 4

Sequential Circuit Building Blocks - Flip Flops, Registers, Counters: Basic Latch, Gated SR latch, gated latch, master slave and edge triggered D flip-flops, T flip-flop, JK flip-flop, registers, Asynchronous (ripple) counters, Reset synchronization, Design of Synchronous counters, Shift Registers, Ring counter, Johnson Counter.

Unit 5

Introduction to D/A circuits: Weighted Resistor DAC - R-2R Ladder DAC.

Introduction to A/D Circuits - Flash ADC - Counter type ADC(Only qualitative treatment required for DACs and ADCs)

Synchronous Sequential Circuits: Basic Design Steps, State Assignment Problem, Mealy state Model, Serial Adders, State minimization, Simple examples. Introduction to microcontroller-architecture and programming (Fundamentals).

TEXTBOOKS:

1. *M. Morris Mano, Michael D. Ciletti, Digital design, 4th Edition, Pearson Publisher, 2008.*
2. *Floyd, Digital Fundamentals, 10th edition, Prentice Hall, 2008.*
3. *T.R.Padmanabhan, Introduction to Microcontrollers and their Applications, Alpha Science Intl Ltd, 2007.*

REFERENCE BOOKS:

1. *Donald P. Leach, Albert Paul Malvino, Digital principles and applications, 7th Edition, Tata McGraw-Hill Education, 2011.*
2. *Albert Paul Malvino, Jerald A. Brown, Digital Computer Electronics, 3rd Ed. McGraw-Hill electricity & electronics series.*

15PHY302 ELECTRODYNAMICS 3 1 0 4

Unit 1

Review of vector analysis: Vector Algebra, Differential calculus, Differential calculus, curvilinear co-ordinates, Dirac Delta Function, Green's function.

Unit 2

Electrostatics: Electrostatic fields, potentials, work and energy, conductors, Special techniques for calculating potentials: Laplace's equation, method of images, separation of variables, multipole expansion.

Unit 3

Electrostatic fields in matter: Polarization, field of a polarized object, electric displacement, linear dielectrics.

Magnetostatics: The Lorentz force, The Biot-Savart's law, the divergence and curl of B, magnetic vector potential.

Unit 4

Magnetostatic fields in matter: Magnetization, the field of a magnetized object, the Auxiliary field H, linear and Nonlinear Media.

Unit 5

Electrodynamics: Electromotive force, Faraday's law, Maxwell's equations, potential formalism, energy and momentum in ED.

TEXTBOOK:

David J. Griffiths, Introduction to Electrodynamics, 4th ed., Addison-Wesley, 2012.

REFERENCE BOOKS:

1. *Wen Geyi, Foundations of Applied Electrodynamics, Wiley, 2nd Ed.,2010,*
2. *Walter Greiner and D.A.Bromley, Classical Electrodynamics, Springer, 2nd Ed. 1998.*
3. *Tung Tsang, Classical Electrodynamics, World Scientific publishing, 1st Ed, 1998.*
4. *Bo Thide, Electromagnetic field theory, Dover Publications, 2011, (Free downloadable at www.plasma.uu.se/CED/Book/EMFT_Book.pdf)*

15PHY303 SOLID STATE PHYSICS 3 1 0 4

Unit 1

Statistical mechanics: Statistical distribution, Maxwell-Boltzmann statistics, Phase Space - molecular energies of an ideal gas, Quantum statistics: Rayleigh-Jeans Formula, Planck's radiation law, specific heat of solids, free electrons in a metal, Fermi energy and Fermi Dirac Statistics - electron-energy Distribution, Bose–Einstein condensate, Debye model of specific heat of solids.

Unit 2

Crystal physics: Classification of crystals - Reflection and rotation symmetries - lattice and basis, unit cell and lattice parameters, primitive cell, Crystal Structures: Bravais lattice, calculation of atomic packing factor and coordination number for cubic and hexagonal close packed structure, directions, planes,

Unit 3

Miller indices and its relation with Inter-plannar spacing, determination of crystalline structure: X-ray diffraction, electron-diffraction and neutron diffraction.

Unit 4

Electrons in periodic lattice: Bloch theorem, Kronnig Penny model. Classification of solids on the basis of band theory: metals, semiconductors and insulators, effective mass. Superconductivity (qualitative), bound electron pairs, Quantum Hall effects, Landau levels.

Unit 5

Nuclear and particle physics: Nuclear composition, nuclear properties, stable nuclei, binding energies.

Nuclear models: Liquid - drop model, shell model, collective model. Meson theory of nuclear forces.

Elementary particles: Types of interactions, classifications. Quantum number: Baryon and Lepton number. Strangeness, the Eightfold way. Quarks: color, flavor, quark confinement. Particle detectors and accelerators.

TEXTBOOKS:

1. *Arthur Beiser, Concepts of Modern Physics, Tata McGraw-Hill, 6th Ed., 2008*
2. *Robert Eisberg and Robert Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and particles, 2nd Ed., Wiley, Reprint: 2012*

REFERENCE BOOKS:

1. *Kenneth Krane, Modern Physics, 2nd Ed., John Wiley and Sons, 1996*
2. *Raymond A. Serway, Moses, Moyer, Modern Physics, 3rd Ed., Thomson Learning, 2005*
3. *T. Thornton and A. Rex, Modern Physics for Scientist and Engineers, 2nd Ed., Fort Worth: Saunders, 2000.*

15PHY304 MODERN PHYSICS 3 1 0 4

Unit 1

Special theory of relativity: Correspondence principle - reference frame, inertial systems and Galilean transformations, postulates of special theory of relativity, Michelson-Morley experiment and its consequences, Lorentz transformations, Length contraction, Time dilation, relativistic velocity addition, simultaneity, relativistic Energy and momentum, mass–energy equivalence, particles with zero rest mass, relativistic Doppler effect.

Unit 2

Origin of quantum theory of radiation: Black body radiation, photo-electric effect, Compton Effect – pair production and annihilation, De-Broglie hypothesis, description of waves and wave packets, group velocities. Evidence for wave nature of particles: Davisson-Germer experiment, Heisenberg uncertainty principle.

Unit 3

Atomic structure: Historical Development of atomic structures: Thomson's Model, Rutherford's Model: Scattering formula and its predictions, Atomic spectra - Bohr's Model, Sommerfield's Model, The correspondence principle, nuclear motion, and atomic excitation. Application: Lasers.

Unit 4

Quantum mechanics: Wave function, Probability density, expectation values - Schrodinger equation – time dependent and independent, Linearity and superposition, expectation values, operators, Eigen functions and Eigen values, Application of 1D Schrodinger Wave equation: Free particle, Particle in a box, Finite potential well, Tunnel effect, Harmonic oscillator. Quantum theory of the hydrogen atom. Schrodinger wave equation in spherical coordinates, separation of variables, quantization of energy and orbital angular momentum,

Unit 5

Many-electron atoms: Electron Spin, exclusion principle, symmetric and anti-symmetric wave functions, Many-electron atoms, atomic structures, Spin-Orbit Coupling, total angular momentum, X-ray Spectra.

TEXTBOOKS:

1. *Arthur Beiser, Concepts of Modern Physics, Tata McGraw-Hill, 6th Ed., 2008*
2. *Robert Eisberg and Robert Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and particles, 2nd Ed., Wiley, Reprint: 2012*

REFERENCE BOOKS:

1. *Kenneth Krane, Modern Physics, 2nd Ed., John Wiley and Sons, 1996*
2. *Raymond A. Serway, Moses, Moyer, Modern Physics, 3rd Ed., Thomson Learning, 2005*
3. *T. Thornton and A. Rex, Modern Physics for Scientist and Engineers, 2nd Ed., Fort Worth: Saunders, 2000.*

15PHY311 ATOMIC AND MOLECULAR PHYSICS 3 1 0 4

Unit 1

General discussion in Hydrogen spectra, Hydrogen-like systems, Spectra of monovalent atoms, quantum defect, penetrating and non-penetrating orbits, introduction to electron spin, spin-orbit interaction and fine structure, relativistic correction to spectra of hydrogen atom, Lamb shift.

Unit 2

Effect of magnetic field on the above spectra, Zeeman and Paschen-Back effect. Spectra of divalent atoms: Singlet and triplet states of divalent atoms.

Unit 3

Spectra of Multivalent atoms ideas only; complex spectra, equivalent electrons and Pauli Exclusion Principle.

Unit 4

Hyperfine structure in spectra of monovalent atoms, origin of X-rays spectra, screening constants, fine structure of X-ray levels, spin-relativity and screening doublet-laws, non-diagram lines, Auger effect.

Unit 5

Elements of Molecular Spectroscopy – Molecular Bond, Hydrogen Molecule, Complex Molecules, Rotational Energy Levels, Vibration Energy Levels, Electronic Spectra of Molecules.

TEXTBOOKS:

1. Introduction of Atomic Spectroscopy: White, McGraw-Hill Inc.US; 1st Edition, 1934.
2. Concepts of Modern Physics, Arthur Beiser, Tata McGraw Hill, 6th Edition, 2009.

15PHY312 INTERMEDIATE MECHANICS 3 1 0 4

Unit 1

Galilean transformation, absolute and relative velocities, inertial and non-inertial frames, rotating frames, centrifugal and coriolis forces; Foucault pendulum.

Unit 2

Conservative forces; contact forces – friction, stress, viscous drag, etc. Pseudo forces and fundamental forces. Mathematical aside: work as a line integral, collisions and conservation laws; potential energy and conservation of energy in gravitational and electric field; stokes theorem, curl, irrotational force fields.

Unit 3

Motion under a centre force, Kepler's laws, Gravitational law and field, conservative and non-conservative forces, system of particles, centre of mass, equations of motion for centre of mass and relative motion, Angular momentum about centre of mass elastic and inelastic collision, conservation of linear and angular momentum. Variable mass systems.

Unit 4

Fixed axis rotations, rotation and translation, moments of inertia and products of inertia. Principal moments and axes. Behaviour of angular momentum vector.

Unit 5

Mechanics of particles, Mechanics of system of particles, Constraints, D'Alembert's Principle and Lagrange's equation, Simple applications of the Lagrange's formulation,

TEXTBOOKS:

1. *David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics, 6th Ed, John-Wiley, 2000*
2. *H. Goldstein, Charles Poole, John Safko, Classical Mechanics, 3rd Ed., Pearson education, 2002*

REFERENCE BOOKS:

1. *D.A. Walls, Lagrangian mechanics, Schaum Series, 1st Ed., McGraw-Hill, 1967.*
2. *J.B. Marion and S.T. Thornton, Classical dynamics of particles and systems, 4th Ed., Harcourt College Publishers, 1995.*

3. Howard D. Curtis, Orbital Mechanics for Engineering Students, Elsevier, pp.475 – 543
4. John David Anderson, Modern Compressible flow, 1st Ed., McGraw–Hill, 2004.

15PHY313 MODERN OPTICS 3 1 0 4

Unit 1

Basics of Coherence theory: Introduction, spatial and temporal coherence, complex degree of coherence, partial coherence, stellar interferometer.

Fourier Optics: transformers - One dimensional, two dimensional-dirac delta function, sines and cosines, Displacement and phase shifts, diffraction theory-Fourier method.

Unit 2

Laser - Fundamentals, Stimulated emission, Einstein's co-efficients, active medium, resonant cavities, Q-Switching, Mode locking, Types of lasers - Ruby Laser, He-Ne Laser, CO2 laser and Semiconductor laser. Holography - fundamentals, construction and reconstruction of hologram.

Unit 3

Optoelectronic devices: LED, Characteristic of LED - Internal photon flux, Output photon flux, efficiency, Responsivity, Spectral distribution, Response time and device structure.

Unit 4

Characteristic of semiconductor photo detector - Quantum Efficiency, wave length dependence, Responsivity and Response time: Photo conductors, Photodiodes, PIN photodiodes.

Unit 5

Optical fibers and wave guides - Optical fiber, Critical angle of propagation, Mode of Propagation, Acceptance angle, Fractional refractive index change, Numerical aperture, Types of optical fiber, Normalized frequency, Pulse dispersion, Attenuation, optical fiber communication system, modulation and multiplexing, fiber optic networks.

TEXTBOOKS:

1. Hecht, Eugene, Optics, 2ndEd, Addison Wesley, 1987
2. A.K. Ghatak, Introduction to Modern optics, Tata McGraw Hill, 1972.
3. Bahaa E.A. Salesh, Fundamentals of photonics, 2nd Ed., Wiley Interscience, 2007.

REFERENCE BOOKS:

1. Moller. K.D, Optics, University Science Books, 1988
2. Richard P. Feynman, Robert. P. Leighton and Matthew Sands, Feynmann Lectures on Physics Vol.1, Narosa, 2003.

3. G.B. Fowls, Introduction to Modern Optics, 2nd Ed., Dover Publications, Inc., USA, 1989.
4. M. Born and E. Wolf, Principles of Optics, 7th Ed., Cambridge University Press, 2002.
5. S.C. Lipson and H. Lipson, Optical Physics, Cambridge University Press, 1969.

15PHY331 ASTRONOMY 3 0 0 3

Unit 1

Astronomy, an Observational Science: Introduction - Indian and Western Astronomy – Aryabhatta - Tycho Brahe's observations of the heavens - The laws of planetary motion - Measuring the astronomical unit - Isaac Newton and his Universal Law of Gravity - Derivation of Kepler's third law - The Sun - The formation of the solar system - Overall properties of the Sun - The Sun's total energy output - Black body radiation and the sun's surface temperature - The Fraunhofer lines in the solar spectrum and the composition of the sun - Nuclear fusion - The proton–proton cycle - The solar neutrino problem - The solar atmosphere: photosphere, chromosphere and corona - Coronium - The solar wind - The sunspot cycle - Solar The Planets - Planetary orbits - Orbital inclination - Secondary atmospheres - The evolution of the earth's atmosphere.

Unit 2

Observational Astronomy

Observing the Universe - The classic Newtonian telescope - The Cassegrain telescope - Catadioptric telescopes - The Schmidt camera - The Schmidt–Cassegrain telescope - The Maksutov–Cassegrain telescope - Active and adaptive optics - Some significant optical telescopes - Gemini North and South telescopes - The Keck telescopes - The South Africa Large Telescope (SALT) - The Very Large Telescope (VLT) - The Hubble Space Telescope (HST) - The future of optical astronomy - Radio telescopes - The feed and low noise amplifier system - Radio receivers - Telescope designs - Large fixed dishes - Telescope arrays - Very Long Baseline Interferometry (VLBI) - The future of radio astronomy - Observing in other wavebands – Infrared – Sub-millimetre wavelengths - The Spitzer space telescope - Ultraviolet, X-ray and gamma-ray observatories - Observing the universe without using electromagnetic radiation - Cosmic rays - Gravitational waves.

Unit 3

The Properties of Stars: Stellar luminosity - Stellar distances - The hydrogen spectrum - Spectral types - Spectroscopic parallax - The Hertzsprung–Russell Diagram - The main sequence - The giant region - The white dwarf region - The stellar mass – luminosity relationship - Stellar lifetimes - Stellar Evolution – White dwarfs - The evolution of a sun-like star - Evolution in close binary systems – Neutron stars and black holes - The discovery of pulsars - Black holes: The Milky Way - Open star clusters - Globular clusters - Size, shape and structure of the Milky Way – observations of the hydrogen line - Other galaxies - Elliptical galaxies

- Spiral galaxies - The Hubble classification of galaxies - The universe - The Cepheid variable distance scale - Starburst galaxies - Active galaxies - Groups and clusters of galaxies – Superclusters - The structure of the universe - Cosmology – the Origin and Evolution of the Universe - The expansion of the universe - The cosmic microwave background - The hidden universe: dark matter and dark energy - The Drake equation - The Search for Extra Terrestrial Intelligence (SETI) - The future of the universe.

TEXTBOOK:

Introduction to Astronomy and Cosmology, Ian Morison, Wiley (UK), 2008

REFERENCE BOOK:

Astronomy: Principles and Practice, 4th Edition (Paperback), D. C. Clarke, A. E. RoyInstitute of Physics Publishing

15PHY332 COMPUTATIONAL METHODS FOR PHYSICISTS 3 0 0 3

Unit 1

Differentiation: Numerical methods, forward difference and central difference methods, Lagrange's interpolation method.

Unit 2

Integration: Newton-cotes expression for integral, trapezoidal rule, Simpson's rule, Gauss quadrature method.

Unit 3

Solution of Differential Equations: Taylor series method, Euler method, Runge Kutta method, predictor - corrector method.

Unit 4

Roots of Equations: Polynomial equations, graphical methods, bisectional method, Newton-Raphson method, false position method.

Unit 5

Solution of simultaneous equations: Elimination method for solving simultaneous linear equations, Gauss eliminations method, pivotal condensation method, Gauss-seidal iteration method, Gauss Jordan method, Matrix inversion method.

Eigen values and Eigen vectors of Matrix: Determinant of a matrix, characteristic equation of a matrix, eigenvalues and eigenvectors of a matrix, power method.

TEXTBOOK:

Rubin H Landau & Manuel Jose Paez Mejia, "Computational Physics", John Wiley & Sons

REFERENCE BOOKS:

1. *Suresh Chandra, "Computer Applications in Physics", Narosa Publishing House, New Delhi*
2. *M Hijroth Jensen, Department of Physics, University of Oslo, 2003 (Available in the Web)*

15PHY333 CONCEPTS OF NANOPHYSICS AND NANOTECHNOLOGY 3 0 0 3

Unit 1

Introduction: Introduction to nanotechnology, Comparison of bulk and nanomaterials - change in band gap - novel properties of nanomaterial, classification of nanostructured materials. Synthesis of nanomaterials - Classification and fabrication methods - Top down and bottom up methods.

Unit 2

Concept of Quantum Confinement and Phonon Confinement: Basic concepts - excitons, effective mass, free electron theory and its features, band structure of solids. Bulk to nano transition - Density of states, quantum confinement effect - weak and strong confinement regime. Electron confinement in infinitely deep square well, confinement in two and three dimension. Blue shift of band gap, Effective mass approximation. Vibrational properties of Solids - Phonon Confinement effect and presence of surface modes.

Unit 3

Tools for Characterization: Structural - X-ray Diffraction, Surface analysis- Transmission Electron Microscope, Scanning Tunneling Microscope, Atomic Force Microscope. Optical studies - UV - Visible absorption, Photoluminescence, Raman spectroscopy.

Unit 4

Nanostructured Materials: Properties and Applications. Carbon nanotube - structure, electrical, vibration and mechanical properties. Applications of carbon nanotubes - Field emission and Shielding - computers - Fuel cells - Chemical sensors - Catalysis - Mechanical reinforcement. Quantum dots and Magnetic nanomaterials – Applications.

Unit 5

Nanoelectronics and Nanodevices: Impact of nanotechnology on conventional electronics. Nanoelectromechanical systems (NEMSs) - Fabrication (Lithography) and applications. Nanodevices - Resonant Tunnelling Diode, Quantum Cascade lasers, Single Electron Transistors - Operating principles and applications.

TEXTBOOKS:

1. *Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd 2004.*

2. *W.R. Fahrner (Ed.), Nanotechnology and Nanoelectronics, Springer 2006.*

REFERENCE BOOKS:

1. *Charles P. Poole, Jr.Frank J. Owens, "Introduction to nanotechnology", A John Wiley 81 Sons, Inc., Publication*
2. *T. Pradeep, "Nano the essentials understanding nanoscience and nanotechnology", Professor Indian Institute of Technology, Madras, Chennai, India.*

15PHY334 INTRODUCTION TO PHOTONICS 3 0 0 3

Unit 1

Laser sources and detectors

Laser fundamentals - Einstein's coefficients, gain coefficient, laser rate equations, optical resonator, Q-factor and stability of optical resonator - modes of laser resonator, Q-switching and mode locking, Properties of lasers - coherence, line width and divergence,

Unit 2

Laser systems - Ruby laser, He-Ne laser, dye laser, Argon ion laser, free electron laser. Laser, applications - Material processing, holography, LIDAR, Biomedical applications, laser fusion, laser cooling and Bose-Einstein condensates - Photo detectors and display devices, photodiodes, APD, PMT, CCD, PIN photo diodes.

Unit 3

Optical fibre and its applications. Fibre Optics - classification of fibres - step index, graded index fibres, Numerical aperture, modes in optical fibre, single mode and multi-mode fibre, evanescent modes, losses in fibres - bending and coupling losses, dispersion in fibres, polarization maintaining fibres.

Unit 4

Fibreoptic sensors - advantages of FOS, intensity modulated sensors, interferometric sensors, rotation sensors, biosensors - Optical Communication - Optical communication - advantages, modulation, time division and wave length multiplexing.

Unit 5

Physical origin of nonlinear optical coefficients, second order optical nonlinearity, propagation of EMW through NLO medium, optical second harmonic generation, phase matching conditions, Third order NLO, intensity dependent refractive index, Four wave mixing and optical phase conjugation.

REFERENCES:

1. *Photonics: Optical Electronics in Modern communication (6th Edition, 2007), Ammon Yariv, Pochi yeh, oxford university.*
2. *Lasers: Fundamentals and Applications (2nd Edn (1981), Springer (New York)*
3. *Quantum Electronics (3rd Edn), 1989, Amman Yariv, John Wiley & Sons*

15PHY335 MEDICAL PHYSICS 3 0 0 3

Unit 1

Ultrasonics - production methods and properties - acoustic impedance - Doppler velocimetry - echo cardiography – resolution – speckle-ultrasound imaging - therapeutic use of ultrasound - use in diagnostics of cardiac problems.

Unit 2

X-rays – production – intensity - Hard and soft X-rays - Characteristic and continuous X-ray spectrum - attenuation of x-rays by hard and soft tissues – resolution – contrast-X-ray imaging - Fluoroscopy modes of operation - Image quality - Fluoroscopy suites - Radiation dose – Computer-aided tomography (CAT).

Unit 3

Nuclear medicine - Principles of Nuclear Physics – Natural radioactivity, Decay series, type of radiation and their applications, artificially produced isotopes and its application, accelerator principles; Nuclear Isomerism, Internal conversion - ideal energy for radiotherapy based on interactions. Radionuclide used in Medicine - radioisotope production – dosimetry – safety - radiation hazards – PET.

Unit 4

Nuclear magnetic resonance physics - magnetic moment – magnetization – relaxation- Nuclear magnetic resonance spectroscopy.

Nuclear magnetic resonance imaging (MRI) – principle - chemical shift - magnetic resonance signal induction and relaxation - pulse sequencing and spatial encoding.

Unit 5

Laser Physics – Characteristics of Laser radiation, mode locking - power of laser radiation - lasers as diagnostic tool - lasers in surgery - Laser speckle, biological effects, laser safety management.

TEXTBOOK:

Hendee W R and Rittenour E E, "Medical Imaging Physics", John Wiley & Sons, Chicago, 2001.

REFERENCE BOOKS:

1. *Glasser.O. Medical Physics Vol.1,2,3 Book Publisher Inc Chicago, 1980*
2. *Jerraold T Bush Berg etal, The essentials physics of medical imaging, Lippincott Williams and wilkins (2002)*

15PHY336 NONLINEAR OPTICS 3 0 0 3

Unit 1

Introduction to Nonlinear Optics: Brief review of electromagnetic waves -

Wave propagation in an anisotropic crystal - Nonlinear optical effects - Polarization response of materials to light, Harmonic generation.

Unit 2

Second order effects: Second harmonic generation - Sum and difference frequency generation - Phase matching - Parametric amplification, parametric fluorescence and oscillation; Concept of quasi-phase matching; Periodically poled materials and their applications in nonlinear optical devices.

Unit 3

Third order effects: Third harmonic generation – bistability - self focusing, Self-Phase modulation, Temporal and spatial solitons, Cross Phase modulation, four wave mixing, Phase conjugation.

Unit 4

Multiphoton Processes: Two photon process - Theory and experiment - Three photon process, Parametric generation of light - Oscillator - Amplifier - Stimulated Raman scattering - Intensity dependent refractive index optical Kerr effect - photorefractive, electron optic effects.

Unit 5

Nonlinear Optical Materials: Basic requirements - Inorganics - Borates - Organics - Urea, Nitro aniline - Semi organics - Thiourea complex - X-ray diffraction FTIR, FINMR- Second harmonic generation - Laser induced surface damage threshold.

TEXTBOOKS:

1. *Robert W. Boyd, Nonlinear Optics, 2nd Ed., Academic Press, 2003.*
2. *D.L. Mills, Nonlinear Optics – Basic Concepts, Springer, 1998.*
3. *B.B. Laud, Lasers and Nonlinear Optics, 2nd Ed. New Age International (P) Ltd., 1991.*

REFERENCE BOOKS:

1. *A Yariv, Quantum Electronics, John Wiley, NY, 1989.*
2. *A Ghatak and K Thyagarajan, Optical Electronics, Cambridge Univ Press, 1989.*
3. *Scully and M S Zubairy, Quantum optics, Cambridge Univ. Press, 1997.*

15PHY337 OPTICAL ENGINEERING 3 0 0 3

Unit 1

Review of Geometrical Optics, Gaussian optics, geometrical aberrations: Review of Physical Optics: waves, Interference – Young's experiment, fringe visibility, Michelson interferometer, Mach-Zehnder interferometer, two beam interference, multiple beam interference and optical thin film: Diffraction – Fraunhofer and Frenel diffractions, Fresnel–Kirchoff integral, Fourier transform in Fraunhofer diffraction, Fresnel zone plate, spatial and temporal coherence and coherence Measurement, Polarisation, Black Body radiation, Quantum nature of light.

Unit 2

Introduction to optical instruments: magnifiers, telescopes and microscopes, the human eye and projection systems as optical instruments, optical components: principles and operations of light sources – Lamps, LED, lasers and super continuum sources, principles and operation of detectors – photoconductive detectors, photodiodes, photomultipliers, IR detectors, charge-coupled devices and detector arrays, noise and sensitivity of detectors, Recording media, Prisms, Gratings, Polarizing elements.

Unit 3

Spatial light modulators: acousto-optic modulators, magneto-optic modulators, pockel's readout optical modulators, liquid crystal light valves, micro channel plate spatial light modulators, Photoplastics devices, deformable mirror array devices, optical discs and photorefractive crystals.

Unit 4

Holography; on axis holography, off–axis holography, holographic magnifications, reflection holography, rainbow holography, one-step rainbow holograms, colour holography and photorefractive holograms.

Unit 5

Signal processing: optical system under coherent and incoherent illumination, coherent optical signal processing, spatial filter, joint transform correlator, white-light optical signal processing, hybrid optical signal processing and photorefractive matched filters: fiber optics; fiber construction, fiber waveguides, types of optical fiber, optical fiber communications – fiber communication systems, splices and connectors, couplers and switches, time and wavelength – division multiplexing, coherent light wave communication, and fibre sensors.

REFERENCES:

1. *FTS Yu and X.Yang, Introduction to optical engineering, Cambridge Univ. press (1997)*
2. *Sirohi, R S and Kothiyal, M.P.Optical Components, Measurement techniques, and systems, Marcel Dekker, Inc., New York (1991).*
3. *Malacara, D. Geometrical and Instrument Optics. (Vol 25. Methods of experimental*

15PHY338 PHYSICS OF SEMICONDUCTOR DEVICES 3 0 0 3

Unit 1

Unit cell, Bravais lattices, crystal systems, Crystal planes and Miller indices, symmetry elements. Defects and imperfections – Point defects, line defects, surface defects and volume defects.

Unit 2

Electrical Conductivity: Classical free electron theory – Assumptions, drift velocity,

mobility and conductivity, drawbacks. Quantum free electron theory – Fermi energy, Fermi factor, carrier concentration. Band theory of solids – origin of energy bands, effective mass, distinction between metals, insulators and semiconductors.

Unit 3

Theory of Semiconductors:Intrinsic and extrinsic semiconductors, band structure of semiconductors, carrier concentration in intrinsic and extrinsic semiconductors, electrical conductivity and conduction mechanism in semiconductors, Fermi level in intrinsic and extrinsic semiconductors and its dependence on temperature and carrier concentration. Carrier generation - recombination, mobility, drift-diffusion current. Hall effect.

Unit 4

Theory of p-n junctions – diode and transistor: p-n junction under thermal equilibrium, forward bias, reverse bias, carrier density, current, electric field, barrier potential. V-I characteristics, junction capacitance and voltage breakdown - Bipolar junction transistor, p-n-p and n-p-n transistors: principle and modes of operation, current relations. V-I characteristics. Fundamentals of MOSFET, JFET. Heterojunctions – quantum wells.

Unit 5

Optical devices: optical absorption in a semiconductor, e--hole generation. Solar cells – p-n junction, conversion efficiency, heterojunction solar cells. Photo detectors – photo conductors, photodiode, p-i-n diode. Light emitting diode (LED) – generation of light, internal and external quantum efficiency.

Modern Semiconducting Devices: CCD-Introduction to nano devices, fundamentals of tunneling devices, design considerations, physics of tunneling devices.

TEXTBOOKS:

1. *C Kittel, "Introduction to Solid State Physics", Wiley, 7th Edn. 1995.*
2. *DA Neamen, "Semiconductor Physics and Devices", TMH, 3rd Edn. 2007.*

REFERENCES:

1. *SM Sze, "Physics of Semiconductor Devices", Wiley, 1996.*
2. *P Bhattacharya, "Semiconductor Opto-Electronic Devices", Prentice Hall, 1996.*
3. *MK Achuthan & KN Bhat, "Fundamentals of Semiconductor Devices", TMH, 2007.*
4. *J Allison, "Electronic Engineering Materials and Devices", TMH, 1990.*

15PHY340 PHYSICS OF WAVES 3 0 0 3

Unit 1

Introduction - Essence of wave motion, Local view, Cause & effect,Examples; Wave equations & their solutions – Waves on long string, Waves alongcoaxial

cable, EM waves, Ocean waves, Waves & weather, Gravity waves, Capillarywaves; Sinusoidal waveforms – Sinusoidal solutions, Energy, Normal modes,Standing waves & Orthogonality; Complex wavefunctions – Complex harmonicwaves, Dispersion in dissipative systems; Huygens wave propagation – Huygensmodel, propagation in free space, Reflection & refraction at an interface; Fermat's principle of least time; Geometrical Optics – Ray optics, Refraction at a spherical surface, thin lens.

Unit 2

Interference – Wave propagation around obstructions, Young's double slitexperiment, Wavefront dividers, Michelson interferometer; Fraunhofer diffraction –Definition, Diffraction by single slit, Babinet's principle, Diffraction grating, Wavefront reconstruction & holography, Resolution of an imaging system; Longitudinal waves – Sound waves in an elastic medium, Thermal waves; Continuity conditions – Wave propagation in changing media, Reflection & Transmission bymultiple interfaces; Total & frustrated total internal reflection, Applications, Evanescent fields; Boundary conditions – External constraints, Examples, Drivenboundaries & Cyclic boundary conditions.

Unit 3

Linearity & Superposition – Wave motions in linear systems, Dispersion & group velocity, Wave packets; Fourier series & transforms – Fourier synthesis & analysis, Periodic functions, Fourier Spectrum, Orthogonality, Power Calculations & Spectral intensities, Fourier Analysis of dispersive propagation, Convolution of wave forms.

Unit 4

Waves in three dimensions – Wave equations in 2D & 3D, Plane waves and the wave vector, Fourier transform in 2D & 3D, Diffraction in 3D, Wave radiation in 3D; Polarization; Operators for wave motions – Mathematical operator, Operator for frequency & wavenumber, Expectation value, Uncertainty, Operator analysis of Gaussian wave packet; Uncertainty in quantum mechanics – Bandwidth theorem, Wave particle duality, QM Wavefunction & its measurement.

Unit 5

Waves from moving sources – slow and fast sources, Ship wakes; Radiation from moving charges – Solution to EM equation, Retarded EM potentials, Retarded EM fields, Radiation from moving charges.

TEXTBOOKS/ REFERENCES:

1. *Billingham J & King AC: Wave motion, CUP, 2001*
2. *Crawford Jr., Frank S: Waves (Berkeley Physics Course, Vol 3, 1E), TMHE, 2011*
3. *Freegarde T: Introduction to the Physics of Waves, CUP, 2013*
4. *French, A.P: Vibrations and Waves (The MIT Introductory Physics Series), CBS Publishers India, 2003*

15PHY381 PHYSICS LAB. - ELECTRONICS 0 0 2 1

1. Study of charging and decay of current in RC, LC and LCR circuits using Lab view.
2. Design and performance study of active filters (Low pass, high pass, band pass, band rejection).
3. Characteristic of Zener diode, tunnel diode and voltage regulation using Zener diode (Line and load regulation).
4. Bridge rectifier and regulator circuits using CRO.
5. Study of bipolar transistor characteristics in CE and CB configuration and determination of a & ß.
6. Experiments on UJT and MOSFET characterization.
7. Voltage Amplifier with coupling capacitor with feedback.
8. Power amplifier Push-pull class A type.
9. Experiments with IV 741- Operational Amplifier.
10. AND, OR, NOT, NAND, NOR, XOR Verification, Boolean Algebra verification of DeMorgan's theorem.
11. Combination of gate universal building blocks NAND, NOR.
12. Encoders and Decoders 4 bits.
13. Half adder and Subtractor.

15PHY385 PHYSICS LAB. - MODERN PHYSICS 0 0 2 1

1. Studying the Energy gap of semiconductors.
2. To estimate the value of Planck's constant.
3. To estimate the value of Rydberg's constant.
4. Estimation of Charge of electron – Thomson's method.
5. Studying the Hall Effect and estimation of Hall voltage, Hall Coefficient and number of charge carriers.
6. Studying the characteristic of Photoelectric effect.
7. Studying the thermal Expansion of crystal Using Interference fringes.
8. Michelson Interferometer – to find the refractive index of transparent material.
9. Fabry Perot Interferometer.
10. Full adder IC 7483s.
11. Counters 4 bits.
12. Flip flops, RS JK Master slave.
13. Registers 4 bits.
14. Experiment on multiplexing and de-multiplexing.
15. Experiments based on operational amplifier (741) all the basic circuits.
16. Multivibrators - Astable, Monostable and Bistable - Using Op AMP.
17. Study of Wien's bridge oscillator using OP AMP.

15PHY390 LIVE-IN-LAB. 3 cr

This initiative is to provide opportunities for students to get involved in societal problems which need scientific solutions. The students shall visit villages or rural sites during vacation (after fourth semester) and if they identify a worthwhile project, they will register for a 3-credit Live-in-Lab project, in the fifth semester. The objectives and projected outcome of the project will be reviewed and approved by the department chairman and a faculty will be assigned as the project guide. On completion of the project, the student shall submit a detailed project report. The report will be evaluated by a panel of experts.

15PHY399 PROJECT 6 cr

Students who want to exercise the exit-option at the end of the sixth semester shall decide on it at the end of the fourth semester. These students shall execute a project and earn six credits.

The proposed project work will get initiated at the beginning of the fifth semester and is to be credited during the sixth semester. The project work involves simple experimental/ simulation methods in various research and development institutes or existing research laboratories at university departments for solving research problems. The project work will be supervised by a faculty from physics department and periodical reviews of the work accomplished will be conducted by a panel involving minimum of three faculty members. The student should give a presentation of the work carried out at the end of the sixth semester to a panel of experts.

15PHY501 CLASSICAL MECHANICS 3 1 0 4

Unit 1

Elementary Principles: Review of mechanics of a particle and systems of particles; constraints and generalized coordinates; D'Alembert's principle and Lagrange's equations of motions, applications to simple systems, velocity-dependent potentials and dissipation function.

Unit 2

Variational Principle & Lagrangian Formulation: Hamilton's principle, calculus of variations, Lagrange's equations from Hamilton's principle; symmetries, conservation theorems and cyclic coordinates, energy function; Two-body central force problem: equivalent 1D problem, classification of orbits, integrable power law potentials, the Kepler problem; scattering in a central force field, Rutherford scattering.

Unit 3

Hamiltonian Formulation: Legendre transformations, Hamiltonian, Hamilton's equations;

cyclic coordinates and conservation theorems, Hamilton's equations from a variational principle, the principle of least action; Canonical Transformations (CT): equations of CT, examples, generating functions; Poisson brackets (PB), equations of motion and conservation theorems in PB form, infinitesimal CTs & generators, fundamental & angular momentum PB relations; Liouville's theorem.

Unit 4

Hamilton-Jacobi (HJ) Theory: Hamilton-Jacobi equation, harmonic oscillator using HJ method, Hamilton's characteristic function; the action-angle variables; harmonic oscillator using action-angle variable; Small oscillations: eigenvalue equation, principal axis transformation, normal coordinates, vibrations of a linear tri-atomic molecule.

Unit 5

Rigid Body Dynamics: Degrees of freedom, rotations - orthogonal transformation and its properties, Euler angles, Euler's theorem, infinitesimal rotations; Rotating frames: rates of change of position and velocity, Coriolis-effect; angular momentum, energy, inertia and Euler equations of motion; torque-free motion of rigid body; symmetrical top.

TEXTBOOKS:

1. *H. Goldstein, C. Poole and J. Safko: Classical Mechanics, 2E, Pearson, 2011*
2. *Kleppner and Kolenknow: An Introduction to Mechanics, TMH, 2007*

REFERENCES:

1. *Landau and Lifshitz, Mechanics, 3E, Butterworth–Heinemann, 1976.*
2. *S.T. Thomton and J.B Marion, Classical Dynamics of Particles and Systems, 5E, Cengage, 2012.*
3. *Walter Greiner, Classical Mechanics: systems of particle and Hamiltonian Dynamics, 2nd Ed., Springer, 2010.*

15PHY503 MATHEMATICAL PHYSICS I 3 1 0 4

Unit 1

Vector Analysis: Scalar and vectorfields, gradient, divergence, curl and Laplacian, vector identities; Line, surface and volume integrals – Gauss, Stokes & Green's theorems, applications; Orthogonal curvilinear coordinates - expression for gradient, divergence, curl and Laplacian in cylindrical and spherical coordinates.

Unit 2

Linear Algebra & Matrices: Definitions, linear independence of vectors, dimension, inner product, Schwartz inequality, Schmidt's orthogonalization, orthonormal basis; linear transformations, change of basis; Algebra of matrices, special matrices, eigenvalues and eigenvectors, diagonalization, simultaneous diagonalization of matrices.

Unit 3

Second order differential equations: ordinary differential equations, singular points, series solutions – Frobenius' method;

Special Functions: Gamma and Beta functions, Relation between Gamma and Beta functions, Duplication formula, Error function, Bessel's Functions of different kinds, Integral representations of Bessel's Functions, Orthogonality of Bessel's Functions, Modified Bessel's Functions.

Unit 4

Legendre Polynomials: recurrence relations, Rodrigue's formula, orthogonality; associated Legendre polynomials.

Unit 5

Fourier series and function spaces: Examples and applications; sine, cosine and complex series; Basic ideas in function spaces: generalized series of orthogonal functions and polynomials – Legendre, and Bessel series; convergence in the mean, Parseval identity & Bessel inequality, completeness (statement only).

TEXTBOOK:

Arfken & Weber, Mathematical Methods for Physicists, Elsevier Indian Reprint, 7E, 2013.

REFERENCE BOOKS:

1. *Riley K F, Hobson M P, Bence S J, Mathematical Methods for Physics and Engineering, CUP, 3E, 2010*
2. *M.L. Boas, Mathematical Methods in Physical Sciences, Wiley Indian Reprint 3E, 2006*
3. *Mathews J and Walker R L, Mathematical Methods of Physics, Pearson India, 2E, 2004*

15PHY504 QUANTUM MECHANICS I 3 1 0 4

Unit 1

Origins and Schrödinger equation: Summary of experiments & inferences, inadequacy of classical physics, DeBroglie's hypothesis, wave-particle duality; Wave function and Schrödinger equation, probability density, probability current density, Ehrenfest's theorem, classical - quantum correspondence; expectation values and uncertainties, position, momentum and Hamiltonian operators; wave packets, position-momentum uncertainty principle, classical physics as a limiting case of quantum physics.

Unit 2

Stationary states, energy spectrum and eigenfunctions: time-independent Schrödinger equation and stationary states; bound states in infinite square well, linear harmonic oscillator – Heisenberg and Schrodinger's treatments; bound and scattering states in finite square wells and barriers, tunnelling, scattering resonances

– Ramsauer-Townsend effect; free particle solutions – Gaussian wave packet; Three dimensional and spherically symmetric potentials: spherical potential well and hydrogen atom, radial wave functions and spherical harmonics, degeneracy of levels.

Unit 3

Postulates and principles: Quantum states, wave functions, and linear vector spaces, bra and ket vectors; Observables and hermitian operators, measurements, eigen values, eigen states, collapse postulate; discrete and continuous spectra; generalized statistical interpretation, expectation values, generalized uncertainty relations; position and momentum representations.

Unit 4

Quantum dynamics: postulate of time evolution of a quantum state and Schrodinger equation, calculation of evolution of linearly superposed states and expectation values in various potentials, quantum oscillations, two-level systems; motion and spread of free Gaussian wave packet; Heisenberg picture of quantum dynamics of observables; energy-time uncertainty relation; introduction to unstable states - decay lifetimes - natural line-widths of spectral lines; coherent-states.

Unit 5

Scattering theory: incident and scattered waves, scattering amplitude and cross section, Integral equation and Greens functions, Born approximation and its validity, partial wave analysis, optical theorem, calculation of phase shifts, scattering by hard sphere and Coulomb potentials.

TEXTBOOKS:

1. *David Griffiths, Introduction to Quantum Mechanics, Pearson India (LPE), 2E, 2005*
2. *R Shankar, Principles of Quantum Mechanics, Pearson India (LPE), 2E 2005*

REFERENCE BOOKS:

1. *L I Schiff, Quantum Mechanics, TMH, 3E, 2010*
2. *J.S. Townsend, A Modern Approach to Quantum Mechanics, 1E, Viva Books, 2010*
3. *S Gasiorowicsz, Quantum Physics, Wiley India, 2E*
4. *J J Sakurai, Modern Quantum Mechanics, Pearson, 1E, 1994*

15PHY506 COMPUTATIONAL PHYSICS 3 1 0 4

Unit 1

Beginning programming: description of programming, procedure for writing a program, basic programming elements. MATLAB tutorial: Vectors, matrices, vector operations, loops, plots, executable files, functions, if statements and real-time plotting, data files. Basic concepts: Real and complex numbers, matrices, real functions, errors.

Unit 2

Ordinary differential equations: Cauchy problem, Euler methods, convergence analysis, the Crank-Nicolson method, zero-stability, stability on unbounded intervals, high-order methods, predictor-corrector methods, systems of differential equations. Eigenvalues and eigenvectors: power method, convergence analysis, inverse power method with shift, computing the shift, computation of all eigenvalues.

Unit 3

Nonlinear equations: Bisection method, Newton's method, secant method, systems of nonlinear equations, fixed-point iterations, acceleration using Aitken method, Newton-Hörner method for polynomial roots. Approximation of functions and data: Taylor's polynomials, interpolation – Lagrangian, stability of polynomial, Chebyshev, trigonometric, barycentric, piecewise linear; spline functions; least squares method.

Unit 4

Numerical differentiations and integration: Approximation of function derivatives; numerical integration – midpoint, trapezoidal and Simpson methods; interpolatory quadratures; Simpson adaptive formula. Linear Systems: linear system complexity, LU factorization method, pivoting, accuracy of LU factorization, tridiagonal systems, overdetermined systems, how the MATLAB backslash operator works, iterative methods, Richardson and gradient methods, conjugate gradient method, when to stop iterating, direct methods vs. iterative methods.

Unit 5

Unconstrained optimization: derivative-free methods, Newton method, descent methods, trust region methods, nonlinear least-squares method; constrained optimization. Approximation of boundary value problems by finite differences and finite elements, finite differences in 2 dimensions, consistency and convergence, heat and wave equations.

TEXTBOOK:

Quarteroni, A., and Saleri, F., Scientific Computing with MATLAB and Octave, 4E, Springer-Verlag Berlin Heidelberg, 2014

ADDITIONAL REFERENCES:

1. *Hunt, B.R., Lipsman, R.L., Rosenberg, J.M., A Guide to MATALB for Beginners and Experienced Users, Cambridge University Press, New York, 2001*
2. *Quarteroni, A., Sacco, R., and Saleri, F., Numerical Mathematics, Springer-Verlag, New York, 2000*
3. *Press, W.H., Teukolsky, S.A., Vetterling, W.T., and Flannery, B.P., Numerical Recipes, The Art of Scientific Computing, 3rdEdition, Cambridge University Press, New York, 2007*

15PHY511 QUANTUM MECHANICS II 3 1 0 4

Unit 1

Angular momentum, spin and identical particles: Angular momentum, various commutation relations, eigenvalues and eigenfunctions of the angular momentum, maximal set of commuting operators and levels of hydrogen atom; Spin, spin operators, Pauli's spin matrices, spin in magnetic field; Addition of angular momenta – Clebsch-Gordan Coefficients. Many particle systems, identical particles spin and statistics, symmetric and anti-symmetric wave functions, Pauli's exclusion principle.

Unit 2

Variational and WKB methods: Variational estimate of ground state energies in simple systems; WKB (semiclassical) approximation of wave functions, tunnelling amplitudes, application to theory of alpha decay, bound states and Bohr-Sommerfeld quantization rule.

Unit 3

Time independent perturbation theory: non-degenerate and degenerate cases, application to simple systems; Elementary discussion of corrections to energy levels of Hydrogen atom: Zeeman and Stark effects, fine and hyperfine structures.

Unit 4

Time-dependent perturbation theory: first order correction, constant, sudden, adiabatic and sinusoidal perturbations; transition rates & Fermi golden rule, lifetime of an excited state; selection rules, interaction of an atom with electromagnetic radiation, the Einstein's A & B coefficients; *Schrodinger, Heisenberg, and Interaction Pictures.

Unit 5

Elements of relativistic quantum mechanics: Klein-Gordon equation for a free particles and particle in electromagnetic (EM) fields; Dirac Hamiltonian and relativistic wave equation, free particle solutions, negative energy states; Dirac equation in EM fields – non-relativistic limit and spin.

TEXTBOOKS:

1. *R Shankar, Principles of Quantum Mechanics, Pearson India (LPE), 2E 2005*
2. *David Griffiths, Introduction to Quantum Mechanics, Pearson India (LPE), 2E, 2005*
3. *L I Schiff, Quantum Mechanics, TMH, 3E, 2010*

REFERENCE BOOKS:

1. *S Gasiorowicsz, Quantum Physics, Wiley India, 2E*
2. *JJ Sakurai, Modern Quantum Mechanics, Pearson, 1E, 1994*
3. *David Griffiths, Introduction to Quantum Mechanics, Pearson India (LPE), 2E, 2005*

15PHY512 MATHEMATICAL PHYSICS II 3 1 0 4

Unit 1

Complex variables: Analytic functions, Cauchy-Riemann conditions, Cauchy's Integral theorem and Integral formula, Laurent expansion, Singularities, Residue theorem, evaluation of integrals.

Unit 2

Complex variables II: Singularities, branch cuts, Riemann surfaces, analytic continuation, principal value, dispersion relations; Integral representations of special functions; saddle point approximation, asymptotic expansions.

Unit 3

Integral Transforms: Laplace transforms, Inversion, convolution theorem, application to initial value problems; Fourier transforms, Inversion, Fourier sine and cosine transforms, convolution theorem, Fourier transforms of derivatives, applications to ODEs.

Unit 4

Partial differential equations: selected examples of partial differential equations of theoretical physics, solution by the methods of separation of variables, eigenfunction expansions and transform techniques.

Unit 5

Linear integral equations (a selection of topics): classification of integral equations, separable kernels, Neumann and Fredholm's series solutions, Hilbert-Schmidt theory for symmetric kernels; Group Theory (a selection topics): Elementary introduction and examples from theory of groups and representations in physics, symmetries and groups in physics.

TEXTBOOKS:

Arfken & Weber, Mathematical Methods for Physicists, Elsevier Indian Reprint, 6E, 2005

REFERENCE BOOKS:

1. *Riley K F, Hobson M P, Bence S J, Mathematical Methods for Physics and Engineering, CUP, 3E, 2010*
2. *M Boas, Mathematical Methods in Physical Sciences, Wiley Indian Reprint 3E, 2006*
3. *Mathews J and Walker R L, Mathematical Methods of Physics, Pearson India, 2E, 2004*

15PHY513 STATISTICAL MECHANICS 3 1 0 4

Unit 1

Foundations of statistical mechanics: specification of states of a system – micro- and macrostates in quantum and classical systems - phase space - trajectories

and density of states; Liouville's theorem, ergodic theorem, fundamental postulate; Ensembles: Microcanonical ensemble – postulate equal a priori probabilities – contact between statistics and thermodynamics – spin system – classical ideal gas-entropy of mixing and Gibb's paradox.

Unit 2

Canonical and grand canonical ensembles - partition function – connection with thermodynamics - calculation of thermodynamic quantities - energy and density fluctuations.

Unit 3

Statistics of indistinguishable particles - Maxwell-Boltzman, Fermi dirac and Bose Einstein statistics – properties of ideal Bose and Fermi gases – Bose-Einstein condensation. Density matrix formalism.

Unit 4

Interacting systems and phase transitions: thermodynamics of magnetic systems, paramagnetism; Ising model – exact solution in one dimension, spin-spin correlations, mean field theory of Ising model, ferromagnetic phase transition; Liquid-gas system - cluster expansion of classical gas, virial equation of state, liquid-gas transition - critical exponents; Landau theory of phase transition – order parameter, scaling, dimensional analysis, universality.

Unit 5

Basics ideas on fluctuations and dissipation: Nyquist noise – Brownian motion – diffusion & dissipation – Einstein's relation – fluctuations and spatial and time correlations – power spectrum & white noise - Langevin theory - fluctuation dissipation theorem - The Fokker-Planck equation – approach to Maxwell-Boltzmann distribution.

TEXTBOOKS/ REFERENCES:

1. *F Reif, Foundations of Statistical and Thermal Physics, TMH, 1E, 2011*
2. *Silivio Salinas, Introduction to Statistical Physics, Springer Indian Reprint, IE, 2006.*
3. *Tobochnik and Gould, Thermal and Statistical Physics, Princeton University Press, 2010*
4. *Kerson Huang, Introduction to Statistical Physics, 2E, CRC Press (Indian Reprint), 2010.*
5. *R.K. Pathria, Statistical Mechanics, 3E, Elsevier India,*
6. *Landau and Lifshitz, Statistical Physics, Pergamon Press.*

15PHY514 ADVANCED ELECTRODYNAMICS 3 1 0 4

Unit 1

Electrostatics: Gauss' law and its applications; Laplace and Poisson equations, boundary value problems – basics, multipoles; macroscopic electrostatics in dielectrics.

Unit 2

Magnetostatics: Biot-Savart's law, Ampere's theorem, vector potential, magnetic multipole expansion, macroscopic magnetostatics in matter.

Unit 3

Changing Fields: electromagnetic induction, electrodynamics in free space and linear isotropic media, Maxwell's equations; boundary conditions on fields at interfaces; Poynting vector, conservations laws; gauge transformation and gauge invariance.

Unit 4

Electromagnetic Waves: Propagation in free space, dielectrics, conductors, and plasma; transmission lines and wave guides; reflection, refraction, Fresnel's laws; states of polarization.

Unit 5

Radiation from moving charges, retarded potentials; dipole radiation; power radiated; Relativity of electromagnetic fields: Lorentz invariance of Maxwell's equations, transformation of electromagnetic fields.

TEXTBOOKS/ REFERENCES:

1. *J.D. Jackson, Classical Electrodynamics, 3E, Wiley, 2007*
2. *D. Griffiths, Electrodynamics, 4E, Pearson, 2015*
3. *W. Greiner, Classical Electrodynamics, 1E, Springer, 2006*
4. *E.M. Purcell, Berkeley Physics, Vol 2, 2E, TMH India, 2011*
5. *R.P. Feyman, R.B. Leighton, M. Sands, Feyman Lectures in Physics, Vol 2, Narosa, 2010*

15PHY515 EXPERIMENTAL TECHNIQUES 3 1 0 4

Unit 1

Data analysis: Date interpretation and analysis; Precision and accuracy, error analysis, propagation of error, least squares fitting, linear and non-linear curve fitting, chi-square test.

Unit 2

Transducers: Temperature, pressure/vacuum, magnetic field, vibration, optical, and particle detectors

Unit 3

Electronics: Nyquist noise in electronic measurements, filtering and noise reduction, shielding and grouping; Fourier transforms; lock-in detector, box-car integrator, modulation techniques; Data acquisition through computers.

Unit 4

Spectroscopic techniques I: ESR, NMR, FTNMR, X-ray diffraction (Power, Laue), SEM TEM, AFM.

Unit 5

Spectroscopic techniques II: IR, FTIR, Raman.

TEXTBOOKS:

1. *P.R. Bevington, D.K. Robinson, Data reduction and Error Analysis for the Physical Sciences, 3E, McGraw Hill (2002)*
2. *N.C. Barford, Experimental Measurements: Precision, Error, and Truth, Addison-Wesley (1968)*
3. *Paul Horowitz, The Art of Electronics, 2E, CUP (2006)*
4. *Colin Banwell, Elaine McCash, Fundamentals of Molecular Spectroscopy, TMH (2011)*
5. *T. Pradeep, NANO: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw Hill India (2007)*

15PHY516 ADVANCED EXPERIMENTAL TECHNIQUES 3 1 0 4

Unit 1

Transducers: Temperature, pressure/ vacuum, magnetic field.

Unit 2

Vibration, optical, and particle detectors.

Unit 3

Spectroscopic Techniques I: Electron Spin Resonance (ESR), Nuclear Magnetic Resonance (NMR).

Unit 4

FTNMR, X-ray diffraction (Power, Laue), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM).

Unit 5

Spectroscopic Techniques II: Infra-red, Ultraviolet, Fourier Transform IR, Raman Spectroscopy.

TEXTBOOKS:

1. *Paul Horowitz, Winfield Hill, The Art of Electronics, 2ndRev.Edn., CUP (2006)*
2. *Colin Banwell, Elaine McCash, Fundamentals of Molecular Spectroscopy, McGraw Hill Education, 4th edition.*
3. *Pradeep, T., NANO: The Essentials: McGraw Hill Education, (2007)*

15PHY531 ANTENNAS AND WAVE PROPAGATION 3 0 0 3

Unit 1

Review of electromagnetic theory: Vector potential, Solution of wave equation, retardedcase, Hertizian dipole. Antenna characteristics: Radiation pattern, Beam solid angle,Directivity, Gain, Input impedance, Polarization, Bandwidth, Reciprocity, Equivalence of Radiation patterns, Equivalence of Impedances, Effective aperture, Vector effective length, Antenna temperature.

Unit 2

Wire antennas: Short dipole, Radiation resistance and Directivity, Half wave Dipole, Monopole, Small loop antennas. Antenna Arrays: Linear Array and Pattern Multiplication, Two-element Array, Uniform Array, Polynomial representation, Array with non-uniform Excitation - Binomial Array.

Unit 3

Aperture Antennas: Magnetic Current and its fields, Uniqueness theorem, Fieldequivalence principle, Duality principle, Method of Images, Pattern properties, Slotantenna, Horn Antenna, Pyramidal Horn Antenna, Reflector Antenna - Flat reflector, Corner Reflector, Common curved reflector shapes, Lens Antenna.

Unit 4

Special Antennas: Long wire, V and Rhombic Antenna, Yagi-Uda Antenna, Turnstile Antenna, Helical Antenna - Axial mode helix, Normal mode helix, Biconical Antenna, Logperiodic Dipole Array, Spiral Antenna, Microstrip Patch Antennas. Antenna Measurements: Radiation Pattern measurement, Gain and Directivity Measurements

Unit 5

Calculation of Great Circle Distance between any two points on earth, Ground Wave Propagation, Free-space Propagation, Ground Reflection, Surface waves, Diffraction, Wave propagation in complex Environments, Tropospheric Propagation, Tropospheric Scatter. Ionospheric propagation: Structure of ionosphere, Sky waves, skip distance. Virtual height, Critical frequency, MUF, Electrical properties of ionosphere, Effects ofearth's magnetic fields, Faraday rotation.

TEXTBOOKS:

1. *E.C.Jordan and Balmain, "Electromagnetic waves and Radiating Systems", Pearson Education/ PHI, 2006*
2. *A.R.Harish, M.Sachidanada, "Antennas and Wave propagation", Oxford University Press, 2007.*

REFERENCE BOOKS:

1. *John D.Kraus, Ronald J Marhefka and Ahmad S Khan, "Antennas for all Applications", Tata McGraw-Hill Book Company, 3ed, 2007.*
2. *G.S.N.Raju, Antenna Wave Propagation, Pearson Education, 2004.*

3. Constantine A. Balanis, Antenna Theory Analysis and Design, John Wiley, 2nd Edition,2007.
4. R.E.Collins, "Antenna and Radiowave propagation", W.L Stutzman and G.A. Thiele, "Antenna analysis and design", John Wiley, 2000.

15PHY533 BIOPHOTONICS 3 0 0 3

Unit 1

Photobiology: Interaction of light with cells and tissues, Photo–processes in Biopolymers, human eye and vision, photosynthesis. Photo-excitation: free space propagation, optical fiber delivery system, articulated arm delivery, hollow tube wave-guides. Optical coherence tomography, special and time-resolved imaging, fluorescence resonance energy transfer (FRET) imaging, nonlinear optical imaging, Bio-imaging:

Unit 2

Transmission microscopy, Kohler illumination, microscopy based on phase contrast, dark-field and differential interference contract microscopy, fluorescence, confocal and multi-photon microscopy. Applications of bio-imaging: Bio-imaging probes and fluorophores, imaging of microbes, cellular imaging and tissue imaging.

Unit 3

Optical biosensors: Fluorescence and energy transfer sensing, molecular beacons and optical geometries of bio-sensing, biosensors based on fibre optics planar waveguides, evanescent waves, interferometry and surface Plasmon resonance. Flow cytometry: Basics, fluorochromes for flow cytometry, DNA analysis.

Unit 4

Laser activated therapy: Photodynamic therapy, photo-sensitizers for photodynamic therapy, applications of photodynamic therapy, two photon photodynamic therapy. Tissue engineering using light: Contouring and restructuring of tissues using laser, laser tissue regeneration, femto-second laser surgery.

Unit 5

Laser tweezers and laser scissors, design of laser tweezers and laser scissors, optical trapping using non Gaussian optical beam, manipulation of single DNA molecules, molecular motors, lasers for genonmocs and proteomics, semiconductor quantum dots for bio imaging, metallic nano-particles and nano-rods for bio-sensing. Photonics and biomaterials: Baceria as bio-synthesizers for photonic polymers.

TEXTS:

1. Introduction to Bio-photonics- V N Prasad (Wiley-Interscience April 2003)
2. Biomedical photonics: A Handbook - Tu Vo Dinh (CRC Press, Boca Raton, FL 2003)

REFERENCES:

1. A Handbook of Optical Biomedical diagnostics, SPIE press monograph vol pm 107

2. Biomedical Optics - Principles and Imaging - Lihong V and Hsin-IWU, Wiley Interscience 1 sted, 2007
3. Optical coherence Tomography - Principles and Applications – Mark E.Brezinski, (Academic press 1st ed, 2006)
4. Biophysics - An Introduction - Rodney cotterill, (John Wiley Student edition)

15PHY534 BIOPHYSICS 3 0 0 3

Unit 1

Introduction: Laws of Physics and Chemistry, introduction to crystallography, Introduction to chromatography, electrophoresis Physico-Chemical Techniques to study Biomolecules: hydration of macromolecules, diffusion of osmosis, sedimentation, ultracentrifuge, rotational diffusion, light scattering, small angle X-ray scattering, Mass spectrometry.

Unit 2

Spectroscopy: UV spectroscopy, circular dichroism, Fluorescence spectroscopy, IR, Raman and Electron spin spectroscopy, NMR spectroscopy.

Unit 3

Molecular Modeling & Macromolecular Structure: building the structure of H_2O_2, nucleic acid structure, monomers, polymers, double helical structure of DNA, Polymorphism andnanostructure of DNA, structure of RNA, protein structure: amino acids, virus structure.

Unit 4

Energy Pathways in Biology: free energy, couple reactions, group transfer potential, pyridinenucleotides, photosynthesis, energy conversion pathways, membrane transport. Biomechanics: strained muscles, mechanical properties of muscles, cardiovascular system.

Unit 5

Neurobiophysics: nervous system, physics of membrane potentials, sensory mechanisms. Origin and evolution of life: prebiotic earth, theories of origin and evolution of life, laboratory experiments on formation of small molecules.

TEXTBOOKS:

1. "Cell and Molecular Biology - Concepts and Experiments" by G.Karp, 2nded. John Wiley & Sons, Inc. Singapore, 1999.
2. "Principles of Physical Biochemistry" by K.van Holde, W.C. Johnson, and P.S.Ho.Prentice Hall, 1998.

15PHY535 EARTH'S ATMOSPHERE 3 0 0 3

Unit 1

Earth's atmosphere: overview and vertical structure. Warming the earth and the

atmosphere: temperature and heat transfer; absorption, emission, and equilibrium; incoming solar energy. Air temperature: daily variations, controls, data, human comfort, measurement. Humidity, condensation, and clouds: circulation of water in the atmosphere; evaporation, condensation, and saturation; dew and frost; fog.

Unit 2

Cloud development and precipitation: atmospheric stability & determining stability, cloud development and stability, precipitation processes, collision and coalescence, precipitation types, measuring precipitation. Air pressure and winds: atmospheric pressure, pressure measurement, surface and upper-air charts, surface winds, winds and vertical air motions, measuring and determining winds. Atmospheric circulations: scales of atmospheric motion, eddies, local wind systems, global winds, global wind patterns and the oceans.

Unit 3

Air masses, fronts, and mid-latitude cyclones. Weather forecasting: acquisition of weather information, forecasting methods and tools, forecasting using surface charts. Thunderstorms: ordinary (air-mass) thunderstorms, mesoscale convective complexes, floods and flash floods, distribution of thunderstorms, lightning and thunder. Tornadoes: severe weather and Doppler radar, waterspouts.

Unit 4

Hurricanes (cyclones, typhoons): tropical weather; anatomy, formation, dissipation and naming of hurricanes. Air pollution: a brief history, types and sources, factors that affect air pollution, the urban environment, acid deposition. Global climate: climatic classification; global pattern of climate.

Unit 5

Climate change: possible causes; carbon dioxide, the greenhouse effect, and recent global warming. Light, color, and atmospheric optics: white and colors, white clouds and scattered light; blue skies and hazy days, red suns and blue moons; twinkling, twilight, and the green flash; the mirage; halos, sundogs, and sun pillars; rainbows; coronas and cloud iridescence.

TEXTBOOK:

C. Donald Ahrens: Essentials of Meteorology: An Invitation to the Atmosphere (6th edition), Brooks-Cole, 2010.

REFERENCE:

Frederick K. Lutgens & Edward J. Tarbuck: The Atmosphere, An Introduction to Meteorology (11th Edition), Prentice Hall, 19 January, 2009

15PHY536 EARTH'S STRUCTURE AND EVOLUTION 3 0 0 3

Unit 1

Introduction: geologic time; earth as a system, the rock cycle, early evolution, internal structure & face of earth, dynamic earth. Matter and minerals: atoms, isotopes and radioactive decay; physical properties & groups of minerals; silicates, important nonsilicate minerals, resources. Igneous rocks: magma, igneous processes, compositions & textures; naming igneous rocks; origin and evolution of magma, intrusive igneous activity, mineral resources and igneous processes.

Unit 2

Volcanoes and volcanic hazards: materials extruded, structures and eruptive styles, composite cones and other volcanic landforms, plate tectonics and volcanic activity. Weathering and soils: earth's external processes; mechanical & chemical weathering, rates; soils, controls of formation, profile, classification, human impact, erosion, weathering and ore deposits. Sedimentary rocks: the importance and origins of sedimentary rocks; detrital & chemical sedimentary rocks, coal, converting sediment into sedimentary rock; classification & structures, nonmetallic mineral & energy resources. Metamorphism and metamorphic rocks: metamorphic textures, common metamorphic rocks, metamorphic environments & zones.

Unit 3

Mass wasting: gravity, mass wasting and landform development, controls and triggers, classification of mass-wasting processes, slump, rockslide, debris flow, earthflow, slow movements. Running water: hydrologic cycle, running water, streamflow, work of running water, stream channels, base level and graded streams, shaping stream valleys, depositional landforms, drainage patterns, floods and flood control. Groundwater: importance and distribution, water table, factors influencing storage and movement, springs, wells, artesian wells, environmental problems, hot springs and geysers, geothermal energy, geologic work. Glaciers and glaciation: formation and movement, erosion & landforms, deposits, other effects, causes. Deserts and wind: distribution and causes, geologic processes, basin and range, wind transport, erosion & deposits.

Unit 4

Shorelines: coastal zone, waves & erosion, sand movement, shoreline features & stabilization; erosion problems along U.S. coasts, hurricanes, coastal classification, tides. Earthquakes and earth's interior: faults, seismology, locating the source of an earthquake, measuring intensity, belts and plate boundaries, destruction, damage east of the Rocky Mountains, earthquake prediction, earth's interior. Plate tectonics: continental drift, divergent boundaries, convergent boundaries, transform fault boundaries, testing the plate tectonics model, the breakup of Pangaea, measuring plate motion, what drives plate motions, plate tectonics in the future.

Unit 5

Origin and evolution of the ocean floor: continental margins, features of deep-ocean basins, anatomy of oceanic ridge, oceanic ridges and seafloor spreading, nature of oceanic crust, continental rifting, destruction of oceanic lithosphere. Crustal deformation and mountain building: structures formed by ductile & brittle deformation, mountain building at subduction zones, collisional mountain belts, fault-block mountains, vertical movements of the crust. Geologic time: time scales, relative dating, correlation of rock layers; dating with radioactivity, the geologic time scale, difficulties in dating. Earth's evolution: birth of a planet, origin of the atmosphere and oceans, Precambrian (formation of continents); Phanerozoic (formation of modern continents & earth's first life); Paleozoic (life explodes); the Mesozoic (dinosaurs); Cenozoic era (mammals). Global climate change: climate & geology, climate system, detecting change; atmospheric basics & heating the atmosphere; natural & human causes; carbon dioxide, trace gases, and climate change; climate-feedback mechanisms, aerosols, some possible consequences.

TEXTBOOK:

Frederick K. Lutgens, Edward J. Tarbuck & Dennis G. Tasa: Essentials of Geology (11th edition), Prentice Hall, 8 March, 2012.

REFERENCE:

Graham R. Thompson & Jonathan Turk: Introduction to Physical Geology (2nd Edition), Brooks Cole, 23 June, 1997.

15PHY537 FIBRE OPTIC SENSORS AND APPLICATIONS 3 0 0 3

Unit 1

MM and SM fibers for sensing, Lasers & LEDs suitable for sensing, PIN & APDs for fiber optic sensing. Principles of electro optic modulators bulk & integrated optic modulators. Optical sensor types, advantages and disadvantages of fiber optic sensors, Senser system performance: basic specifications, Intensity modulated sensors, reflective concept, micro-bend concept, evanescent fiber sensors, polarization modulated sensors.

Unit 2

In-fiber Bragg grating based sensors – sensing principles – temperature and strain sensing, integration techniques, cross sensitivity, FB Gmultiplexing techniques. Long period fiber grating sensors - temperature and stain sensing, refractive index sensing, optical load sensors and optical bend sensors.

Unit 3

Interferometric sensors, Mach-Zehnder & Michelson interferometric sensors, theory-expression for fringe visibility, Fabry-perot fiber optic sensors – theory and configurations, optical integration methods and multiplication techniques, application – temperature, pressure and strain measurements, encoded sensors.

Unit 4

Sagnac interferometers for rotation sensing fiber gyroscope sensors – Sagnac effect – open loop biasing scheme – closed loop signal processing scheme – fundamental limit – performance accuracy and parasitic effects – phase-type bias error – shupe effect – anti-shupe winding methods – applications of fiber optic gyroscopes. Faraday effect sensors. Magnetostriction sensors - Lorentz force sensors.

Unit 5

Biomedical sensors, sensors for physical parameters, pressure, temperature, blood flow, humidity and radiation loss, sensors for chemical parameters. pH, oxygen, carbon, dioxide, spectral sensors. Distributed fiber optic sensors – intrinsic distributed fiber optic sensor – optical time domain reflectometry based Rayleigh scattering – optical time domain reflectometry based Raman scattering – optical time domain reflectometry – quasi – distributed fiber optic sensors. An overview on the optical fiber sensors in nuclear power industry, fly-by light aircraft, oil field services, civil and electrical engineering, industrial and environmental monitoring.

TEXTBOOKS:

1. *Francis T.S Yu, Shizhuo Yin (Eds), Fiber Optic Sensors, Marcel Dekker Inc., New York, 2002*
2. *Dakin J and Culshow B., (Ed), Optical fiber sensors, Vol. I, II, III, Artech House, 1998*
3. *Pal B.P, Fundamentals of fiber optics in telecommunication and sensor systems, Wiley Eastern, 1994*

REFERENCES:

1. *Jose Miguel Lopez-Higuera (Ed), Handbook of optical fiber sensing technology, John Wiley and Sons Ltd., 2001*
2. *Eric Udd (Ed), Fiber optic sensors: An introduction for engineers and scientists, John Wiley and Sons Ltd., 1991*
3. *B.D Gupta, Fiber optic Sensors: Principles and applications, New India Publishing Agency, New Delhi., 2006*
4. *Bio-medical sensors using optical fibers, Report on progress in physics Vol 59.1,1996*

15PHY538 FIBRE OPTICS AND TECHNOLOGY 3 0 0 3

Unit 1

Classification of fibers: based on refractive index profiles, modes guided applications and materials. Fibers for specific applications: polarization maintaining fibers (PMF), dispersion shifted and dispersion flattened fibers, doped fibers. Photonic crystal fibers, holly fibers.

Fiber specifications: Numerical aperture of SI and GI fibers, Fractional refractive index difference, V–parameter, Cut off wavelength, dispersion parameter, bandwidth, rise time and Non linearity coefficient.

Unit 2

Impairment in fibers: group velocity dispersion (GVD), wave guide and modal dispersions. Polarization mode dispersion (PMD), Birefringence – liner and circular.

Fiber drawing and fabrication methods: modified chemical vapor deposition (MCVD) and VAD techniques.

Unit 3

Mode theory of fibers – different modes in fibers. Dominant mode, Derivations for modal equations for SI and GI fibers. Approximate number of guided modes in a fiber (SI and GI fibers). Comparison of single mode and multimode fibers for optical communications. LED and LD modulators. Coupling of light sources to fibers – (LED and LD) – Derivations required. Theory and applications of passive optical components: connectors, couplers, splices, Directional couplers, gratings: FBGs and AWGs, reflecting stars: Optical add drop multiplexers and SLMs.

Unit 4

Active components: Optical Amplifiers (OAS) - Comparative study of OAS - SLAs, FRAs, FBAs EDFAs and PDFAs based on signal gain, pump efficiency, Noise Figure, Insertion loss and bandwidth. Design and Characterization of forward pumped EDFAs.

Unit 5

Fiber measurements: Attenuation measurement – cut back method. Measurement of dispersion – differential group delay, Refractive index profile measurement.

Numerical aperture (NA) measurement, diameter measurement, mode field diameter (MFD) measurement, V-Parameter, Cut off wavelength Measurement, splicing and insertion losses, OTDR – working principle and applications. OSA - Basic block schematic and applications in measurements. (John M senior).

TEXTBOOKS:

1. *Gerd Keiser, Optical Fiber communications, McGraw Hill, 200*
2. *Maynbav, Optical Fiber Technology, Pearson Education, 2001*
3. *John M senior, Optical fiber communications, PHI, 1992*

REFERENCES:

1. *Joseph C Palais, Optical Fiber communications, Pearson Education.1998.*
2. *Dennis Deriikson, Fiber optic test and measurement, Prentice hall,1998.*
3. *3 David Bailey and Edwin wright, practical Fiber optics, Elsevier 2003.*
4. *Franz and Jain, optical Fiber communication systems and Components, Narosa Publishers, 2004.*
5. *Ajoy Ghatak and K.Thyagarajan, Introduction to Fiber optics: Cambridge university press,1999.*

15PHY539 NANOPHOTONICS 3 0 0 3

Unit 1

Introduction to nanoscale interaction of photons and electrons. Near field interaction and microscopy - near field optics and microscopy - single molecule spectroscopy - nonlinear optical process.

Unit 2

Materials for nanophotonics - quantum confinement - optical properties with examples - dielectric confinement - super lattices - organic quantum confined structures.

Unit 3

Plasmonics - metallic nanoparticles and nanorods - metallic nanoshells - local field enhancement - plasmonic wave guiding - applications of metallic nanostructures.

Unit 4

Nanocontrol of excitation dynamics - nanostructure and excited states - rare earth doped nanostructures - up converting nanophores - quantum cutting. Growth and characterization of nanomaterials – epitaxial – PLD – nanochemistry – XRD – XPS – SEM – TEM – SPM.

Unit 5

Concept of photonic band gap – photonic crystals – theoretical modeling – features - optical circuitry - photonic crystal in optical communication - nonlinear photonic crystal - applications. Nanoelectronic devices – Introduction - single electron transistor. Basic ideas of nanolithography and biomaterials - nanophotonics for Biotechnology and Nanomedicine – nanophotonics and the market place.

TEXTBOOKS:

1. *Paras N. Prasad, Nanophotonics, Wiley Interscience, 2004*
2. *Lukas Novotny and Bert Hecht, Principles of Nano-Optics, Cambridge University Press, 2006*

REFERENCE:

1. *Herve Rigneault, jean-Michel Lourtioz, Claude Delalande, Juan Ariel Levenson, Nanophotonics, ISTE Publishing Company, 2006.*
2. *Surface Plasmon Nanophotonics, Mark L. Brongersma, Pieter G. Kik, Springer-Verlag, 2006.*
3. *Photonic Crystals, by John D. Joannopoulos, Robert D. Meade, Joshua N. Winn Prienceton University Press.*

15PHY541 NUCLEAR PHYSICS 3 0 0 3

Unit 1

Two-nucleon scattering - partial wave analysis, effective range theory, coherent scattering, spin-flip and polarization, comparison of n-n and p-p scattering.

Unit 2

Nuclear reactions - reaction and scattering cross sections, compound nuclear reactions, resonance reactions, Breit-Weigner formula, experimental determination of resonance widths and shapes, statistical theory, optical model, transfer reactions, pick-up and stripping reactions, spectroscopic factors.

Unit 3

Heavy ion reactions - salient features at low, intermediate and high energies, classical dynamical model, heavy ion fusion, fusion excitation function, deep inelastic collision.

Unit 4

Some aspects of nuclear measurement techniques: (i) Detectors and electronics for high resolution gamma and charge particle spectroscopy; (ii) Fast neutron, detection (iii) Neutrino detection, (iv) Drift chambers, RICH, calorimeter.

BOOKS RECOMMENDED:

1. *Nuclear Physics: L.R.B Elton*
2. *Nuclear reactions: Blatt and Weisskopf*
3. *Nuclear Theory - Roy and Nigam*
4. *Nuclear Physics - B. Cohen*
5. *Nuclear Physics - Preston and Bhaduri*
6. *Nuclear structure - Bohr and Mottelson*
7. *Nuclear structure - M. K. Pal*
8. *Techniques in experimental nuclear physics - Leo*
9. *Techniques in experimental nuclear physics - Knoll*
10. *Techniques in experimental nuclear physics - S.S. Kapur*

15PHY543 PHYSICS OF COLD ATOMS AND IONS 3 0 0 3

Unit 1

Two level atom in a radiation field, Laser light pressure, Atoms in motion, Travelling wave and standing wave - Multilevel atoms, Alkali metal atoms, metastable noble gas atoms, Polarization and interference, Angular momentum and selection rules and Optical transitions in Multilevel atoms.

Unit 2

Temperature and Thermodynamics in Laser Cooling, Kinetic Theory and the Maxwell-Boltzmann Distribution, Random Walks, The Fokker-Planck Equation and Cooling Limits, Phase Space and Liouville's Theorem.

Unit 3

Optical Molasses: Introduction, Low-Intensity Theory for a Two-Level Atom in One Dimension, Atomic Beam Collimation, Low-Intensity Case, Experiments in One- and Two-Dimensions, Experiments in Three-Dimensional Optical Molasses.

Unit 4

Cooling below the Doppler limit - Magnetic trapping of neutral atoms. Optical Traps – Magneto optical traps - Evaporative cooling.

Unit 5

Applications to atom mirrors, lenses, atomic fountain, nano fabrication, atomic clocks and nonlinear optics - Optical lattices - Bose Einstein condensation Entangled states and quantum computing.

TEXTBOOKS:

1. *Laser cooling and trapping by H J Metcalf and Peter Van der Straten Springer-VerlagNew York 1999.*
2. *Laser Manipulation of atoms and ions – Proceedings of the international school of Physics "Enrico Fermi" Course CXVII, Amsterdam (1993) North Holland.*

15PHY544 QUANTUM ELECTRODYNAMICS 3 0 0 3

Unit 1

Lorentz Covariance of the Dirac Equation: Covariant form of the Dirac equation, Proof of Covariance, Space Reflection, Bilinear Covariants, Solution of the Dirac Equation for a free particle: Plane wave Solutions, Projection Operators for Energy and Spin, Physical Interpretations of Free-particle solutions and packets.

Unit 2

The Foldy-Wouthuysen Transformation: Introduction, Free-particle Transformation, The Hydrogen atom Hole Theory: The problem of Negative Energy Solutions, Charge Conjugation, Vacuum Polarization, The time Reversal and other Symmetries.

Unit 3

General Formulation of the Quantum Field Theory: Implication of the Description in Terms of Local Fields, Canonical Formulation and Quantization Procedure for particles, Canonical Formulation and Quantization for Fields, The Klein-Gordon Field: Quantization and Particle Interpretation, Symmetry of the States, Measurability of the Field and Microscopic Causality, Vacuum Fluctuations, The Charged Scalar Field, Feynman Propagator.

Unit 4

Second Quantization of the Electromagnetic Field: Quantum Mechanics of N-identical Particles, The Number Representation for Fermions, The Dirac Theory, Momentum Expansions, Relativistic Covariance, The Feynman Propagator.

Quantization of the Electromagnetic Field: Introduction, Quantization, Covariance of the Quantization Procedure, Momentum Expansions, Spin of the Photon, The Feynman Propagator for Transverse Photons.

TEXTBOOKS:

1. *Bjorken & Drell: "Relativistic Quantum Mechanics"*
2. *Bjorken & Drell: "Relativistic Quantum Fields"*

REFERENCE BOOKS:

1. *Schweber, Bethe and Hoffmann: Mesons and Fields*
2. *Sakural: Advanced Quantum Mechanics*
3. *Lee: Particle Physics and Introduction to Field Theory*

15PHY545 QUANTUM OPTICS 3 0 0 3

Unit 1

Correlation functions of light waves. Spectral representation of mutual coherence function.

Calculation of mutual intensity and degree of coherence, propagation of mutual intensity.

Rigorous theory of partial coherence. Coherency matrix of a quasi-monochromatic plane wave. Stochastic description of light and higher order coherence effects.

Unit 2

Quantization of the radiation field, Quantum mechanical harmonic oscillator, the zero point energy, states of the quantized radiation field, single mode number states and phase states, coherent photon states.

Unit 3

Quantum theory of the laser: photon rate equations, time dependence of photon coherence, laser threshold condition, rate equations for atoms and laser photons, laser photon distribution, fluctuations in laser light and laser phase diffusion.

Unit 4

Statistical optics of photons: Photon coherence properties, photon counting, photon distribution for coherent and chaotic light, quantum mechanical photon counting distribution.

Unit 5

Super radiance: collective cooperative spontaneous radiation. Diecke's theory. Photon echoes. Quantum beats. Quantum chaos and instability hierarchies of laser light, chaos and its routes. Squeezed states of light.

REFERENCES:

1. *L. Mandel and E. Wolf, Coherence and Quantum Optics, Plenum (1973). 41*
2. *H. Haken, Light. Vol.1 & 2, North Holland (1981).*

3. *S.M. Kay and A. Maitland, Quantum Optics. Academic Press (1970).*
4. *R. Loudon, Quantum Theory of Light, Clarendon Press (1979).*
5. *J. Fox, (Ed.), Optical Masers, Interscience Publishers (1963).*
6. *R.G. Brewer and A. Mooradian, Laser Spectroscopy, Plenum (1974).*
7. *Laser Theory: Encyl. of Phy. Vol. 25/2C, Springer-Verlag (1976).*
8. *M.O. Scully, W.E. Lamb and M. Sargent III, Laser Physics, Addison Wesley (1974).*
9. *J. Jacob, M. Sargent III, Laser Applications to Optics and Spectroscopy, Addison Wesley (1975).*
10. *R.H. Pantell and H.E. Puthoff, Fundamentals of Quantum Electronics Wiley (1969).*

15PHY546 THIN FILM TECHNOLOGY 3 0 0 3

Unit 1

Preparation methods: Physical methods: thermal evaporation, cathodic sputtering, Molecular beam epitaxy and laser ablation methods. Chemical methods: electrolytic deposition, chemical vapour deposition.

Unit 2

Thickness measurement and Characterisation: electrical, mechanical, optical interference, microbalance, quartz crystal methods. Analytical techniques of characterization: X-ray diffraction, electron microscopy, high and low energy electron diffraction, Auger emission spectroscopy.

Unit 3

Growth and structure of films: General features-Nucleation theories - Effect of electron bombardment on film structure – Post-nucleation growth - Epitaxial film growth - Structural defects.

Unit 4

Properties of films: elastic and plastic behaviour. Optical properties - Reflectance and transmittance spectra - Absorbing films - Optical constants of film material - Multilayer films - Anisotropic and isotropic films. Electric properties to films: Conductivity in metal, semiconductor and insulating films - Discontinuous films - Superconducting films.

Unit 5

Magnetism of films: Molecular field theory - Spin wave theory - Anisotropy in magnetic films - Domains in films - Applications of magnetic films.

Thin film devices: fabrication and applications.

TEXTBOOKS:

1. *K.L. Chopra, Thin Film Phenomena, McGrawHill (1983),*
2. *George Hass. Physics of Thin Films: Volumes 1':12. Academic Press (1963).*

REFERENCE BOOKS:

1. *K.L. Chopra and I.J. Kaur, Thin Film Solar Cells, Plenum Press (1983).*
2. *L.I. Maissel and Giang (Eds.), Handbook of Thin film Technology, McGrawHill (1970).*
3. *J.C. Anderson, The Use of Thin Films in Physical Investigation, Academic Press (1966).*
4. *J.J. Coutts, Active and Passive Thin Film Devices, Academic Press (1978).*
5. *R.W. Berry, P.M. Hall and M.T. Harris, Thin Film Technology, Van Nostrand (1968). 47*

15PHY548 FUNDAMENTALS OF PLASMA PHYSICS 3 0 0 3

(Pre-requisites: 15PHY514 Advanced Electrodynamics)

Unit 1

Introduction – Spatial scale of an unmagnetized plasma – Debye Length, time scale - plasma period, gyroradius and gyrofrequency of magnetized plasma, single particle motion in prescribed fields- ExB, grad-B, Curvature and polarization drifts, magnetic moment, adiabatic invariants of particle motion, magnetic mirror.

Unit 2

Kinetic theory of plasmas, Boltzmann equation, Maxwell-Boltzmann distribution, Vlasov description of collisionless plasmas, Moments of the Boltzmann equation, Systems of macroscopic equations: Cold and Warm plasma models.

Unit 3

Plasmas as fluids - Two fluid description, equation of motion, Drifts perpendicular to B, parallel pressure balance.

Unit 4

Single fluid theory of plasmas: Magneto hydrodynamics (Hydromagnetic, MHD).

Unit 5

Introduction to waves in plasmas, waves in cold magnetized and unmagnetized plasma, Fourier representation, Dispersion relation, Waves in hot (magnetized) plasmas, Landau Damping, CMA diagram, Instabilities, MHD Waves, Alfven Waves, MHD discontinuities.

TEXTBOOKS/REFERENCES:

1. *Umran S. Inan & Marek Golkowski, Principles of Plasma Physics for Engineers and Scientists, Cambridge, 2011*
2. *Francis F. Chen, Introduction to Plasma Physics and controlled fusion, Springer, 2006*
3. *D.A. Gumett & A. Bhattacharjee, Introduction to Plasma Physics, CUP, 2006*
4. *Boyd, T.J.M., and Sanderson, J.J.: The Physics of plasmas, CUP, 2003*
5. *Krall, N.A, Trivelpiece, A.W., Principles of plasma physics, McGraw Hill, 1973*
6. *Stix, T.H., Waves in plasmas, Springer, 1992*

15PHY549 SPACE PHYSICS 3 0 0 3

(Pre-requisites: 15PHY555 Physics of the Atmosphere)

Unit 1

Brief history of solar-terrestrial physics – The variables Sun and the heliosphere, Earth's space environment and upper atmosphere.

Unit 2

Space plasma physics - single particle motion, plasma state, Fluid description, MHD & kinetic theory, Applications

Unit 3

Solid wind & Interplanetary Magnetic field (IMF), Shocks and Instabilities in space

Unit 4

Solar wind interactions with magnetized planets - Introduction, planetary magnetic fields, spherical harmonic expansions, geomagnetic field and its measurements, variations in Earth's field.

Unit 5

Magnetosphere - Dynamics, SW-magnetosphere interactions; Ionospheres, Currents in space and Ionosphere; Neutral atmosphere - Dynamics.

TEXTBOOKS/ REFERENCES:

1. *Hannu E.J. Koskinen, Physics of Space Storms, Springer, 2011*
2. *Molwin, M., An Introduction to Space Weather, CUP, 2008*
3. *Kallenrode, M.B., Space Physics: An introduction to plasmas and particles in the Heliosphere and Magnetosphers, Springer, 3e, 2004*
4. *Baumjohann, W. & Treumann, R.A., Basic Space Plasma Physics, Imperial College Press, 1997*
5. *Kivelson & Russell, Introduction to Space Physics, CUP, 1995*

15PHY557 ASTROPHYSICS AND COSMOLOGY 3 0 0 3

Unit 1

Stellar dynamics, types of forces on a star in the stellar system, Tidal radii, star-star encounter, time of relaxation determination of time of relaxation, application to Galaxy & star cluster.

Masses of double galaxies, Masses of cluster of galaxies by virial theorem observational determination of masses, clusters of galaxies, Missing mass problem.

Unit 2

Cosmology, cosmological principle, Newtonian cosmology, deceleration parameters

critical density, Robertson walker equation and its properties, solution of Robertson-Walker equations. Einstein field equation in cosmology, Energy tensor of Universe, solution of Friedman's equation, Einstein de-sitter model, open model, particle horizon, Event horizon.

Unit 3

The formation of structures in the Universe: Jean's equation derivation from fluid dynamics and General relativity; evolution of Jean mass, Growth in the Post recombination era; Einstein-do Sitter model; closed model; open model; observation constraints; small angle anisotropy, horizon problem, the scale – invariant spectrum, Hierarchy of structures, Age distribution.

Unit 5

Thermal History of the Universe, Temperature red shift relation, distribution in the early Universe, relativistic and non-relativistic limits, decoupling of matter and radiation, Cosmic microwave background radiation (CMBR), isotropy and anisotropy of CMBR.

TEXT AND REFERENCE BOOKS:

1. *Introduction to Cosmology By J.V.Narliker*
2. *Structure Formation in the Universe by T. Padmanabhan, Cambridge University*
3. *Stellar Dynamics by S.Chandersakher*
4. *Stellar Evolution by Kippenhahn*
5. *Quassars and Active Galactic Nuclei by A.K.Kembehavia & G.V.Narliker, Cambridge University Press*
6. *Modern Astrophysics by B.W.Carroll and D.A.Ostlie, Addison-Wesley Publishing Co.*

15PHY558 NONLINEAR DYNAMICS AND CHAOS 3 0 0 3

Unit 1

Introduction, Phase Space, and Phase Portraits: Linear systems and their classification; Existence and uniqueness of solutions; Fixed points and linearization; Stability of equilibria; Pendulum and Duffing oscillator, Lindstedt's method; Conservative and reversible systems.

Unit 2

Limit Cycles: The van der Pol oscillator, Method of Averaging; Relaxation oscillators; Weakly nonlinear oscillators; Forced Duffing oscillator, Method of Multiple Scales; Forced van der Pol oscillator, Entrainment; Mathieu's equation, Floquet Theory, Harmonic Balance.

Unit 3

Bifurcations: Saddle-node, transcritical, and pitchfork bifurcations; Center manifold theory; Hopf bifurcation; Global bifurcations; and Poincaré maps.

Unit 4

Nonlinear Normal Modes: Nonlinear Normal Mode manifolds of multidegree-of-freedom systems; external and internal resonances; and Energy transfer through nonlinear interactions.

Unit 5

Chaotic Dynamics: Lorentz equations; Lorentz map; Logistics map; Lyapunov Exponents; fractal sets and their dimensions; box, pointwise and correlation dimensions; strange attractors; and forced two-well oscillator.

TEXTBOOKS:

1. *Richard H. Rand, Lecture Notes on Nonlinear Vibrations, version 52, 2005. Available online athttp://audiophile.tam.cornell.edu/randpdf/nlvibe52.pdf*
2. *S.H. Strogatz, Nonlinear Dynamics and Chaos with Applications to Physics, Biology, Chemistryand Engineering, Perseus Books Publishing, 2000.*

REFERENCE BOOKS:

1. *J.C. Sprott, Chaos and Time-Series Analysis, Oxford University Press, 2003.*
2. *G.L. Baker and J.P. Gollub, Chaotic Dynamics, 2nd edition, Cambridge University Press, New York, 1996.*
3. *Edward Ott, Chaos in Dynamical Systems, Cambridge, 1993.*
4. *K.T. Alligood, T.D. Sauer, and J.A. Yorke, CHAOS - An Introduction to Dynamical Systems, Springer, 1996.*
5. *D. Kaplan and L. Glass, Understanding nonlinear dynamics, Springer-Verlag, New York, 1995.*
6. *J.M.T. Thompson and H.B. Stewart, Nonlinear dynamics and chaos, John Wiley and Sons, New York, 1986.*

15PHY559 PHYSICS OF OPTOELECTRONIC DEVICES 3 0 0 3

Unit 1

Introduction: Semiconductor materials; Crystal lattices; Bulk Crystal growth, epitaxial growth.

Unit 2

Energy bands and Charge carriers in Semiconductors: direct and indirect semiconductors; variation of Energy bands with alloy composition. Charge carriers in semi-conductors-electrons, holes, effective mass; intrinsic and extrinsic materials. Drift of carriers in electric and magnetic fields.

Unit 3

Excess carries in Semiconductors: Optical absorption; luminescence – photoluminescence, electroluminescence. Carrier lifetime and photoconductivity, diffusion of carriers.P-N Junction Diode: Current-Voltage Characteristics; hetrojunctions.

Unit 4

Optoelectronic Devices: Principle of operation and characteristics; Light emitting diodes, lasers, photo detectors, solar cells. Relevance of III-V and IV-VI material-systems in optoelectronic devices.

Unit 5

Integrated Optics: Optical waveguides - passive, electro-optical; optical modulators and switches; optical storage devices.

TEXTBOOK:

Pallab Bhattacharya, "Semiconductor Optoelectronic Devices", 2nd Edition.

REFERENCE BOOKS:

1. *Street B G and Banerjee S, "Solid State Electronic Devices", PHI New Delhi, (2004)*
2. *Sze S M, "Physics of Semiconductors Devices", Wiley Eastern Limited, New Delhi.*
3. *Wilson and Hawkes, "Optoelectronics; An Introduction", 2nd Ed., PHI.*
4. *Hummel R E, "Electronic Properties of Materials", Narosa Publishing House, New Delhi.*

15PHY581/ 15PHY585 PHYSICS LAB. A/ PHYSICS LAB. B 0 0 6 2

A selection of experiments from the following list:

Michelson's interferometer; Ultrasonic interferometer; Photoelectric effect; Fourier Analysis Kit; Four Probe and measurement of band gap of Ge; Hall effect of doped semiconductors; Magneto-resistance of Ge; Quincke's tube experiment for measurement of magnetic susceptibility; Electron-spin resonance.

Experiments from Dr. R.Srinivasan's kit:

Calibration of Cu-Constantan thermocouples as temperature sensors, Stefan's constant of radiation, Thermal and electrical conductivities of Cu and its Lorenz number, Thermal conductivity of a poor conductor, Thermal diffusivity of brass; Temperature coefficient of resistance of Cu, Energy band gap of Si, Determination of k/e using a transistor; Dielectric constant of a non-polar liquid, Dipole moment of an organic molecule – acetone, Verification of Curie-Weiss law for a ferroelectric material – temperature dependence of a ceramic capacitor; Magnetic hysteresis and B-H curve of a ferromagnetic material; Principle of phase sensitive detection and the calibration of a lock-in amplifier, Measurement of mutual inductance and low resistance with a lock-in amplifier; Experiments in non-linear dynamics: Chua circuit, Feigenbaum circuit for period doubling.

REFERENCES:

1. *R. Srinivasan, K.R. Kriolkar, Instruction Manual for Kit Developed for Doing Experiments in Physics, Indian Academy of Sciences.*
2. *Other Lab manuals and Handouts.*

15PHY582 SIMULATION LAB. 0 0 3 1

Preliminaries – Programming, Basic elements of MATLAB, Numerical errors;
Basic Projects: Basic MATLAB (i/o, computing, graphics etc.), Doing Math with Computers – Vectors, Interpolation etc.

Ordinary Differential Equations (ODEs – Basic & Advanced methods):
Basic Projects: Projectile motion, Pendulum; Advanced – Runge-Kutta & Adaptive methods.
Projects: Cometary Orbits, Electron motion in crossed electric and magnetic fields, Double pendulum.

Solving systems of equations – Linear systems of equations, Matrix inverse, Non-linear system of equations;
Projects: Gaussian Elimination, Coupled Harmonic Oscillators, Potential well problem.

Data analysis – Curve fitting, Spectral analysis;
Projects: Least square fit, Fourier Transforms, Fourier Spectrum, Coupled Spring Mass systems.

Partial Differential Equations (PDEs) – Foundations and explicit methods: Introduction to PDEs; Advanced explicit methods: Relaxation and Spectral methods; Stability and implicit methods;
Projects: Solving Diffusion and Advection equations using various schemes, Solving Laplace and Poisson equations, Evolution of a Gaussian Wave packet by Solving the Schrödinger equation.

Special functions and quadrature – Special functions and basic numerical integration, Gaussian quadrature;
Projects: Computing Legendre Polynomials and Bessel functions.

TEXTBOOKS/REFERENCES:

1. *Alejandro Garcia, "Numerical methods for Physics", 2E, Prentice-Hall, 2000*
2. *Paul L DeVries & Javier Hasbun, "A First Course in Computational Physics", 2E, Jones & Bartlett, 2011*
3. *Mark Newman, "Computational Physics", CreateSpace Publishing, 2012*
4. *NJ Giordano & H Nakanishi, "Computational Physics", Pearson India, 2012*
5. *Press, W.H., Teukolsky, S.A., Vetterling, W.T., Flannery, B.P., Numerical Recipes 3rd Edition: The Art of Scientific Computing, CUP, 3E, 2007*

15PHY586 SPECTROSCOPY LAB 0 0 6 2

1. Determination of Wavelength and distance between D1 & D2 of sodium vapor light using Michelson Interferometer

2. Thermal expansively using interferometric technique
3. Observation of hyperfine splitting of spectral lines - Fabry-Perot Interferometer
4. Determination of e/m of electron by Normal Zeeman effect using Fabry-Perot etalon
5. Mach-Zehnder Interferometer using a He-Ne laser.
6. Fourier Filtering
7. Measurement and analysis of fluorescence spectrum of I2 vapor
8. Measurement of optical spectrum of an alkali atoms or alkaline earth metals
9. Measurement of Band positions and determination of vibrational constants of N2 molecule
10. Electron Spin Resonance Spectroscopy.
11. Energy band gap of semiconductor by studying the luminescence spectra
12. Study of temperature variation of refractive index of a liquid using hollow prism and laser source.
13. Clausius – Mossotti equation using sugar solution.

15PHY595 SEMINAR 0 0 2 1

Seminars are aimed at improving the confidence level in the subject, communication and presentation skills. It also provides an opportunity for students to understand the basics, visualize and apply ideas gained into frontier areas of research. Students will be asked to choose a topic of their interest and make a presentation in the class. The presentation will be evaluated by an expert panel.

15PHY602 CONDENSED MATTER PHYSICS 3 1 0 4

Unit 1

Basic Concepts: Review of free electron theory of metals, thermal and electrical transport properties; inadequacies; Brief review of crystal structure & symmetry, crystal planes, reciprocal lattices and X-ray diffraction pattern, Bragg planes & Brillouin zones.

Unit 2

Electrons in periodic potentials: Bloch theorem, band energy spectrum; nearly free electron and Tight binding models, Fermi surface, energy spectrum of selected solids.

Unit 3

Electron transport: semiclassical dynamics in electric and magnetic fields, band insulators and metals, Bloch oscillations, effective mass and concepts of holes; Hall effect and magneto-resistance; Landau levels, de-Hass van Alfen oscillations; quantum Hall effect.

Unit 4

Semiconductors: energy band structure & parameters – direct and indirect energy gaps and effective masses, photo-absorption, cyclotron resonance; intrinsic and extrinsic semiconductors, equilibrium carrier concentrations; p-n junctions, Schottky-barrier.

Superconductivity: persistent currents, Meissner effect, London's equations, introduction to BCS theory and its predictions, Ginzburg-Landau theory, flux quantization, Josephson effects, SQUID.

Unit 5

Magnetism in solids: dia- and paramagnetism, quenching of orbital angular momentum, Pauli paramegnetism and Landau diamagnetism in metals and semiconductors; exchange interactions, Heisenberg model, ferro - and anti-ferromagnetism.

TEXTBOOKS/ REFERENCES:

1. *N.W. Ashcroft and N.D. Mermin, Solid State Physics, Brooks Cole, 1E, 2003.*
2. *Ibach and Luth, Soil State Physics, Springer India, 3E, 2002.*
3. *M.Marder, Condensed Matter Physics, Wiley Intersciences, 1E, 2000.*
4. *C.Kittel, Introduction to Solid State Physics, Wiley India, 7E, 2007.*

15PHY603 NUCLEAR AND PARTICLE PHYSICS 3 1 0 4

Unit 1

Nuclear Structure: Basic nuclear properties, Rutherford's scattering, charge distribution, spin and parity, magnetic moment, binding energy – stable & unstable nuclei, packing fraction; liquid drop model – semi empirical mass & binding energy formula, mass parabolas, shell model – validity & limitations.

Unit 2

Nuclear Decay and Radioactivity: Radioactive decays, decay law, radioactive dating; Alpha decay: tunnel theory, angular momentum & parity selection rules, formula for decay constant; Beta decay: energetics, Fermi theory, comparative half-life, allowed & forbidden transitions, selection rules, Parity violation in beta decay, negatron & positron emissions, electron capture, inverse beta decay and the discovery of neutrino; Gamma decay: energetics, decay rates, selection rules; Basic ideas of nuclear isomerism and conversion, interaction of radiation with matter – heavy charged particles, electrons, electromagnetic radiation, relativistic kinematics.

Unit 3

Nuclear reactions Fission and Fusion: Nuclear reactions & mechanisms, compound nuclei and direct reactions – Q value; nuclear fission, neutron capture

cross section – reaction rate, controlled fission reactions, nuclear reactors; fusion reactions, energy production, nuclear fusion in stars – p-p & C-N cycles – formation of heavier elements, controlled fusion.

Unit 4

Nuclear Forces: Nucleon-nucleon potential, effective range theory, p-p & n-p scattering, and simple theory of the deuteron structure, characteristics of nuclear forces, charge symmetry of nuclear forces, Isospin - Meson theory of nuclear forces - pions.

Unit 5

Particle Physics: Classification of fundamental forces and elementary particles, elementary particle quantum numbers, symmetries and conversation Laws, Gell-Mann-Nishijima formula, parity non-conservation in weak interactions, CPT theorem, CP violation, applications of conservation laws to particle reactions; extremely short lived particles, quarks – color and flavor, quark model: field bosons, basic ideas of quantum chromo dynamics, colored quarks; history of the universe – dark matter.

REFERENCE BOOKS:

1. *Nuclear Physics: D.G. Tayal*
2. *Nuclear Physics: S.N. Ghoshal*
3. *R.Murugeshan and Er. K, Sivaprasath – Modern Physics – S.Chand (2010)*
4. *K.S.Krane: "Introductory Nuclear Physics" (Wiley)*
5. *David Griffiths –"Introduction to elementary particles" – Wiley (1989)*
6. *S.B.Patel: "An Introduction to Nuclear Physics" (New age international publishers).*
7. *I.Kaplan: " Nuclear Physics" (Addison Wesley, 1962)*
8. *E.Segre: "Nuclei and Particules" (Benjamin,1967)*
9. *Arthur Beiser: "Concepts of Modern Physics" (5th edition)*
10. *W.E. Burcham and M.Jobes: "Nuclear and Particle Physics" (Longman, 1995)*

15PHY604 ADVANCED ELECTRONICS 3 1 0 4

Unit 1

Optoelectronic devices, solar cells, photodetectors, and LEDs.

Unit 2

Digital technique and applications: registers, counters, comparators and similar circuits.

Unit 3

Introduction to operational amplifiers, concept of negative feedback and virtual short, analysis of simple operational amplifier circuits, frequency response of amplifiers, feedback topologies and analysis of discrete transistor amplifiers; signal conditioning and recovery in measurement and control systems.

Unit 4

Active filters and switched capacitor filters; Wave form generators, A/D instruction set, programmable peripheral devices.

Unit 5

Introduction to 8086 microprocessor and its instruction set Assembly level programming, Introduction to microcontrollers and embedded systems.

REFERENCES:

1. *Malvino & Leech Digital principles and applications, TMH,2003*
2. *John D. Ryder, Electronic Fundamentals and applications PHI, 1999*
3. *Gayakwad, operational Amplifiers & Linear Integrated Circuits, Pearson India , 201*
4. *Millman & Halkias, Integrated Electronics, TMH,1991*
5. *Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, penram international, 1999*

15PHY605 SPECTROSCOPY 3 1 0 4

Unit 1

Atomic Spectra: Quantum states of electron in atoms - Hydrogen atom spectrum - Electron spin - Stern-Gerlach experiment - Spin-orbit interaction - relativistic effects; Many electron systems - SCF-method; Thomas-Fermi potential, LS-JJ coupling schemes - Fine structure - intermediate couplings; configuration mixing; spectra. Spectroscopic terms and selection rules - Hyperfine structure - Exchange symmetry of wave functions - Pauli's exclusion principle - Periodic table - Alkali type spectra - Equivalent electrons - Hund's rule. Computer assisted quantum mechanical calculations and simulations: Calculations of orbital energies including potential energy according to the Thomas -Fermi model; Hartree-Fock calculations; Koopman's theorem.

Unit 2

Atoms in External Fields and Quantum Chemistry: Atoms in External Fields: Zeeman and Paschen-Back effect of one and two electron systems - Selection rules - Stark effect. Quantum Chemistry of Molecules:Covalent, ionic and van der Waals interactions - Born-Oppenheimer approximation - Heitler-London and molecular orbital theories of H_2 - Bonding and anti-bonding MOs - Huckel's molecular approximation - Application to butadiene and benzene.

Unit 3

Microwave and IR Spectroscopy: Rotational spectra of diatomic molecules - Effect of isotopic substitution - The non-rigid rotor - Rotational spectra of polyatomic molecules - Linear, symmetric top and asymmetric top molecules - Experimental techniques - Vibrating diatomic molecule - Diatomic vibrating rotator - Linear and symmetric top molecules - Analysis by infrared techniques - Characteristic and group frequencies.

Unit 4

Raman Spectroscopy and Electronic Spectroscopy of Molecules: Raman spectroscopy: Raman Effect - Quantum theory of Raman Effect – Rotational and vibrational Raman shifts of diatomic molecules - Selection rules. Electronic spectroscopy of molecules: Electronic spectra of diatomic molecules - The Franck-Condon principle - Dissociation energy and dissociation products - Rotational fine structure of electronic vibration transitions.

Unit 5

Resonance Spectroscopy: NMR: Basic principles - Classical and quantum mechanical description - Bloch equations - Spin-spin and spin - lattice relaxation times - Chemical shift and coupling constant - Experimental methods – Single coil and double coil methods - High resolution methods. ESR: Basic principles - ESR spectrometer - nuclear interaction and hyperfine structure - relaxation effects - g-factor - Characteristics - Free radical studies and biological applications. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

BOOKS FOR STUDY AND REFERENCE:

1. *C.N. Banwell, Fundamentals of Molecular Spectroscopy (McGraw Hill, New York, 1994).*
2. *B.P. Straughan and S. Walker, Spectroscopy Vol.I. (Chapman and Hall, New York, 1976).*
3. *R.P. Feynman et al. The Feynman Lectures on Physics Vol. III. (Narosa, New Delhi, 1989).*
4. *Pople, Schneiduer and Berstein, High Resolution NMR (McGraw Hill, New York).*
5. *Ira N. Levine, Quantum Chemistry (Prentice-Hall, New Delhi, 2009).*
6. *Arthur Beiser, Concepts of Modern Physics, Tata McGraw-Hill Education, 2003.*
7. *Charles P. Slichter, (Springer Series in Solid-State Sciences) (v.1). 3rd printing 1996 edition.*

15PHY682 ADVANCED ELECTRONICS LAB. 0 0 6 2

Design and study of CE amplifier with and without feedback, two stage amplifier, Power amplifier, Differential amplifier, Voltage regulated power supplies with Zener diodes and transistors, Design of basic DL. TI and TTL logic gates, RS and JK flip flops using NOR-NAND gates, Schmitt trigger using op-amp, Uses of IC 741, Phase shift oscillator, 555 timer, three terminal IC voltage regulator, Familiarization of 8085 kit and programming, A/D and D/A converters, control of stepper motor.

TEXTBOOK/ REFERENCES:

Paul B. Zbar & Alert P Malvino, Basic Electronics - A text-Lab Manual.

15PHY696 PROJECT 10 cr

The aim of the project work is to give more detailed exposure to the student for research methodology. This can include literature survey, review, data collection,

and theoretical/ experimental work on small parts of research in area chosen by the faculty guiding the project work. If the project to be carried out at other institutions/ laboratories, the experts from these institutions are to be associated in choosing the research topic and its execution.

15SAN101 SANSKRIT I 1 0 2 2

Objectives: *To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.*

Unit 1

Introduction to Sanskrit language, Devanagari script - Vowels and consonants, pronunciation, classification of consonants, conjunct consonants, words – nouns and verbs, cases – introduction, numbers, Pronouns, communicating time in Sanskrit. Practical classes in spoken Sanskrit

Unit 2

Verbs- Singular, Dual and plural – First person, Second person, Third person. Tenses – Past, Present and Future – Atmanepadi and Parasmaipadi-kartharipraYoga

Unit 3

Words for communication, slokas, moral stories, subhashithas, riddles (from the books prescribed)

Unit 4

Selected slokas from Valmiki Ramayana, Kalidasa's works and Bhagavad Gita. Ramayana – chapter VIII - verse 5, Mahabharata - chapter 174 - verse16, Bhagavad Gita –chapter IV - verse 8, Kalidasa's Sakuntalam Act IV –verse 4.

Unit 5

Translation of simple sentences from Sanskrit to English and vice versa.

ESSENTIAL READING:

1. *Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085*
2. *Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad*
3. *Prakriya Bhashyam written and published by Fr. John Kunnappally*
4. *Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston*
5. *Sabdamanjari, R.S. Vadyar and Sons, Kalpathi, Palakkad*
6. *Namalinganusasanam by Amarasimha published by Travancore Sanskrit series*
7. *Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar press*

15SAN111 SANSKRIT II 1 0 2 2

Objectives: *To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.*

Unit 1

Seven cases, indeclinables, sentence making with indeclinables, Saptha karakas.

Unit 2

Ktavatu Pratyaya, Upasargas, Ktvanta, Tumunnanta, Lyabanta.
Three Lakaras – brief introduction, Lot lakara.

Unit 3

Words and sentences for advanced communication. Slokas, moral stories (Pancatantra) Subhashitas, riddles.

Unit 4

Introduction to classical literature, classification of Kavyas, classification of Dramas - The five Mahakavyas, selected slokas from devotional kavyas- Bhagavad Gita – chapter II verse 47, chapter IV verse 7, chapter VI verse 5, chapter VIII verse 6, chapter XVI verse 21, Kalidasa's Sakuntala act IV verse 4, Isavasyopanishat 1st Mantra, Mahabharata chapter 149 verses 14- 120, Neetisara chapter - III

Unit 5

Translation of paragraphs from Sanskrit to English and vice versa.

ESSENTIAL READING:

1. *Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085*
2. *Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad*
3. *Prakriya Bhashyam written and published by Fr. John Kunnappally*
4. *Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston*
5. *Sabdamanjari, R.S. Vadyar and Sons, Kalpathi, Palakkad*
6. *Namalinganusasanam by Amarasimha published by Travancore Sanskrit series*
7. *Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar Press.*

15SSK201 LIFE SKILLS I 1 0 2 2

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, self-motivation and continuous knowledge upgradation.

Self Confidence: Characteristics of the person perceived, characteristics of the situation, Characteristics of the Perceiver. Attitude, Values, Motivation, Emotion Management, Steps to like yourself, Positive Mental Attitude, Assertiveness.

Presentations: Preparations, Outlining, Hints for efficient practice, Last minute tasks, means of effective presentation, language, Gestures, Posture, Facial expressions, Professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words.

Listening Skills: The importance of listening in communication and how to listen actively.

Prepositions and Articles: An experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving; Number System; LCM &HCF; Divisibility Test; Surds and Indices; Logarithms; Ratio, Proportions and Variations; Partnership; Time speed and distance; work time problems;

Data Interpretation: Numerical Data Tables; Line Graphs; Bar Charts and Pie charts; Caselet Forms; Mix Diagrams; Geometrical Diagrams and other forms of Data Representation.

Logical Reasoning: Family Tree; Linear Arrangements; Circular and Complex Arrangement; Conditionalities and Grouping; Sequencing and Scheduling; Selections; Networks; Codes; Cubes; Venn Diagram in Logical Reasoning.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*

REFERENCES:

1. *Quantitative Aptitude, by R S Aggarwal, S Chand Publ.*
2. *Verbal and Non-verbal Reasoning, R S Aggarwal, S Chand Publ.*
3. *Data Interpretation, R S Aggarwal, S Chand Publ.*
4. *Nova GRE, KAPAL GRE, Barrons GRE books;*
5. *Quantitative Aptitude, The Institute of Chartered Accountants of India.*

6. More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
7. The BBC and British Council online resources
8. Owl Purdue University online teaching resources
9. www.thegrammarbook.com online teaching resources
10. www.englishpage.com online teaching resources and other useful websites.

15SSK211 LIFE SKILLS II 1 0 2 2

Professional Grooming and Practices: Basics of Corporate culture, Key pillars of Business Etiquette. Basics of Etiquette: Etiquette – Socially acceptable ways of behaviour, Personal hygiene, Professional attire, Cultural Adaptability. Introductions and Greetings: Rules of the handshake, Earning respect, Business manners. Telephone Etiquette: activities during the conversation, Conclude the call, To take a message. Body Language: Components, Undesirable body language, Desirable body language. Adapting to Corporate life: Dealing with people.

Group Discussions: Advantages of Group Discussions, Structured GD – Roles, Negative roles to be avoided, Personality traits to do well in a GD, Initiation techniques, How to perform in a group discussion, Summarization techniques.

Listening Comprehension advanced: Exercise on improving listening skills, Grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.

Reading Comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving – Money Related problems; Mixtures; Symbol Based problems; Clocks and Calendars; Simple, Linear, Quadratic and Polynomial Equations; Special Equations; Inequalities; Functions and Graphs; Sequence and Series; Set Theory; Permutations and Combinations; Probability; Statistics.

Data Sufficiency: Concepts and Problem Solving.

Non-Verbal Reasoning and Simple Engineering Aptitude: Mirror Image; Water Image; Paper Folding; Paper Cutting; Grouping Of Figures; Figure Formation and Analysis; Completion of Incomplete Pattern; Figure Matrix; Miscellaneous.

Special Aptitude: Cloth, Leather, 2D and 3D Objects, Coin, Match Sticks, Stubs, Chalk, Chess Board, Land and geodesic problems etc., Related Problems.

TEXTBOOKS:

1. A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.

2. Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
3. Gulati S (2006) -"Corporate Soft Skills", New Delhi, India: Rupa & Co.
4. The Hard Truth about Soft Skills, by Amazone Publication.

REFERENCES:

1. Quantitative Aptitude, by R S Aggarwal, S Chand Publ.
2. Verbal and Non-verbal Reasoning, R S Aggarwal, S Chand Publ.
3. Quantitative Aptitude by Abjith Guha, Tata McGraw hill Publ.
4. More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
5. The BBC and British Council online resources
6. Owl Purdue University online teaching resources
7. www.thegrammarbook.com online teaching resources
8. www.englishpage.com online teaching resources and other useful websites.

15SSK301 LIFE SKILLS III 1 0 2 2

Team Work: Value of Team work in organisations, Definition of a Team, Why Team, Elements of leadership, Disadvantages of a team, Stages of Team formation. Group Development Activities: Orientation, Internal Problem Solving, Growth and Productivity, Evaluation and Control. Effective Team Building: Basics of Team Building, Teamwork Parameters, Roles, Empowerment, Communication, Effective Team working, Team Effectiveness Criteria, Common characteristics of Effective Teams, Factors affecting Team Effectiveness, Personal characteristics of members, Team Structure, Team Process, Team Outcomes.

Facing an Interview: Foundation in core subject, Industry Orientation/Knowledge about the company, Professional Personality, Communication Skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced Grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, Critical reasoning: A course on verbal reasoning. Listening Comprehension advanced: An exercise on improving listening skills.

Reading Comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Specific Training: Solving campus recruitment papers, National level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In Mathematics). Lateral Thinking problems. Quick checking of answers techniques; Techniques on elimination of

options, Estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazon Publication.*

REFERENCES:

1. *Speed Mathematics, Secrets of Lightning Mental Calculations, by Bill Handley, Master Mind books;*
2. *The Trachtenberg Speed System of Basic Mathematics, Rupa & Co., Publishers;*
3. *Vedic Mathematics, by Jagadguru Swami Sri Bharati Krsna Tirthayi Maharaja, Motilal Banarsidass Publ.;*
4. *How to Ace the Brainteaser Interview, by John Kador, Mc Graw Hill Publishers.*
5. *Quick Arithmetics, by Ashish Agarwal, S Chand Publ.;*
6. *Quicker Maths, by M tyra & K Kundan, BSC Publishing Co. Pvt. Ltd., Delhi;*
7. *More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.*
8. *The BBC and British Council online resources*
9. *Owl Purdue University online teaching resources*
10. *www.thegrammarbook.com online teaching resources*
11. *www.englishpage.com online teaching resources and other useful websites.*

15TAM101 TAMIL I 1 0 2 2

Objectives: *To introduce the students to different literature - Sangam literature, Epics, Bhakthi literature and modern literature; to improve their ability to communicate with creative concepts, and also to introduce them to the usefulness of basic grammatical components in Tamil.*

Unit 1

Sangam literature: Kuṟuntokai; (2, 6, 8, 40 pāṭalkaḷ) – puṟanāṉūṟu (74, 112, 184, 192 pāṭalkaḷ) – tirukkuṟaḷ (iṟaimāṭci, amaiccu).

Unit 2

Epic literature: cilappatikāram maturaik kāṇṭam (vaḻakkuṟaikkātai 50-55).

Spiritual Literature: tiruppāvai (3,4) – tēvāram (mācilvīṇaiyum)

Medieval Literature: bāratiyar kaṇṇaṉ pāṭṭu (eṉ viḷaiyāṭṭu piḷḷai) – bāratitacaṉ kuṭumpaviḷakku (tāyiṉ tālāṭṭu).

Unit 3

Novel: Jeyakāntaṉ "kuru pīṭam"

Essay: Aṉṉā "ē tāḻnta tamiḻakamē"

Unit 4

Tiruñāṉa campantar – tirunāvukkaracar – cuntarar – māṇikka vācakar – āṇṭāḷ – tirumūlar – kulacēkara āḻvār – cīttalaic cāttaṉār toṭarpāṉa ceytikaḷ, mēṟkōḷkaḷ marrum ciṟappup peyarkaḷ.

Unit 5

Tamil Grammar: Col vakaikaḷ - vēṟṟumai urupukaḷ - valliṉam mikumiṭam mikāyiṭam - canti(puṇarcci) - ilakkaṇakkuṟippu.

Practical skills: Listening, speaking, writing and reading.

TEXTBOOKS:

Aṉṉā "ē tāḻnta tamiḻakamē" nakkīraṉ papḷikēṣaṉs.

Caktitācaṉ cupramaṇiyaṉ "nalla kuṟuntokai mūlamum uraiyum" mullai patippakam, 2008.

http:/Www.Tamilvu.Org/libirary/libindex.Htm.

jeyakāntaṉ "kuru pīṭam" mīṉāṭci puttaka nilaiyam, 1971.

Nā. Pārttacārati "puṟanāṉūṟṟuc ciṟukataikaḷ" tamiḻp puttakālayam, 1978, 2001

Poṉ maṇimāṟaṉ "aṭōṉ tamiḻ ilakkaṇam "aṭōṉ papḷiṣiṅ kurūp, vañciyūr, tiruvaṉantapuram, 2007.

puliyūrk kēcikaṉ "kuṟuntokai mūlamum uraiyum" cārāta patippakam, 2010.

Puliyūrk kēcikaṉ "puṟanāṉūṟu" srīceṇpakā patippakam, 2010

15TAM111 TAMIL II 1 0 2 2

Objectives*: To learn the history of Tamil literature; to analyze different styles, language training, to strengthen the creativity in communication, Tamil basic grammar, Computer and its use in Tamil language.*

Unit 1

The history of Tamil literature: Nāṭṭupuṟap pāṭalkaḷ, kataikkaḷ, paḻamoḻikaḷ - ciṟukataikaḷ tōṟṟamum vaḷarcciyum, ciṟṟilakkiyaṅkaḷ: Kaliṅkattup paraṇi (pōrpāṭiyatu) - mukkūṭaṟ paḷḷu 35.

Kāppiyaṅkaḷ: Cilappatikāram – maṇimēkalai naṭaiyiyal āyvu marrum aimperum – aiñciṟuṅ kāppiyaṅkaḷ toṭarpāṉa ceytikaḷ.

Unit 2

tiṇai ilakkiyamum nītiyilakkiyamum - patiṉeṇkīḻkkaṇakku nūlkaḷ toṭarpāṉa piṟa ceytikaḷ - tirukkuṟaḷ (aṉpu, paṇpu, kalvi, oḻukkam, naṭpu, vāymai, kēḷvi, ceynaṉṟi, periyāraittuṇakkōṭal, viḻippuṇarvu pēṉṟa atikārattil uḷḷa ceytikaḷ.

Aṟanūlkaḷ: Ulakanīti (1-5) – ēlāti (1,3,6) - Cittarkaḷ: Kaṭuveḷi cittar pāṭalkaḷ (āṉantak kaḷippu – 1,4,6,7,8), marrum akappēy cittar pāṭalkaḷ (1-5).

Unit 3

tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūrru ayaṟkūrru.

Unit 4

tamiḻaka aṟiñarkaḷiṉ tamiḻ toṇṭum camutāya toṇṭum: Pāratiyār, pāratitācaṉ, paṭṭukkōṭṭai kalyāṇacuntaram, curatā, cujātā, ciṟpi, mēttā, aptul rakumāṉ, na.Piccaimūrtti, akilaṉ, kalki, jī.Yū.Pōp, vīramāmuṉivar, aṇṇā, paritimāṟ kalaiñar, maṟaimalaiyaṭikaḷ.

Unit 5

tamiḻ moḻi āyvil kaṇiṉi payaṉpāṭu - Karuttu parimārram - viḷampara moḻiyamaippu - pēccu - nāṭakam paṭaippu - ciṟukatai, katai, putiṉam paṭaippu.

TEXTBOOKS:

http:/Www.tamilvu.trg/libirary/libindex.htm.

http:/Www.tunathamizh.tom/2013/07/blog0post_24.html

Mu. Varatarācaṉ "tamiḻ ilakkiya varalāṟu" cāhitya akaṭemi papḷikēṣaṉs, 2012

na. Vaṉamamalai "paḻaṅkataikaḷum, paḻamoḻikaḷum" niyu ceñcuri puttaka veḷiyiṭṭakam, 1980, 2008

nā. Vāṉamāmalai, "tamiḻar nāṭṭuppāṭalkaḷ" niyū ceñcuri puttaka veḷiyīṭṭakam 1964, 2006

poṉ maṇimāṟaṉ "aṭōṉ tamiḻ ilakkaṇam "aṭōṉ papḷiṣiṅ kurūp, vañciyūr, tiruvaṉantapuram, 2007.