

Integrated MSc Programme

CURRICULUM AND SYLLABUS

PHYSICS



REGULATIONS

for students admitted from the year 2018

Vision of the Institute

To be a global leader in the delivery of engineering education, transforming individuals to become creative, innovative, and socially responsible contributors in their professions.

Mission of the Institute:

1. To provide best-in-class infrastructure and resources to achieve excellence in technical education,
2. To promote knowledge development in thematic research areas that have a positive impact on society, both nationally and globally,
3. To design and maintain the highest quality education through active engagement with all stakeholders –students, faculty, industry, alumni and reputed academic institutions,
4. To contribute to the quality enhancement of the local and global education ecosystem,
5. To promote a culture of collaboration that allows creativity, innovation, and entrepreneurship to flourish, and
6. To practice and promote high standards of professional ethics, transparency, and accountability

PROGRAM OUTCOMES (PO)

Students of all Integrated/PG degree Programmes at the time of graduation will be able to

PO1. **Science knowledge:** Knowledge of basic science fundamentals

PO2. **Problem analysis:** Develop analytical skills to identify, formulate, analyze complex mechanisms using first principles basic sciences.

PO3. **Development of solutions:** Design solutions for complex chemical process problems and evolve procedures that meet the specified needs with appropriate consideration for the public health and safety and environmental considerations.

PO4. **Critical review of solutions:** Use of research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern analytical tool usage:** Select, and apply appropriate techniques, resources, and modern analytical tools

PO6. **The scientist and society:** Apply reasoning through the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional chemical practice.

PO7. **Environment and sustainability:** Understand the impact of the chemical processes in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the chemistry practice.

PO9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex scientific activities with the science community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance:** Demonstrate knowledge and understanding of the scientific and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1: Students will demonstrate proficiency in mathematics and the mathematical concepts needed for a proper understanding of physics.

PSO2: Students will demonstrate knowledge of classical mechanics, electromagnetism, quantum mechanics, and thermal and statistical physics, and be able to apply this knowledge to analyze a variety of physical phenomena and related subjects.

PSO3: Students will acquire experimental skills which enable them to take precise measurements in labs and analyze the measurements to draw valid conclusions. In addition, students will exhibit skills in solving problems numerically using computer programming, plotting tools, and related software.

PSO4: Students will show enhanced oral and written scientific communication skills and be able to think critically and work independently as well as in a team and play beneficial role in the society as a person with better scientific outlook.

Integrated MSc Programme

PHYSICS

CURRICULUM

2018 admission onwards

SEMESTER I

Code No	Course Title	L T P	Cr
18ENG101	Communicative English	2 0 2	3
	Language I	1 0 2	2
18CHY103	Chemistry I	3 0 0	3
18CSA100	Problem Solving and Computer Programming	3 0 0	3
18MAT106	Trigonometry and Differential Equations	3 1 0	4
18PHY104	Mechanics and Properties of Matter	3 1 0	4
18CHY182	Chemistry Lab I	0 0 2	1
18CSA180	Problem Solving and Computer Programming Lab	0 0 2	1
18CUL101	Cultural Education I	2 0 0	2
TOTAL			23

SEMESTER II

Code No	Course Title	L T P	Cr
18ENG121	Professional Communication	1 0 2	2
	Language II	1 0 2	2
18CHY114	Chemistry II	3 0 0	3
18PHY113	Advanced Computer Programming Introduction to Python	3 0 0	3
18MAT119	Matrices and Vector Calculus	3 1 0	4
18PHY111	Basics of Electricity and Magnetism	3 1 0	4
18CHY183	Chemistry Lab II - Instrumental	0 0 2	1
18PHY185	Advanced Computer Programming / PythonLab	0 0 2	1
18PHY183	Physics Lab I - Mechanics and Properties of Matter	0 0 2	1
18CUL111	Cultural Education II	2 0 0	2
TOTAL			23

SEMESTER III

Code No	Course Title	L T P	Cr
18PHY201	Basic Experimental Techniques in Physics	3 1 0	4
18PHY203	Optics and Wave Motion	3 1 0	4
	Elective A	3 0 0	3
18PHY204	Analog Electronics	3 1 0	4
18PHY205	Introduction to Mathematical Physics	3 1 0	4
18PHY283	Physics Lab II –Heat, Electricity and Magnetism	0 0 2	1
18SSK201	Life Skills I	1 0 2	2
18AVP201	Amrita Value Programme I	1 0 0	1
TOTAL			23

SEMESTER IV

Code No	Course Title	L T P	Cr
18ENV300	Environmental Science and Sustainability	3 0 0	3
18PHY216	Digital Electronics	3 1 0	4
	Elective B	3 0 0	3
18PHY217	Introduction to computational Physics	3 1 0	4
18PHY284	Physics Lab III - Optics	0 0 2	1
18PHY218	Modern Physics	3 1 0	4
18SSK211	Life Skills II	1 0 2	2
18AVP211	Amrita Value Programme II	1 0 0	1
TOTAL			22

SEMESTER V

Code No	Course Title	L T P	Cr
18PHY306	Thermal Physics	3 1 0	4
18PHY307	Electrodynamics	3 1 0	4
18PHY308	Solid State Physics	3 1 0	4
18PHY390	Free/Open Elective* /Living Lab@	3 0 0	3
	Elective C	3 0 0	3
18PHY384	Physics Lab IV – Modern Physics	0 0 2	1
18SSK301	Life Skills III	1 0 2	2
TOTAL			21

SEMESTER VI

Code No	Course Title	L T P	Cr
18PHY318	Atomic and Molecular Physics	3 1 0	4
18PHY319	Intermediate Mechanics	3 1 0	4
18PHY320	Modern Optics	3 1 0	4
	Elective D	3 0 0	3
18PHY385	Physics Lab V – Electronics	0 0 2	1
TOTAL			16
18PHY399	Project (for Exit-option students)		6
	TOTAL (for Exit-option students)		22
	TOTAL		128
	For Exit option		134

SEMESTER VII

Code No	Course Title	L T P	Cr
18PHY501	Classical Mechanics	3 1 0	4
18PHY502	Quantum Mechanics I	3 1 0	4
18PHY503	Mathematical Physics I	3 1 0	4
18PHY504	Computational Physics	3 1 0	4
18PHY581	Advanced Physics Lab	0 0 6	2
18PHY582	Simulation Lab	0 0 3	1
18PHY591	Mini Project	0 0 3	1
TOTAL			20

SEMESTER VIII

Code No	Course Title	L T P	Cr
18PHY511	Quantum Mechanics II	3 1 0	4
18PHY512	Mathematical Physics II	3 1 0	4
18PHY513	Statistical Mechanics	3 1 0	4
18PHY514	Advanced Electrodynamics	3 1 0	4
18PHY515	Experimental Techniques	3 1 0	4
18PHY583	Advanced Electronics Lab	0 0 6	2
TOTAL			22

SEMESTER IX

Code No	Course Title	L T P	Cr
18PHY601	Atomic, Molecular and Optical Physics	3 1 0	4
18PHY602	Condensed Matter Physics	3 1 0	4
18PHY603	Nuclear and Particle Physics	3 1 0	4
	Elective I	3 0 0	3
	Elective II	3 0 0	3
18PHY681	Spectroscopy Lab	0 0 6	2
TOTAL			20

SEMESTER X

Code No	Course Title	L T P	Cr
18PHY696	Dissertation		18
18PHY697	Viva voce		2
TOTAL			20
	TOTAL for 5 YR Int. MSc		210

Electives – A, B, C, D

Course Code	Course Title	L T P	Cr
18PHY331	Medical Physics	3 0 0	3
18PHY333	Introduction to Nanophysics And Applications	3 0 0	3
18PHY335	Biophysics	3 0 0	3
18PHY337	Astronomy	3 0 0	3
18PHY338	Computational Methods for Physicists	3 0 0	3
18PHY339	Concepts of Nanophysics and Nanotechnology	3 0 0	3
18PHY340	Introduction to Photonics	3 0 0	3
18PHY342	Nonlinear Optics	3 0 0	3
18PHY343	Optical Engineering	3 0 0	3
18PHY344	Physics of Semiconductor Devices	3 0 0	3
18PHY345	Principles of Lasers and Laser Applications	3 0 0	3
18PHY346	Laser Theory	3 0 0	3
18PHY347	Laser Applications	3 0 0	3
18CHY331	Batteries and Fuel Cells	3 0 0	3
18CHY353	Forensic science	3 0 0	3
18CHY348	Electrochemistry	3 0 0	3
18CHY631	Applied Electrochemistry	3 0 0	3

ELECTIVES – I, II

Course Code	Course Title	L T P	Cr
18PHY632	Astrophysics	3 0 0	3
18PHY633	Biophotonics	3 0 0	3
18PHY634	Earth's Atmosphere	3 0 0	3
18PHY635	Earth's Structure and Evolution	3 0 0	3
18PHY636	Fibre-optic Sensors and Applications	3 0 0	3
18PHY637	Fibre Optics and Technology	3 0 0	3
18PHY638	Nanophotonics	3 0 0	3
18PHY639	Nonlinear Dynamics	3 0 0	3
18PHY640	Nuclear Physics	3 0 0	3
18PHY641	Optoelectronic Devices	3 0 0	3
18PHY642	Physics of Cold Atoms and Ions	3 0 0	3
18PHY643	Quantum Electrodynamics	3 0 0	3
18PHY644	Quantum Optics	3 0 0	3
18PHY645	Thin Film Technology	3 0 0	3
18PHY646	Fundamentals of Plasma Physics	3 0 0	3
18PHY336	Space Physics	3 0 0	3
18PHY648	Ultrafast lasers and Applications	3 0 0	3
18PHY649	Energy and Environment in the 21st century	3 0 0	3
18PHY650	Introduction to solar physics	3 0 0	3
18PHY651	Micro and Nano Magnetism Materials and its Applications	3 0 0	3
18PHY652	X-ray Diffraction and its Applications	3 0 0	3
18PHY653	Solar energy conversion	3 0 0	3
18PHY654	Fabrication of Advanced Solar cell	3 0 0	3
18PHY655	Astrophysics and Cosmology	3 0 0	3
18PHY656	Special Theory of Relativity	3 0 0	3

Open Electives

Course Code	Course Title	L T P	Cr
18OEL231	Advertising	3 0 0	3
18OEL232	Basic Statistics	3 0 0	3
18OEL233	Citizen Journalism	3 0 0	3
18OEL234	Creative Writing for Beginners	3 0 0	3
18OEL235	Desktop Support and Services	3 0 0	3
18OEL236	Development Journalism	3 0 0	3
18OEL237	Digital Photography	3 0 0	3
18OEL238	Emotional Intelligence	3 0 0	3
18OEL239	Essence of Spiritual Literature	3 0 0	3
18OEL240	Film Theory	3 0 0	3
18OEL241	Fundamentals of Network Administration	3 0 0	3
18OEL242	Gender Studies	3 0 0	3
18OEL243	Glimpses of Indian Economy and Polity	3 0 0	3
18OEL244	Graphics and Web-designing Tools	3 0 0	3
18OEL245	Green Marketing	3 0 0	3
18OEL246	Healthcare and Technology	3 0 0	3
18OEL247	History of English Literature	3 0 0	3
18OEL248	Indian Writing in English	3 0 0	3
18OEL249	Industrial Relations and Labour Welfare	3 0 0	3
18OEL250	Introduction to Ancient Indian Yogic and Vedic Wisdom	3 0 0	3
18OEL251	Introduction to Computer Hardware	3 0 0	3
18OEL252	Introduction to Event Management	3 0 0	3
18OEL253	Introduction to Media	3 0 0	3
18OEL254	Introduction to Right to Information Act	3 0 0	3
18OEL255	Introduction to Translation	3 0 0	3
18OEL256	Linguistic Abilities	3 0 0	3
18OEL257	Literary Criticism and Theory	3 0 0	3
18OEL258	Macro Economics	3 0 0	3
18OEL259	Managing Failure	3 0 0	3
18OEL260	Media Management	3 0 0	3
18OEL261	Micro Economics	3 0 0	3
18OEL262	Micro Finance, Small Group Management and Cooperatives	3 0 0	3
18OEL263	Negotiation and Counselling	3 0 0	3
18OEL264	New Literatures	3 0 0	3
18OEL265	Non-Profit Organisation	3 0 0	3
18OEL266	Personal Effectiveness	3 0 0	3
18OEL267	Perspectives in Astrophysics and Cosmology	3 0 0	3
18OEL268	Principles of Marketing	3 0 0	3
18OEL269	Principles of Public Relations	3 0 0	3
18OEL270	Science, Society and Culture	3 0 0	3
18OEL271	Statistical Analysis	3 0 0	3
18OEL272	Teamwork and Collaboration	3 0 0	3
18OEL273	The Message of Bhagwad Gita	3 0 0	3
18OEL274	Understanding Travel and Tourism	3 0 0	3
18OEL275	Videography	3 0 0	3
18OEL276	Vistas of English Literature	3 0 0	3

18OEL277	Web-Designing Techniques	3 0 0	3
18OEL278	Organic Farming	3 0 0	3
18OEL279	Basic Legal Awareness on Protection of Women and Rights	3 0 0	3
18OEL280	Ritual Performances of Kerala	3 0 0	3
18OEL281	Documenting Social Issues	3 0 0	3
18OEL282	Fabrication of Advanced Solar Cell	3 0 0	3
18OEL283	Basic Concepts of X-ray Diffraction	3 0 0	3
18OEL284	Introduction to FORTRAN and GNUPLOT	3 0 0	3
18OEL285	Introduction to Porous Materials	3 0 0	3
18OEL286	Forensic Science	3 0 0	3
18OEL287	Introduction to solar Physics	3 0 0	3
18OEL288	Recycling Recovery and Treatment Methods for Wastes	3 0 0	3
18OEL289	Acting and Dramatic Presentation	2 0 2	3
18OEL290	Computerised Accounting	2 0 2	3
18OEL291	Kerala Mural Art and Painting	2 0 2	3
18OEL292	Painting	2 0 2	3
18OEL293	Reporting Rural Issues	3 0 0	3

LANGUAGES

Paper I

Course Code	Course Title	L T P	Cr	ES
18HIN101	Hindi I	1 0 2	2	B
18KAN101	Kannada I	1 0 2	2	B
18MAL101	Malayalam I	1 0 2	2	B
18SAN101	Sanskrit I	1 0 2	2	B
18TAM101	Tamil I	1 0 2	2	B

Paper II

Course Code	Course Title	L T P	Cr	ES
18HIN111	Hindi II	1 0 2	2	B
18KAN111	Kannada II	1 0 2	2	B
18MAL111	Malayalam II	1 0 2	2	B
18SAN111	Sanskrit II	1 0 2	2	B
18TAM111	Tamil II	1 0 2	2	B

* **Two Open Elective** courses are to be taken by each student, one each at the **4th and the 5th** semesters, from the list of Open electives offered by the School.

@ Students undertaking and registering for a Live-in-Lab project, can be exempted from registering for an Open Elective course in the fifth semester.

Evaluation Pattern

50:50 (Internal: External) (All Theory Courses)

Assessment	Internal	External
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

80:20 (Internal: External) (Lab courses and Lab based Courses having 1 Theory hour)

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

70:30(Internal: External) (Lab based courses having 2 Theory hours/ Theory and Tutorial)

Theory- 60 Marks; Lab- 40 Marks

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	10	
Continuous Assessment (Lab) (CAL)	40	
End Semester		30

65:35 (Internal: External) (Lab based courses having 3 Theory hours/ Theory and Tutorial)

Theory- 70 Marks; Lab- 30 Marks

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports

Letter Grade	Grade Point	Grade Description
O	10.00	Outstanding
A+	9.50	Excellent
A	9.00	Very Good
B+	8.00	Good
B	7.00	Above Average
C	6.00	Average
P	5.00	Pass
F	0.00	Fail

Grades O to P indicate successful completion of the course

$$CGPA = \frac{\sum (C_i \times Gr_i)}{\sum C_i}$$

Where

C_i = Credit for the i^{th} course in any semester

Gr_i = Grade point for the i^{th} course

Cr. = Credits for the Course

Gr. = Grade Obtained

Integrated MSc Programme

PHYSICS

SYLLABI

2018 admission onwards

Objectives:

To help students obtain an ability to communicate fluently in English; to enable and enhance the students skills in reading, writing, listening and speaking; to impart an aesthetic sense and enhance creativity

Course Contents:**Unit I**

Kinds of sentences, usage of preposition, use of adjectives, adverbs for description, Tenses, Determiners- Agreement (Subject – Verb, Pronoun- Antecedent) collocation, Phrasal Verbs, Modifiers, Linkers/ Discourse Markers, Question Tags

Unit II

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

Unit III

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 IV

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

Unit V

Prose: John Halt's 'Three Kinds of Discipline' [**Detailed**]

Max Beerbohm's 'The Golden Drugget' [**Detailed**]

Poems: Ogden Nash- 'This is Going to Hurt Just a Little Bit' [**Detailed**]

Robert Kroetsch- 'I am Getting Old Now', Langston Hughes- 'I, Too' [**Detailed**]

Wole Soyinka- 'Telephone Conversation' [**Non-Detailed**]

Kamala Das- 'The Dance of the Eunuchs' [**Non-Detailed**]

Short Stories: Edgar Allan Poe's 'The Black Cat', Ruskin Bond's 'The Time Stops at Shamili' [**Non-Detailed**]

Outcomes:

CO1: Demonstrate competency in all the four linguistic skills, viz. listening, speaking, reading and writing

CO2: Apply different styles of communication in professional context

CO3: Participate in different planned & extempore communicative activities

CO4: Interpret and discuss facts and information in a given context

CO5: Develop an appreciation for human values

CORE READING:

1. *Ruskin Bond, Time Stops at Shamli and Other Stories, Penguin Books India Pvt Ltd, 1989*
2. *Syamala, V. Speak English in Four Easy Steps, Improve English Foundation Trivandrum: 2006*
3. *Beerbohm, Max, The Prince of Minor Writers: The Selected Essays of Max Beerbohm (NYRB Classics), Phillip Lopate (Introduction, Editor), The New York Review of Book Publishers.*
4. *Edger Allan Poe. The Selected Works of Edger Allan Poe. A Running Press, 2014.*
5. *Online sources*

References:

1. *Ruskin Bond, Time Stops at Shamli and Other Stories, Penguin Books India Pvt Ltd, 1989*
2. *Martinet, Thomson, A Practical English Grammar, IV Ed. OUP, 1986.*
3. *Murphy, Raymond, Murphy's English Grammar, CUP, 2004*
4. *Online Sources*

18CHY103

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, coordinate 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's 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-Einstein law, Beer-Lamberts law, quantum efficiency-determination, photochemical processes - Jablonsky diagram, internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo sensitization, photopolymerization.

Course Outcomes:

The student at the end of the course will

CO 1	Understand the fundamental concepts of chemistry to predict the structure and properties of engineering materials
CO 2	Develop analytical skills to evaluate the cause, feasibility and course of chemical reactions
CO 3	Design and apply the idea of cutting edge area of chemistry to solve basic science related problems

CO- PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	1	1	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-

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

18CSA100 PROBLEM SOLVING AND COMPUTER PROGRAMMING 3 0 0 3

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

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.

Course Outcomes:

CO	Description
CO1	Understand the structured programming constructs: Data types, Control, selection, recursion thereby to understand a given program.
CO2	Understand and analyze a given program by tracing, identify coding errors and debug them.
CO3	Apply structured programming constructs and modularity appropriately for given problem Scenarios.
CO4	Develop Computer programs that implement suitable algorithms for problem scenarios and application performance.
CO5	Understand the efficient way of storing and retrieving data.

TEXTBOOK:

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

REFERENCE:

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

18MAT106 TRIGNOMETRY AND DIFFERENTIAL EQUATIONS 3 1 0 4

Unit 1

Trigonometry: (Mathematics for Degree students, P.K.Mittal) Expansions of $\sin n\theta$, $\cos\theta$, $\tan n\theta$ in powers of $\sin\theta$, $\cos\theta$, $\tan\theta$. Expansion of $\text{Sinn}\theta$, $\text{Cosn}\theta$, $\text{Sinm}\theta$, $\text{Cosm}\theta$ in terms of Sines and Cosines of Multiplies of θ – Power series for $\sin\theta$, $\cos\theta$, $\tan\theta$ - 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.

Outcomes:

- CO1: Understand the basic trigonometric ratios, hyperbolic and inverse trigonometric and inverse hyperbolic functions
- CO2: Understand the concept of differentiability and its applications to find maxima and minima and curve sketching using first and second derivatives
- CO3: Understand the basic concepts of ODE, apply them in modeling and solving first order equations.
- CO4: Recall the techniques of solving second order linear homogeneous ODE with constant coefficients. Understand and modify the above techniques for solving Euler-Cauchy equations. Understand and apply methods of undetermined coefficients and variation of parameters to solve the second order linear nonhomogeneous differential equations
- CO5: Understand the concept of particular solutions and obtain them by using boundary conditions

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.

18PHY104

Mechanics & Properties of Matter

3 1 0 4

UNIT 1

Physical quantities, dimensional analysis, significant figures. Vectors - basics, derivatives, elementary operations, angles, expansion in series, spherical polar and cylindrical coordinates, vector identities.

UNIT 2

Instantaneous velocity and acceleration. One dimensional Kinematics. Kinematics in 2D: Projectile Motion, Circular Motion. Galilean Relativity: Relative velocity and acceleration.

UNIT 3

Newton's Laws of Motion Forces, Frictional Forces, Dynamics of uniform circular motion. Work, Kinetic Energy, Work-Energy Theorem, Potential Energy, Conservation of Energy Newton's law of gravitation, Motion in uniform gravitational field.

UNIT 4

Centre of Mass, Conservation of linear momentum, collisions, systems with variable mass. Torque, Angular momentum, Moment of Inertia, Conservation of Angular momentum, Kinetic Energy of Rotation.

UNIT 5

Stress, Strain, Hooke's law Elastic properties of matter. Kinematics of moving fluids, Equation of continuity, Euler's equation, Bernoulli's theorem, Viscous fluids, Reynold's number, Surface tension, Surface energy.

Course Outcomes

- CO1. To apply dimensional analysis and vector approach in solving problems.
- CO2. Understand and analyze two and three dimensional translational motion problems including conservation laws.
- CO3. Analyze rotational motions and apply it to rotational dynamics including rotational inertia.
- CO4. Understand and apply the universal law of gravitation to solve problems.
- CO5. Apply Hooke's laws and get elastic constants and apply law of buoyancy, Archimedes principle, Bernoulli's theorem in problem solving in fluids in motion

Text Books:

1. David Halliday, Robert Resnick & Jearl Walker, Fundamentals of Physics, John Wiley, 9E, 2012

Reference Books:

1. Kittel et al, Mechanics, Berkeley Physics Course Vol-1, Tata McGraw Hill, 2011
2. R.P. Feynman, R. P. Leighton and M. Sands, Feynman Lectures on Physics Vol.1, Narosa, 2003
3. F. W. Sears, M. W. Zemansky and H. D. Young, University Physics, Narosa, 2011
4. D. S. Mathur, Elements of Properties of Matter, S. Chand, 2010

18CHY182

CHEMISTRY LAB I.

0 0 2 1

Course Objective

The objective of the laboratory sessions is to enable the learners to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.

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.

Course Outcomes:

The student at the end of the course will:

CO1	Develop analytical skills for the determination of water quality parameter
CO2	Understand the electrochemical principles of conductance and electrode potentials and its application in analytical science
CO3	Develop analytical skills in the determination of rates of chemical reactions and its application
CO4	Learn the basics of redox reaction and applying it for quantitative determination.
CO5	Create skills to convert basic chemical reactions to analytical application.

CO-PO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	2	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-			-	-	-	-	-	-	-	-	-
CO4	2	-	-	-		1	1	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

18CSA180

**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.

Course Outcomes:

CO	Description
CO1	To understand the operating System Environment.
CO2	Develop computer programs for a given problem Scenario using imperative constructs.
CO3	Develop computer programs handling different data types.
CO4	Develop Modular Solutions for a given Scenario.

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.

Outcomes:

- CO1: Gain a positive appreciation of Indian culture, traditions, customs and practices
- CO2: Understand the foundational concepts of Indian civilization like purusharthas, law of karma, etc, which contributes towards personality growth.
- CO3: Understand the cultural ethos of Amrita Vishwa Vidyapeetham, and Amma's life and vision of holistic education
- CO4: Imbibe spirit of living in harmony with nature
- CO5: Get guidelines for healthy and happy living from the great spiritual masters

TEXTBOOKS:

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

Objectives:

To convey and document information in a formal environment; to acquire the skill of self projection in professional circles; to inculcate critical and analytical thinking.

Unit I

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

Unit II

Instruction, Suggestion & Recommendation - Sounds of English: Stress, Intonation

- Essay writing: Analytical and Argumentative

Unit III

Circulars, Memos – Business Letters - e - mails

Unit IV

Reports: Trip report, incident report, event report - Situational Dialogue - Group Discussion

Unit V

Listening and Reading Practice - Book Review

Outcomes:

CO1: Demonstrate competency in oral and written communication

CO2: Apply different styles of communication in professional context

CO3: Participate in different planned & extempore communicative activities

CO4: Interpret and discuss facts and information in a given context

CO5: Develop critical and analytical thinking

References

1. *FelixaEskey. 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 Mc Graw Hill Pub. Co. New Delhi. 2005. Tenth Edition.*
5. *Thampi, G. Balamohan. Meeting the World: Writings on Contemporary Issues. Pearson, 2013.*
6. *Lynch, Tony. Study Listening. New Delhi: CUP, 2008.*
7. *Kenneth, Anderson, Tony Lynch, Joan Mac Lean. Study Speaking. New Delhi: CUP, 2008.*
8. *Marks, Jonathan. English Pronunciation in Use. New Delhi: CUP, 2007.*
9. *Syamala, V. Effective English Communication For You (Functional Grammar, Oral and Written Communication): Emerald, 2002.*

18CHY114

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 K_p and K_c -Temperature dependence – The van't Hoff's equation – Pressure dependence of the equilibrium constant K_p and K_c – 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 SO_2 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.

Outcomes:

CO1: To get profound knowledge on chemical and ionic equilibria including problem-solving

CO2: To understand the fundamentals of organic chemistry

CO3: To develop proficiency in theory behind basic chemical analytical techniques

CO4: To learn the theory of the properties of different types of solutions

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.

Prerequisites

The students should have studied any basic computer language as a prerequisite for the course.

Objective of the course

In this course students are introduced to use Python as a tool to solve Physics problems. The emphasis is to learn using a high level programming language without actually going through the logic behind the equations that are to be coded. A minimal understanding of the basic mathematics is assumed. This develops familiarity and equips them to code a large number of physics problems and learn how to obtain results and plots using the software.

Unit –I:

Computing Software Basics

Programming Warm-up, Structured and Reproducible Program Design, Shells, Editors, and Execution, Python I/O, Computer Number Representations, Floating-Point Numbers, Overflow and Underflow Exercises, Machine Precision, Summing Series, Numerical Summation implementation and Assessment.

Errors and Uncertainties in Computations: Types of Errors , Model for Disaster: Subtractive Cancellation, Subtractive Cancellation Exercises, Round-off Errors, Round-off Error Accumulation, Error in Bessel Functions, Numerical Recursion, Implementation and Assessment: Recursion Relations, Experimental Error Investigation, Error Assessment.

Unit-II:

Differentiation and Integration

Differentiation: Forward Difference (Algorithm), Central Difference (Algorithm), Extrapolated Difference (Algorithm), Error Assessment, Second Derivatives (Problem), Second-Derivative Assessment.

Integration: Quadrature as Box Counting , Algorithm: Trapezoid Rule, Algorithm: Simpson's Rule, Integration Error (Assessment), Algorithm: Gaussian Quadrature, Mapping Integration Points, Gaussian Points Derivation, Integration Error Assessment, Higher Order Rules (Algorithm), Monte Carlo Integration by Stone Throwing, Stone Throwing implementation, Mean Value Integration, Integration Exercises, Multidimensional Monte Carlo Integration, Multi Dimension Integration Error Assessment, Integrating Rapidly Varying Functions. Variance Reduction.

Unit- III:

Matrix Computing

N-D Newton-Raphson; Two Masses on a String, Theory: Statics, Algorithm: Multidimensional Searching, Classes of Matrix Problems, Practical Matrix Computing, Python Lists as Arrays, Numerical Python (NumPy) Arrays, NumPy's linalg Package, Exercise: Testing Matrix Programs, Matrix Solution of the String Problem, Explorations

Unit – IV:

Trial-and-Error Searching and Data Fitting

Algorithm: Trial-and-Error Roots via Bisection, Implementation: Bisection Algorithm, Improved Algorithm: Newton–Raphson Searching, Newton–Raphson with Backtracking, Implementation: Newton–Raphson Algorithm.

Exercises: Temperature Dependence of Magnetization, Fitting An Experimental Spectrum, Lagrange Implementation, Cubic Spline Interpolation, Fitting Exponential Decay, Least-Squares Fitting, Fitting Exponential Decay, Heat Flow and Hubble’s Law, Linear Quadratic Fit.

Unit- V:

Solving Differential Equations: Nonlinear Oscillations

Free Nonlinear Oscillations, Nonlinear Oscillators (Models), Types of Differential Equations, Dynamic Form for ODEs, ODE Algorithms, Euler’s Rule, Runge–Kutta Rule, Adams–Bashforth–Moulton Predictor–Corrector Rule, Assessment: rk2 vs. rk4 vs. rk, Solution for Nonlinear Oscillations, Precision Assessment: Energy Conservation,, Extensions: Nonlinear Resonances, Beats, Friction, Time-Dependent Forces.

ODE Applications: Eigenvalues, Scattering, and Projectiles

Problem: Balls Falling Out of the Sky, Theory: Projectile Motion with Drag, Simultaneous Second-Order ODEs, Assessment, Exercises: 2- and 3-Body Planet Orbits and Chaotic Weather.

Course Outcomes:

At the end of the course students will be able to:

CO1 :Master the fundamentals of writing Python scripts.

CO2 :Use basic mathematical methods in Python to solve physics problems

CO3 :Write Python functions to facilitate code reuse.

CO4 :Discover how to work with lists and sequence data.

CO5 :Use python libraries like Numpy,Scipyetc to mathematically evaluate physical systems

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	2		2	3								1		3	
CO2	3	2		2	3								1		3	
CO3				2	3								1		3	
CO4				2	3								1		3	
CO5				3	3								1		3	

Text Book

1. Rubin H. Landu, Manuel J. Paez, and cristian C.Bordeianu, “Computational Physics Problem solving with Python” - Third Edition, Wiley VCH, 2015.

Reference Books

1. Ashok Namdev Kamthene and Amit Ashok Kamthene, “Programming and problem solving with Python” Mc Graw Hill Education, 2017.

2. Balagurusamy E, "Introduction to computing and Problem solving using Python" Mc Graw Hill Education, 2017.

18MAT119

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 irrotational functions – physical interpretation of divergence and curl of a vector point function.

Unit 5

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

Outcomes:

- CO1: Understand the basic concepts of matrices, classification and determinants and its properties
- CO2: Understand the concept of solutions to system of linear equations and their solutions by using matrices
- CO3: Understand the notion of eigenvalues and eigenvectors, analyze the possibility of diagonalization and hence compute a diagonal matrix, if possible. Apply the knowledge of diagonalization to transform the given quadratic form into the principal axes form and analyze the given conic section.
- CO4: Understand the vector functions, scalar and vector fields. Understand the derivatives of vector functions and its physical and geometrical interpretations. Understand the concept of gradient, divergence and curl and apply.
- CO5: Understand the concept of line integrals surface and volume integrals and related theorems for evaluations

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.

18PHY111

Basics of Electricity and Magnetism

3 1 0 4

Course Objective:

Having successfully completed this module, the student will be able to demonstrate knowledge and understanding of: Vector algebra and vector calculus from the perspective of electrodynamics, Coulomb's law, Superposition principle concept of electric field, Potential formalism and its importance, Working of capacitors and RC circuits, Magnetic fields and their origin, Ohm's law, Faraday's law, Lenz's law and working of LC, LR, LCR circuits.

Unit 1:

Vector analysis

[16 hrs]

Review of vectors, Dot products, Cross products, and Triple products. Differential calculus: Gradient, Divergence, Curl, Second derivatives, Integral calculus: Fundamental theorem of calculus, Fundamental theorem of gradient, Fundamental theorem of divergence, Fundamental theorem of curls, Curvilinear coordinates: Spherical coordinates, Cylindrical coordinates. Dirac delta function.

Unit 2:

Electrostatics

[10 hrs]

Coulomb's law. Superposition principle. Electric field – discrete and continuous distribution, Gauss's law, Applications of Gauss's law.

Unit 3:

Potential

[12 hrs]

The curl of electric field, Electric potential, meaning of electric potential, Equipotential surfaces, Potential of localized charge distribution, Work and energy in electrostatics, Energy of a point charge distribution, Energy of continuous charge distribution, Conductors and Capacitors, Charging and discharging of RC Circuit.

Unit 4:

Magnetostatics

[10 hrs]

Magnetic fields, Magnetic forces, Currents, Biot-Savart law, Ampere's law.

Unit 5:

Electrodynamics

[12 hrs]

Ohm's law, EMF, Motional EMF. Electromagnetic induction: Faraday's law, Lenz's law, induced electric field, Examples of LC, LR, LCR circuits.

18PHY185 ADVANCED COMPUTER PROGRAMMING - PYTHON LAB 0 0 2 1

1. Program to find Area of a circle
2. Solving Monte–Carlo integration via von Neumann rejection.
3. To produces an animation of a cooling bar
4. Determines spherical Bessel functions by downward recursion method
5. Calls the random-number generator from the random package
6. Spontaneous decay simulation
7. Trapezoid integration, $a < x < b$, N pts , N–1 intervals
8. Gaussian quadrature generator of pts.& wts.
9. Monte–Carlo integration via. stone throwing
10. Multi Dimension Newton Search
11. Find zero via Bisection algorithm
12. Linear least–squares fit; e.g. of matrix computation arrays
13. Program for 4th order Runge Kutta method
14. Adams BM method to integrate ODE
15. Numerical solution for projectile with drag

Course Outcomes

At the end of the course students will be able to:

- CO1. Master the fundamentals of writing Python scripts.
- CO2. Use basic mathematical methods in Python to solve physical problems
- CO3. Write Python functions to facilitate code reuse.
- CO4. Discover how to work with lists and sequence data.
- CO5. Use python libraries like Numpy, Scipy etc. to mathematically evaluate physical systems

18PHY183 Physics Lab. I - Mechanics & 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.

Course Outcomes:

At the end of the course students will be

- CO1. Able to apply the knowledge gained from mechanics course which they had studied.
- CO2. Able to analyze and understand the fundamental concepts of mechanics and properties of matter by performing experiments

CO3. Able to interpret the data and perform error analysis

18CUL111

CULTURAL EDUCATION II

2002

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

Outcomes:

- CO1: Get an overview of India and her contribution to the world in the field of science and literature
- CO2: Understand the foundational concepts of ancient Indian education system and practices associated with them
- CO3: Learn the important concepts of Vedas, Bhagavad-Gita and Yogasutras and their relevance to daily life
- CO4: Familiarize themselves with the inspirational characters and anecdotes from the epics and Indian history
- CO5: Gain a rational understanding of the underlying principles of Indian spirituality

TEXTBOOKS:

1. *Common Resource Material II (in-house publication)*
2. *Sanatana Dharma - The Eternal Truth (A compilation of Amma's teachings on Indian Culture)*

Expected Outcomes:

- (a) Student should be capable of calculating errors in measurements
- (b) Understand error propagation
- (c) Plot a scatter graph, preferably of simple linear systems and fit a linear line and calculate the errors in the constants; Estimate the goodness of fits
- (d) Understand basic electronics instrumentation- pick out signal from noise, description of noise, optimising and signal averaging
- (e) Understand pressure and temperature measurements, vacuum science and techniques

Unit I:**Error analysis**

Introductory probability – Random experiment, discrete random variable, continuous random variable, probability distributions, Definition of mean, median, mode, standard deviation and standard error. Definition of Errors: Random error and systematic error, Uncertainties, precision and accuracy, reporting errors (error bars), Error Propagation.

18 hrs

Unit II:**Data analysis**

Curve fitting, Linear regression analysis, goodness of fits (χ^2 test), correlation analysis (R^2) – with relevance to simple physics experiments.

12 hrs

Unit III:**Extraction of signal from noise**

Signal to noise ratio, Types of noise, Addition of noisy waveforms and optimising of S/N ratio, signal averaging, waveform recovery.

12 hrs

Unit IV:**Vacuum physics**

Definition of pressure - Kinetic theory of gases, average velocity, mean free path, impingement rate, creation of vacuum using different pumps

6 hrs

Unit V:**Measurement of pressure and temperature**

Pressure gauges – All direct and indirect gauges, Temperature measurement – Thermocouples (basic principle and construction), creation of low temperature.

12 hrs

Course Outcomes

At the end of the course students should be able to
CO1. Calculate errors in measurements

- CO2. Understand error propagation
- CO3. Plot a scatter graph, preferably of simple linear systems and fit a linear line and
Calculate the errors in the constants; Estimate the goodness of fits
- CO4. Understand basic electronics instrumentation- pick out signal from noise, description of
noise, optimizing and signal averaging
- CO5. Understand pressure and temperature measurements, vacuum science and techniques

Text / Reference Books

1. Philip Bevington, D. Keith Robinson, Data Reduction and Error Analysis for the physical sciences, 3rd Ed., McGraw-Hill Education, 2002.
2. John. R Taylor, An introduction to error analysis: The study of uncertainties in physical measurements, University Science Books, 1997
3. Paul Horowitz , Winfield Hill, The Art of Electronics, 2nd Ed., Cambridge University Press, 1989.
4. Milton Ohring, Materials Science of Thin Films, 2nd Ed., Academic Press, 2001.
5. John H. Moore, Christopher C. David, and Michael A. Coplan, Building Scientific Apparatus, 4th Ed., Cambridge University Press, 2017.

18PHY203

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, Matrix methods in optics, determining Cardinal points, Microscopes, Telescopes- reflecting type

UNIT 2

Wave Motion:

One dimensional wave equation, Differential wave equation, Simple Harmonic motion (SHM), superposition 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:

Fraunhofer 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.

Course Outcomes:

After completion of the course, students will have knowledge and skills to:

- CO 1. Understand the concepts of reflection, refraction, image formation with mirrors, spherical refracting surfaces, lens systems and aberrations using ray theory of light and describe the working of optical instruments.
- CO 2. Understand the Simple Harmonic Motion (SHM) and explain the nature of wave motion, superposition of waves and working real systems.
- CO 3. Comprehend wave theory of light and phenomena such as interference, diffraction and polarization, birefringence in terms of wave model.
- CO 4. Describe the operation of optical devices, including, polarizers, retarders, modulators and interferometers.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO 1	3	3	3	3	3				2	1			3	3		2
CO 2	3	3	3	3	3				2	1			3	3		2
CO 3	3	3	3	3	3				2	1			3	3		2
CO 4	3	3	3	3	3				2	1			3	3		2

Text books

1. David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics, 10th Ed., John Wiley, 2013.
2. A.K. Ghatak, Introduction to Modern optics, 5th Ed., Tata McGraw Hill, 1977.
3. Hecht, Optics, 4th Ed., Pearson Education, 2008.

Reference books

1. Bahaa E. A. Saleh, Fundamentals of photonics, 2nd Ed., Wiley Interscience, 2007.

2. Richard P. Feynman, Robert. P. Leighton and Matthew Sands, Feynmann Lectures on Physics Vol.1, Narosa Publishing House, 2008.
3. Grant R. 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, 2011.

18PHY204

Analog Electronics

3 1 0 4

UNIT 1

Network Analysis:

Basic circuit analysis methods: star-delta - transformation, nodal, mesh and modified nodal-analysis. Transient analysis of RL, RC and RLC circuits.

Network Theorems:

Superposition theorem, Thevenin-Norton theorem, maxpower-transfer theorem,

(12Hr)

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.

(10Hr)

UNIT 3

Transistor – Basics of 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. 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 runaway,

(15Hr)

UNIT 4

BJT small signal analysis: Common emitter fixed bias configuration, Voltage divider bias.

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

(10Hr)

UNIT 5

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, Instrumentation amplifiers, Active filters. **555**- Timers fundamentals and applications.

(13 Hr)

Course Outcomes

At the end of the course students will be able to:

- CO1. Analyze DC circuits using circuit theory and its applications
- CO2. Analyze and construct diode based DC and AC circuits
- CO3. Analyze and construct the DC biased BJT transistor circuit
- CO4. Analyze the AC parameters of BJT amplifier circuits under small AC signal mode
- CO5. The analysis of complete DC based Operational amplifier circuit.

Text Books

1. Charles K. Alexander, Matthew N. O. Sadiku. Fundamentals of electric Circuits, 5th Ed., McGraw Hill, 2013.
2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, 11th Ed., Pearson Education India, 2015.
3. Adel S. Sedra, Kenneth C. Smith, Microelectronic circuits Theory and Applications, 6th Ed., Oxford Press, 2013.

Reference Books

1. Albert Malvino, David J Bates, Electronic Principles, 7th Edition, McGraw Hill, 2017.
2. John D. Ryder, Electronic Fundamentals and Applications, 5th Ed., Prentice Hall of India Pvt. Ltd. New Delhi, 2009.
3. Horowitz and Hill, The art of Electronics, 3rd Ed., Cambridge University press, 2015.

18PHY205

Introduction to Mathematical Physics

3 1 0 4

Unit –I

Fourier analysis:

(10Hrs)

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 –II

(10 Hrs)

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

Unit –III

Laplace Transforms:

(10 Hrs)

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

Unit –IV

(10 Hrs)

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

Unit –V

Partial Differential Equations:

(20Hrs)

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.

Course Outcomes:

At the end of the course Students will be able to:

CO1. Develop real and complex Fourier series methods to synthesize a required function

CO2. Understand 1D Fourier transforms and how to solve problems using them.

CO3. Understand how to do the Laplace transform and solve problems using them.

CO4. Apply the mathematical tools of Fourier series, Fourier transforms and Laplace transforms to solve linear ordinary and partial differential equations.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 01	PSO 02	PSO 03
CO1		2		3	2								3		2
CO2				3	2								3		2
CO3				3	2								3		
CO4		2		2	3								3		2

Text Books:

1. E Kreyszig, Advanced Engineering Mathematics, 10th Ed., John Wiley and Sons, 2015.
2. P. P. G. Dyke, An Introduction to Laplace Transforms and Fourier series, 2nd Ed., Springer, 2014.
3. Larry C. Andrews and Bhimson, K. Shivamoggi, The Integral Transforms for Engineers, Prentice Hall India Learning Private Limited, 2003.

18PHY283

Physics Lab. II – Heat, Electricity and Magnetism

0 0 2 1

1. Thermal conductivity of a bad conductor – Lee’s disc method
2. Spherical calorimeter – specific heat capacity
3. Thermal conductivity of good conductor – Forbe’s method
4. Studying the variation of total thermal radiation with temperature.

5. Verification of Joule's Law of Heating.
6. Potentiometer calibration, potential drop Calibration of Ammeter and volt meter
7. Calibration of thermocouple using potentiometer
8. Specific resistance carry forester bridge
9. Studying the field along the axis of the coil
10. Mapping of electric field.
11. Studying of Mutual inductance
12. Deducing the magnetic properties of a sample from its Hysteresis curve on CRO
13. Studying the charging and discharging and Energy dissipation of capacitor in RC circuits.
14. Studying the amplitude response and phase relation of V_R , V_C and V_L in LCR series resonance circuit.

Course Outcomes

On completion of the course students should be able to

CO1. Map Electric and Magnetic fields

CO2. Independently carry out simple electrical, heat experiments and analyze the data.

CO3. Comprehend the corresponding topics in theory course through the experiments performed.

18SSK201

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: A 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.*

18AVP201 /	Amrita Values Programme I /	1 0 0 1
18AVP211	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 Smriti - 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, SatyakamaJabala, 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 Paramahansa, 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 'Unity 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.

Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirties, and demons of the theatrical world, Identical myths are popular the birth of Rama, the story of Bhīma and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and ganga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the Vasthupurusha.

Organic Farming in Practice

Organic agriculture is the application of a set of cultural, biological, and mechanical practices that support the cycling of farm resources, promote ecological balance, and conserve biodiversity. These include maintaining and enhancing soil and water quality; conserving wetlands, woodlands, and wildlife; and avoiding use of synthetic fertilizers, sewage sludge, irradiation, and genetic engineering. This factsheet provides an overview of some common farming practices that ensure organic integrity and operation sustainability.

Ayurveda for Lifestyle Modification:

Ayurveda aims to integrate and balance the body, mind, and spirit which will ultimately leads to human happiness and health. Ayurveda offers methods for finding out early stages of diseases that are still undetectable by modern medical investigation. Ayurveda understands that health is a reflection of when a person is living in harmony with nature and disease arises when a person is out of harmony with the cycles of nature. All things in the universe (both living and nonliving) are joined together in Ayurveda. This leaflet endow with some practical knowledge to rediscover our pre- industrial herbal heritage.

Life Style and Therapy using Yoga

Yoga therapy is the adaptation of yogic principles, methods, and techniques to specific human ailments. In its ideal application, Yoga therapy is preventive in nature, as is Yoga itself, but it is also restorative in many instances, palliative in others, and curative in many others. The therapeutic effect comes to force when we practice daily and the body starts removing toxins and the rest is done by nature.

Insights into Indian Classical Music

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala,- Saptatalas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Sixs limbs of Indian paintings) and the contextual stories from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriya, Rajput, Tanjore etc.

Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the AbhinavaBharati. The course introduces various styles of Indian classical dance such as Bharatanatyan, Mohiniyatton, Kuchipudi, Odissy, Katak etc. The course takes the students through both contextual theory as well as practice time.

Indian Martial Arts and Self Defense

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala's traditional KalariPayattu. The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

Social Awareness Campaign

The course introduces the students into the concept of public social awareness and how to transmit the messages of social awareness through various media, both traditional and modern. The course goes through the theoretical aspects of campaign planning and execution.

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combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

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Yoga therapy is the adaptation of yogic principles, methods, and techniques to specific human ailments. In its ideal application, Yoga therapy is preventive in nature, as is Yoga itself, but it is also restorative in many instances, palliative in others, and curative in many others. The therapeutic effect comes to force when we practice daily and the body starts removing toxins and the rest is done by nature.

Outcomes:

- CO1: Understanding the impact of itihasas on Indian civilization with reference to Mahabharata
- CO2: Enabling students to appreciate the relevance of Mahabharata and Bhagavad-Gita in the modern world.
- CO3: Understanding the four goals of life (Purusharthas) as presented in the Mahabharata
- CO4: Assimilating the positive qualities of the characters depicted in the itihasa.
- CO5: Analysis of the critical events and turning points in the Mahabharata with emphasis on the underlying values and principles.

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.

Outcomes:

CO1: Integrate facts and concepts from ecological, physical and social sciences to characterize some common socio-environmental problems.

- CO2: Develop simple integrated systems and frameworks for solving common interconnected socio-environmental problems.
- CO3: Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
- CO4: Identify the ethical underpinnings of socio-environmental issues in general.

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](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>.

18PHY216

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.

Asynchronous Sequential Circuits:

Basic Design Steps.

Course Outcomes:

At the end of the course students will be able to

- CO1. Understand and examine the structure of various number systems and its application in digital design.
- CO2. Analyze and design various combinational and sequential circuits.
- CO3. Identify basic requirements for a design application and propose a cost effective solution.
- CO4. Develop skills to build, and troubleshoot digital circuits and apply knowledge of logic gates to select the appropriate gate for the circuit design.

Text Books

1. Stephen Brown, Zvonko Vranesic, Fundamental of Digital logics with VHDL Design, 3rd Ed., McGraw-Hill Education, 2008.
2. Donald P. Leach, Albert Paul Malvino, Digital principles and applications, 7th Edition, Tata McGraw-Hill Education, 2011.
3. Albert Paul Malvino, Jerald A. Brown, Digital Computer Electronics, 3rd Ed. McGraw-Hill, Electricity & Electronics series, 1992.

Reference Books

1. M. Morris R. Mano, Michael D. Ciletti, Digital design, 5th Edition, Pearson Publisher, 2012.

18PHY217

Introduction to Computational Physics

3 1 0 4

Unit I

Modeling, Computers and Error Analysis: Mathematical Modeling, Programming and Software, Approximations and Round off errors, Truncation errors and the Taylor series.

Unit II

Algebraic Equations and Curve Fitting: Bracketing Methods, Open Methods, Roots of Polynomials, Gauss Elimination, LU Decomposition and Matrix Inversion, Special Matrices and Gauss-Seidel, Least-Squares Regression, Interpolation, Fourier Approximations

Unit III

Numerical Integration and Differentiation: The Trapezoidal Rule, Simpson's Rules, Open Integration Formulas, Multiple Integrals, Gauss Quadrature, Improper Integrals, Richardson Extrapolation, Derivatives of Unequally Spaced Data, Derivatives and Integrals for Data with Errors, Partial Derivatives

Unit IV

Ordinary Differential Equations: Euler's Method, Runge-Kutta Methods, System of Equations, Stiffness, Multistep Methods, General Methods for Boundary-Value Problem, Eigenvalue Problems

Unit V

Partial Differential Equations: The Laplace Equation, Solution Technique, Boundary Conditions, The Control Volume Approach, The Heat Conduction Equation, Explicit Methods, Parabolic Equations in Two Spatial Dimensions

Course Outcomes:

After the completion of the course, the student will be able to:

CO1. Learn how numerical methods can be developed

CO2. Become aware of the role that computer models and simulations play in studies of physical systems

CO3. Understand and know different numerical methods that can be used to solve scientific problems

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 01	PSO 02	PSO 03
CO1	3	3	3	2	1		1						3		3
CO2	1	2		2	1					1			1		3
CO3	3	3	3	3	3				1	2			3	1	3

Text Book

1. Steven Chapra, Raymond Canale, Numerical Methods for Engineers, 7th Ed., McGraw-Hill Higher Education, 2015.

Reference Book

1. V. Rajaraman, Computer Oriented Numerical Methods, PHI LEARNING PVT LTD, 2016.

18PHY284

Physics Lab III – 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 power of a 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. Determination of refractive index of the liquids by applying Snell's law.
9. Diffraction at single, double and multiple slits using laser - studying the intensity distribution.
10. Diffraction at circular aperture using laser and estimation of unknown particle size.
11. Optical Fiber - Measuring the numerical aperture, beam profile and bending loss.
12. Assembling a Michelson Interferometer and measuring glass refractive index

Course Outcomes:

On Completion of this laboratory course, the student will be able to:

- CO1. Apply the basic knowledge gained from optics course to perform optics experiments in the laboratory
- CO2. Present experimental data in various appropriate forms like tabulation and plots.
- CO3. Analyze, interpret and summarize the experimental results
- CO4. Communicate clearly the understanding of various experimental principles, instruments/setup, and procedure

18PHY218

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 antisymmetric wave functions, Many-electron atoms, atomic structures, Spin-Orbit Coupling, total angular momentum, X-ray Spectra.

Course Outcomes

At the end of the course, the students can

CO1: Give simple, clear and mathematically uncomplicated explanation of physical concepts

connected with theories of special relativity and elementary quantum mechanics.

CO2: Understand the development of physical concepts of modern physics.

CO3: Analyze and solve problems based on concepts of modern physics.

CO4: Understand the relation between observation and theory, and their application in

science and engineering.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	3	3				2	1	1	1	2	1		1
CO2	3	3	3	3	3				2	1	1	1	3	3		1
CO3	3	3	3	3	3				2	1	1	1	3	3		2
CO4	3	3	3	3	3				2	1	1	1	3	3		2

TEXT BOOKS

1. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, Tata McGraw-Hill, 7thEd., 2017.
2. Robert Eisberg and Robert Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and particles, 2ndEd., 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.

18SSK211

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

Course Outcomes:

- CO1: Soft Skills: At the end of the course, the students will have the ability to communicate convincingly and negotiate diplomatically while working in a team to arrive at a win-win situation. They would further develop their inter-personal and leadership skills.
- CO2: Soft Skills: At the end of the course, the students shall learn to examine the context of a Group Discussion topic and develop new perspectives and ideas through brainstorming and arrive at a consensus.
- CO3: Aptitude: At the end of the course, students will be able to identify, recall and arrive at appropriate strategies to solve questions on geometry. They will be able to investigate, interpret and select suitable methods to solve questions on arithmetic, probability and combinatorics.
- CO4: Verbal: At the end of the course, the students will have the ability to relate, choose, conclude and
- CO5: Verbal: At the end of the course, the students will have the ability to utilise prior knowledge of grammar to recognise structural instabilities and modify them.
- CO6: Verbal: At the end of the course, the students will have the ability to comprehend, interpret, deduce and logically categorise words, phrases and sentences. They will also have the ability to theorise, discuss, elaborate, criticise and defend their ideas.

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.*

18PHY306

THERMAL PHYSICS

3 1 0 4

UNIT 1

Temperature & Zeroth law of thermodynamics:, Introduction:-state variables, Thermal equilibrium, Zeroth law of thermodynamics. Concept of temperature & its measurement, Scales of measurement. Construction and calibration of various Liquid, gas, resistance and radiation thermometers, Thermal expansion, Equation of state. Extensive and intensive variables: Kinetic theory of gases : Pressure exerted by ideal gas, molecular properties of temperature, Mean free path, Molecular speed distribution

UNIT 2

First law of thermodynamics: Methods of work transfer, free expansion, work as a path function, heat: Specific heat capacity and latent heat First law of thermodynamics: Internal energy and work, Heat and Enthalpy, Path function and state function, Corollaries of First law of thermodynamics;

UNIT 3

Work and Heat: Heat Capacity: equation of state, measurement of specific heat, Work done in various Processes, Mayer's relation, Poisson's relation. Einstein's and Debye theory of Specific heat capacity Heat transfer mechanisms:-Conduction, Convection, and Radiation. Methods of thermal conduction, conductivity measurements, Kirchhoff's laws, Pressure of radiation, Stefan Boltzmann law. Wien's law, Rayleigh jeans law, Planck's law (qualitative analysis), Solar constant, temperature of sun, Solar spectrum.

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. Entropy:- entropy in reversible and irreversible process, Clausius inequality, TS diagram,

UNIT 5

Thermodynamical Potentials. Maxwell's Thermodynamical relations, Applications: Specific heat equation, Joule Thomson cooling, Temperature inversion, Clausius Clapeyron equation. Thermodynamic Potentials; Relation with Thermodynamic variables, Tds equation, Heat capacity equations, Phasetransitions; First and second order, Pure substances: PV,PT,TS Phase diagram and PVT Surface . Applications of fundamental concepts, Mean free path, Equipartition of energy, Equilibrium distribution.

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand all the concepts needed to state the laws of thermodynamics, such as

'thermodynamic equilibrium', 'exact' and 'inexact' differentials and 'reversible' and 'irreversible' processes, internal energy, entropy, temperature, Free energies

CO2: Identify and describe the concepts and laws in thermodynamics in different but equivalent forms and

CO3: Demonstrate and apply laws of thermodynamics in thermodynamic derivatives,

including a number of 'material properties' such as heat capacity, thermal expansivity and compressibility, and solve problems in which such derivatives appear.

CO4: Apply the concepts and laws of thermodynamics to solve problems in thermodynamic systems such as gases, heat engines and refrigerators etc.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3			1								2	3		
CO2	3	3											2	3		
CO3	3	3		1									2	3		
CO4	3	3		1									2	3		

Text Book

1. M. W. Zemansky and R. H. Dittman Amit K. Chattopadhyay, Heat and Thermodynamics, 8th edition, Tata McGraw- Hill, 2011.
2. David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics, 10th Edition, John Wiley, 2012.

References

1. Walter Greiner, Ludwig Neisse, Horst Stocker, Thermodynamics and statistical mechanics, 1st Ed, Springer, 1995, 3rd reprint 2001 .
2. Sears.F.W and Salinger.G.L, Thermodynamics Kinetic Theory and Statistical Thermodynamics, 3rd Ed, Addison Wesley, 1998
3. Hugh.D. Young and Freedman, Sears & Zemansky's University Physics, 13th Ed, Pearson, 2013.
4. Richard P. Feynman, Robert. P. Leighton and Matthew Sands, Feynman Lectures on Physics, Vol.1, 1E, Narosa ,2008
5. P.K.Nag, Basic & Applied Thermodynamics, 2nd edition McGraw Hill Education; 2017.

18PHY307

ELECTRODYNAMICS

3 1 0 4

Course Objective:

Having successfully completed this module, the student will be able to demonstrate knowledge and understanding of: Electric Potentials, Boundary conditions, Maxwell's equations, Various techniques of solving Laplace equation, Electric field in matter, Magnetic field in matter, Maxwell's equations in matter, Poynting's Theorem, Maxwell's Stress Tensor, Conservation of Momentum, Angular momentum.

Unit 1

Review of electric potential, boundary conditions, Poisson's and Laplace equation, Laplace equation in one, two and three dimensions, Boundary conditions and Uniqueness theorem, Conductors and second Uniqueness theorem, Review of Electrostatics and Magnetostatics, Maxwell's equations, Maxwell's equations: Electrodynamics before Maxwell, Maxwell's correction to Ampere's law, Magnetic charge.

Unit 2

Techniques of solving Laplace equation, Numerical methods: Finite difference method, Relaxation method, other methods of finding the potentials: Method of images, Separation of variables, Spherical co-ordinates, Multipole expansion, Electric field of a dipole.

Unit 3

Electric field in matter: Induced dipoles, Polarization, Field of polarized Object, Bound charges, Physical interpretation of bound charges, Field inside a dielectric, Electric displacement, Linear dielectrics, Boundary value problem with linear dielectrics, Energy in dielectric systems, Force on dielectrics.

Unit 4

Magnetic field in matter: Diamagnets, Paramagnets, Ferromagnets. Torques and Forces on Magnetic dipoles, Effect of magnetic field on atomic Orbits, Magnetization, Bound currents, Physical interpretation of bound currents, Magnetic field inside matter, Ampere's law in magnetized materials, Linear and Nonlinear media: Magnetic susceptibility and permeability. Ferromagnetism.

Unit 5

Maxwell's equations in matter, Boundary conditions, Review of Maxwell's equations, The Continuity Equation, Poynting's Theorem, Newton's Third Law in Thermodynamics, Maxwell's Stress Tensor, Conservation of Momentum, Angular momentum.

Course Outcomes

At the end of the course, students will be able

CO1. To understand and familiarize the fundamental concepts of mathematical back ground

such as vector algebra, coordinate system, gradient, divergences, fundamental principles of calculus and Dirac delta function.

CO2. To Learn the fundamental principles, develop knowledge on theoretical concepts of

electrostatics, boundary conditions and its important applications in evaluating electric field in vacuum as well as in dielectric medium .

CO3. To develop critical thinking, learn various techniques and ability to solve various

problems related to electric potential and hence electric field.

CO4. To emphasis the knowledge in magnetostatics, magnetic field in medium,

Electromagnetic induction and Maxwell's equation.

Textbooks

1. Introduction to Electrodynamics – David J. Griffiths, 4th Ed., Pearson Publication, 2015.
2. David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of physics, 10th Edition, John Wiley, 2017.

Reference books

1. Richard P. Feynman, Robert P. Leighton and Matthew Sands, Feynman Lectures on Physics Vol.1, 1E, Narosa Publishing House, 2008.
2. J.D. Jackson, Classical Electrodynamics, 3rd Ed., Wiley, 2007.

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**Crystalline structure:**

Miller indices and its relation with Inter planar 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.

Unit 5**Dielectrics**

Maxwell's equations, Macroscopic electric field, Depolarization field, Local electric field at an atom, Lorentz field, Dielectric constant and polarizability, Electronic polarizability, classical theory of Electronic polarizability, Ferroelectric crystals, antiferroelectricity and piezoelectricity.

Course Outcomes

At the end of the course, students should be able

CO1. To understand different types of statistics and their applications.

CO2. To draw crystal planes and directions within the unit cells of different crystal systems and understand the importance of symmetries.

CO3. To correlate structure of crystalline solids with various properties.

CO4. To develop a strong theoretical basis to understand the classification of solids into metals, semiconductors and insulators

CO5. Apply the knowledge gained to solve problems in solid state physics using relevant mathematical tools.

Text books

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
3. Charles Kittel, Introduction to Solid State Physics, Wiley, 8th Ed., Reprint: 2016.

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.

18PHY384

PHYSICS LAB IV - 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 characteristic of solar cell Studying the characteristic of photodiode, photo transistor, LDR and opto coupler
8. Studying the thermal Expansion of crystal Using Interference fringes.
9. Michelson Interferometer – to find the refractive index of transparent material.
10. Fabry Perot Interferometer

Course Outcomes

At the end of the course students will be able to:

- CO1. Demonstrate the usage of various instruments thereby improving their experimental skills.
- CO2. Familiarize the error analysis and report the result with more precision.
- CO3. Comprehend the theoretical concepts by performing the corresponding experiments.
- CO4. Improve various skills such as observation, analysis, pictorial representation of the data etc.
- CO5. Verify theoretical concepts learnt through experiments and compare their proximities.

18SSK301

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.

Course Outcomes:

- CO1: Soft Skills: At the end of the course, the students will have the ability to prepare a suitable resume (including video resume). They would also have acquired the necessary skills, abilities and knowledge to present themselves confidently. They would be sure-footed in introducing themselves and facing interviews.
- CO2: -Soft Skills: At the end of the course, the students will have the ability to analyse every question asked by the interviewer, compose correct responses and respond in the right manner to justify and convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication.
- CO3: Aptitude: At the end of the course, students will be able to interpret, critically analyze and solve logical reasoning questions. They will have acquired the skills to manage time while applying methods to solve questions on arithmetic, algebra, logical reasoning, and statistics and data analysis and arrive at appropriate conclusions.
- CO4: Verbal: At the end of the course, the students will have the ability to understand and use words, idioms and phrases, interpret the meaning of standard expressions and compose sentences using the same.
- CO5: Verbal: At the end of the course, the students will have the ability to decide, conclude, identify and choose the right grammatical construction.
- CO6: Verbal: At the end of the course, the students will have the ability to examine, interpret and investigate arguments, use inductive and deductive reasoning to support, defend, prove or disprove them. They will also have the ability to create, generate and relate facts / ideas / opinions and share / express the same convincingly to the audience / recipient using their communication skills in English.

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 Tirthaji 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.

18PHY318

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.

Course Outcomes

At the end of the course, students will be able

CO1. To acquire knowledge on the fundamental physics of atoms and molecules and their

interaction with e m waves.

CO2. To solve problems related to physics of atoms and molecules.

CO3. To realize a role and practical application of physics of atoms and molecules in the modern world.

TEXT / REFERENCE BOOKS

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.

18PHY319

Intermediate Mechanics

3 1 0 4

UNIT 1

Equations of Motion:

Review of basic principles, Forces, Friction, Motion under Linear and Quadratic Viscous Drag, Relativistic Equations of Motion. Conservation of linear momentum, Dynamics of bodies of variable mass, Non relativistic rockets, Relativistic rockets.

UNIT 2

Conservation of Energy:

Work & Kinetic Energy, Conservative forces, Potential Energy, Work Energy Theorem, Conservation of Energy, Energy Diagrams, Determining the Motion using Energy Integral. Relativistic Dynamics. **Gravitational Field:** Law of Gravitation, Gravitational Field, Gravitational Potential, Gravitational Field Equations, Motion in a gravitational field.

UNIT 3

Rotational Dynamics of Rigid Bodies:

Conservation of Angular momentum, Moment of Inertia, Rotational Kinetic Energy, Torque and Work-Energy Theorem, Properties of Centre of mass, Orthogonal Transformations, Euler Angles, Inertia Tensor, Parellel Axis Theorem, The Euler Equations.

UNIT 4

Accelerating Frames of References:

Linearly accelerating Reference Frame, Rotating Coordinate Frame, Fictitious Forces, Coriolis Force, Tides, Foucault Pendulum.

UNIT 5

The Lagrangian Method:

Calculus of Variation, The Lagrangian, Lagrange's Equations, Degrees of Freedom, Generalized momentum & Hamilton's Equations.

Course Outcomes

After completion of the course, students should be able to

- CO1. Apply the concepts of Newtonian formalism in solving dynamical problems.
- CO2. Understand the concept of constraint, principle of least action and formulation of Lagrange's method and apply Lagrange's equation for simple dynamical systems.
- CO3. Understand Central force and its application in Kepler's problem and scattering problems
- CO4. Use the Centre of mass and laboratory frames of references in solving problems.
- CO5. Understand the basics of rotating frames of references and Euler angles and Euler's equations.

Text Books:

1. P. Hamill, Intermediate Dynamics, Jones & Bartlett, 2010.
2. David Morin, Introduction to Classical Mechanics, Cambridge University Press, 2008.

Reference Books:

1. John Taylor, Classical Mechanics, University Science Books, 1E, 2004.
2. S T Thomson and J B Marion, Classical Dynamics of Particles and Systems, Brooks Cole, 1E, 2009.
3. Walter Greiner, Classical Mechanics: Point Particles and Relativity, Springer – Verlag, 1E, 2004.

18PHY320

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.

Course outcomes:

At the end of the course Students will be able to

CO1. Understand and analyze the problems related to optics and its application based on the

Fourier transforms.

CO2. Understand and analyze the basic problems related to signal transition using optical

fibers

CO3. Analyze the basic problems related Laser physics, Laser parameters and its

applications.

CO4. Understand and analyze the basic problems in usage of optoelectronic devices, its

limitations and usage parameters.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	2		3			2		1			3	3		
CO2	3	3	2		2			2		1			3	3		
CO3	3	3	2		2			2		1			3	3		
CO4	3	3	2		2			2		1			3	3		

TEXT BOOKS

1. Hecht, Eugene, Optics, 2ndEd, Addison Wesley, 1987.
2. A.K. Ghatak, Introduction to Modern optics, Tata McGraw Hill, 1972.

3. Bahaa E.A. Saleh, 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.

18PHY385

Physics Lab. V Electronics

0 0 2 1

1. Design and performance study of active filters (Low pass, high pass, band pass, band rejection)
2. Characteristic of Zener diode, and voltage regulation using Zener diode (Line and load regulation).
3. bridge rectifier and regulator circuits using CRO
4. Construction of Power supply, Dual supply with 12 V - IC regulator
5. Study of frequency response of transistor amplifier.
6. Basic Opp –amp circuits- Inverting and non inverting amplifier, Summing and difference amplifier
7. Multi vibrators Astable, Monostable and Bistable- Using 555 -Timers
8. Combination of gate universal- NAND and NOR as universal building blocks and verification of DeMorgan's theorem
9. Flip flops ,RS JK Master slave
10. Half adder and Subtractor
11. Counters 4 bits
12. Encoders and Decoders 4 bits
13. full adder IC 7483s
14. Registers 4 bits

Course Outcomes

On successful completion of the course students will be able to

- CO1. Acquire basic knowledge on the working of various semiconductor devices.
- CO2. Develop analyzing capability in Diode rectification and BJT amplifier circuits.
- CO3. Design and test various basic linear application circuits and active filters using Operational amplifiers.
- CO4. Develop the skill to build and troubleshoot the Analog circuits.
- CO5. Acquire knowledge on basic digital electronic gates and perform combinational logical circuits.
- CO6. Explain the experimental results in the laboratory with theoretical analysis.

18PHY399

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.

Course Outcomes

At the end of the course students will be able

CO1. To understand the fundamental physical concepts and their applications in real-time problems.

CO2. To develop scientific knowledge that leads to new innovation.

CO3. To develop the communication and report writing skills.

18PHY501

Classical Mechanics

3 1 0 4

UNIT 1

Constrained Motion: Constraints, Classification of Constraints, Principal of Virtual Work, D'Alembert's principal and its applications.

UNIT 2

Lagrangian formulation: Generalized coordinates, Lagrange's equations of motion, properties of kinetic energy function, theorem on total energy, generalized momenta, cyclic-coordinates, integrals of motion, Jacobi integrals and energy conservation, Concept of symmetry, invariance under Galilean transformation, velocity dependent potential.

UNIT 3

Hamilton's formulation: Hamilton's function and Hamilton's equation of motion, configuration space, phase space and state space, Lagrangian and Hamiltonian of relativistic particles and light rays.

UNIT 4

Canonical Transformations: Generating function, Conditions for canonical transformation and problem. **Poisson Brackets:** Definition, Identities, Poisson theorem, Jacobi-Poisson theorem, Jacobi identity, (Statement only), invariance of PB under canonical transformation.

UNIT 5

Central Force Problem:

Kepler's laws, Orbital Dynamics, Stability

Rotational Motion:

Rotating frames of reference, inertial forces in rotating frames, Larmour precession, electromagnetic analogy of inertial forces, effects of Coriolis force, Foucault's pendulum.

Course Outcomes

At the end of the course students will be able to

- CO1. Understand the basic conservation laws in physics and the concept of phase portrait
- CO2. Understand and apply the Lagrangian formalism to simple dynamical systems
- CO3. Apply Hamilton's equations and solve dynamical systems
- CO4. Apply the properties of Poisson's bracket and canonical transformations for solving simple systems
- CO5. Apply the theory of Rigid body dynamics and analyze the motion of rigid bodies
- CO6. Apply small oscillation theory developed in getting the frequencies of different of modes of oscillations in a coupled systems

Text Books:

H. Goldstein, Classical Mechanics, Addison – Wesley, 2E, 1980.

Reference Books:

1. Landau and Lifshitz, Mechanics, Butterworth-Heinemann, 3, 1976
2. S T Thomson and J B Marion, Classical Dynamics of Particles and Systems, Brooks Cole, 1E, 2009
3. Walter Greiner, Classical Mechanics: Systems of Particle and Hamiltonian Dynamics, Springer – Verlag, 1E, 2004

18PHY502

Quantum Mechanics I

3 1 0 4

Objective

The course emphasize the students to familiarise the mathematical background (Hilbert space) required to understand the basic and applied quantum mechanics. The course further emphasize the students to understand the basic postulate and standard one dimensional problems of quantum mechanics. As outcome of the course, the students is expected to solve physical problems in few selected topics like quantum angular momentum, one and two body problems etc.,

UNIT 1:

Mathematical Introduction

Linear Vector Spaces : Basics, Inner Product Spaces , Dual Spaces and the Dirac Notation, Subspaces, Linear Operators, Matrix Elements of Linear Operators, Active and Passive Transformations, The Eigenvalue Problem, Functions of Operators and Related Concepts, Generalization to Infinite Dimensions.

UNIT 2:

Review of Classical Mechanics

The Principle of Least Action and Lagrangian Mechanics, The Electromagnetic Lagrangian, The Two-Body Problem, The Hamiltonian Formalism, The Electromagnetic Force in the Hamiltonian Scheme, Cyclic Coordinates, Poisson Brackets, and Canonical Transformations, Symmetries and Their Consequences

The Postulates of Quantum Mechanics

The Postulates, Discussion of Postulates I-III, The Schrödinger Equation, The Free Particle, The Particle in a Box, The Continuity Equation for Probability, The Single-Step Potential, The Double-Slit Experiment, Absence of degeneracy in one dimensional bound states, Ehrenfest's theorem.

UNIT 3:

The Harmonic Oscillator

Review of the Classical Oscillator, Quantization of the Oscillator (Coordinate Basis), The Oscillator in the Energy Basis, Passage from the Energy Basis to the X Basis.

Derivation of the Uncertainty Relations. (2 hours)

UNIT 4:

Systems with N Degrees of Freedom

N- Particles in One Dimension, More Particles in More Dimensions, Identical Particle

Symmetries and Their Consequences

Overview, Translational Invariance in Quantum Theory, Time Translational Invariance, Parity Invariance, Time-Reversal Symmetry

UNIT 5:

Rotational Invariance and Angular Momentum

Translations in Two Dimensions, Rotations in Two Dimensions, The Eigenvalue Problem of Angular Momentum in Three Dimensions, The Eigenvalue Problem of L^2 and L_z . Solution of Rotationally Invariant Problems

The Hydrogen Atom

The Eigenvalue Problem, The Degeneracy of the Hydrogen Spectrum, Numerical Estimates and Comparison with Experiment, Multi electron Atoms and the Periodic Table.

Course Outcomes

At the end of the course students will be able to

- CO1. Understand and familiarize the mathematical background (Hilbert space) in which the basic and applied quantum mechanics are framed.
- CO2. Apply the various postulates of quantum mechanics to one and three dimensional problems.
- CO3. Understand the basic concepts of angular momentum and improve problem solving Skills

Text Books:

1. R Shankar, Principles of Quantum Mechanics, Pearson India (LPE), 2nd Ed., 2005.
2. JJ Sakurai, Modern Quantum Mechanics, Pearson, 1st Ed., 1994.

Referene Books:

- S Gasiorowicz, Quantum Physics, Wiley India, 2E
- L I Schiff, Quantum Mechanics, TMH, 3E, 2010.
- David Griffiths, Introduction to Quantum Mechanics, Pearson India (LPE), 2E, 2005.

18PHY503

Mathematical Physics 1

3 1 0 4

UNIT 1:

VECTOR ANALYSIS:

Laws of vector algebra, Unit vectors, Rectangular unit vectors, Components of a vector, Scalar fields, Vector fields, Reciprocal sets of vectors, Ordinary derivatives of vectors, Space curves, Continuity and differentiability, Differen-tiation formulas, Partial derivatives of vectors Differentials of vectors, Differential geometry, Mechanics.

The vector differential operator del, Gradient, Divergence, Curl, Formulas involving del, Ordinary integrals of vectors, Line integrals, Surface integrals, Volume integrals, Divergence theorem of Gauss, Stokes' theorem, Green's theorem in the plane, integral theorems, Integral operator form for del.

Unit- II

Transformation of coordinates, Orthogonal curvilinear coordinates, Unit vectors in curvilinear systems, Arc length and volume elements, Gradient, divergence and curl, Special orthogonal coordinate systems, Cylindrical coordinates,

Spherical coordinates, Parabolic cylindrical coordinates, Paraboloidal coordinates, Elliptic cylindrical coordinates, Prolate spheroidal coordinates, Oblate spheroidal coordinates, Ellipsoidal coordinates, Bipolar coordinates.

Unit- III

TENSOR ANALYSIS:

Physical laws, Spaces of N dimensions, Coordinate transformations, The summation convention, Contravariant and covariant vectors, Contravariant, covariant and mixed tensors. The Kronecker delta. Tensors of rank greater than two. Scalars or invariants.

Tensor fields. Symmetric and skew-symmetric tensors. Fundamental operations with tensors. The line element and metric tensor.

Conjugate or reciprocal tensors. Associated tensors. Physical components. Christoffel's symbols. Transformation laws of Christoffel's symbols. Geo-desics. Covariant derivatives. Permutation symbols and tensors. Tensor form of gradient, divergence and curl. The intrinsic or absolute derivative. Relative and absolute tensors.

Unit- IV

GROUP THEORY Part – 1:

Elements of Group Theory :

Correspondences and transformations, Groups. Definitions and examples, Subgroups. Cayley's theorem, Cosets, Lagrange's theorem, Conjugate classes, Invariant subgroups, Factor groups, Homomorphism, Direct products.

Symmetry Groups :

Symmetry elements. Pole figures, Equivalent axes and planes, Two-sided axes, Groups whose elements are pure rotations, uniaxial groups, dihedral groups, The law of rational indices, Groups whose elements are pure rotations, Regular polyhedra, Symmetry groups containing rotation reflections, Adjunction of reflections to C_n , Adjunction of reflections to the groups D_n , The complete symmetry groups of the regular polyhedra, Summary of point groups. Other systems of notation, Magnetic symmetry groups (color groups).

Unit- V

Group Representations:

Linear vector spaces, Linear dependence; dimensionality, Basis vectors (coordinate axes), coordinates Mappings, linear operators, matrix representations, equivalence, Group representations, Equivalent representations, characters, Construction of representations, Addition of representations, Invariance of functions and operators, Classification of eigenfunctions, Unitary spaces; scalar product, unitary matrices, Hermitian matrices.

Unitary representations, Hilbert space, Analysis of representations, reducibility, irreducible representations. Schur's lemmas, The orthogonality relations, Criteria for irreducibility. Analysis of representations. The general theorems. Group algebra, Expansion of functions in basis functions of irreducible representations. Representations of direct products.

Course Outcomes

At the end of the course, students should be able

- CO1. To understand the basics of tensor calculus and familiarize with a range of Mathematical methods that are essential for studying different branches of physics.
- CO2. To develop independent problem solving ability and enhance conceptual understanding using several mathematical techniques.
- CO3. To develop required mathematical skills to study and solve problems in quantum mechanics, electrodynamics, statistical mechanics and other fields of theoretical physics.

Text Books:

1. Murray R Spiegel, Seymour Lipschutz, Schaum's Outline of Vector Analysis, 2nd Ed., Schaums' Outline Series, 2009.
2. Murray Spiegel, Vector Analysis And An Introduction To Tensor Analysis, Tata Mcgraw Hill. 1989
3. Morton Hamermesh, Group Theory and its Application to Physical Problems, Reprint Ed., Addison-Wesley Publishing Company Inc. 1989.
4. Arfken & Weber, Mathematical Methods for Physicists, Elsevier Indian Reprint, 7th Ed., 2012.

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.

18PHY504

Computational Physics

3 1 0 4

Course Objective:

The objective of the Computational Physics course is to introduce the students to computational methods, to solve problems in physics which are hard to solve analytically. Therefore, the course is designed to make students think of programming as a way to learn physics, learn how to approach a problem computationally. It covers examples from various important core branches of Physics such as Mathematical Physics, Mechanics, Heat and Thermodynamics, Electrodynamics, Quantum Mechanics and Statistical Mechanics. The objective is to introduce computational techniques by considering one or two pedagogical examples in each of these fields and is by no means exhaustive. Students are therefore encouraged to work out further examples to consolidate their understanding of the subject through computational means.

Prerequisite:

1) Problem solving and computer programming: Introduction to Python 2) Introduction to Computational Physics.

Unit I

Methods of Mathematical Physics and introduction to programming languages: Python, Fortran/Matlab.

Unit II

Mechanics, Heat and Thermodynamics: Optimisation techniques, finite element and finite volume methods. Introduction to heat transfer.

Unit III

Electrodynamics: Boundary value problems, Solutions to Laplace Equations, finite difference method, relaxation methods. Calculations of magnetic field in a solenoid and Helmholtz coil.

Unit IV

Solutions for Quantum Mechanical problems: Functions as vectors, Differential operators as matrices, 1D potential well. Step Potentials.

Unit V

Advanced topics: Monte Carlo method for atomic collisions: Introduction to Monte Carlo method, Random Numbers, Distribution Functions, Monte-Carlo Integration, application to Coulomb collisions.

Course Outcomes

After completion of the course students will be able to

CO1. Analyze a Physics problem from the point of view of computation and compare that

with a traditional analytical solution.

CO2. Able to formulate a computational method to solve a Physics problem.

CO3: Demonstrate the advantages of a computational approach over a traditional method.

CO3: Improve skills in writing a computer code in a suitable language to solve a Physics problems

Text / Reference books

1. P. Hamill, Intermediate Dynamics, Jones & Bartlett, 2010.
2. David Morin, Introduction to Classical Mechanics, Cambridge University Press, 2008.
3. Lecture notes -Numerical Methods in Quantum Mechanics - Paolo Giannozzi, 2017. (<http://www.fisica.uniud.it/~giannozz/Corsi/MQ/LectureNotes/mq.pdf>)
4. Computational Electrodynamics: The Finite-Difference Time-Domain Method - Allen Taflove, Susan C. Hagness, Artech. House, 2005

18PHY581

Advanced Physics Lab

0 0 6 2

1. Current-Voltage characteristics of dc glow discharge
2. Calibration of a vacuum gauge (Pirani) with the aid of McLeod gauge.
3. Mass susceptibility of paramagnetic Liquid substance by Quinckes's method
4. Studying the Hall Effect parameters
5. Elastics Constants – Elliptical and Hyperbolic Fringes
6. Skin depth in Al using electromagnetic radiation.
7. Thermionic Emission
8. Verification of Bohr's theory Franck – Hertz Experiment.
9. Stefan's constant – Black body radiation.
10. Study of plasma density, plasma conductivity and plasma temperature by glowing discharge method.
11. Van der Pauw method or Four Probe Method – Measurement of resistivity and Hall Coefficient of Thin Film .
12. e' by Millikan oil drop method.
13. Counting statistics, G.M. tube.

Course Outcomes

At the end of this course, students should be able

CO1. To expertise the usage of instruments and improve their skills pertaining to it.

CO2. To expertise the methods of error analysis and familiarize them to report their result

With more precession.

CO3. To comprehend the theoretical concepts by doing the corresponding experiments.

CO4. To develop various skills such as observation, analysis, pictorial representation of the
Data etc.

CO5. To verify or reproduce the concepts and results learnt in theory by performing
Experiments and compare their proximities.

18PHY582

Simulation Lab

0 0 6 2

Mechanics:

- (1) Motion of a Body Falling in Viscous Medium
- (2) Motion of One-Dimensional Simple Harmonic Oscillator
- (3) Motion of a Projectile Thrown Horizontally
- (4) Motion of a Satellite

Waves and Optics:

- (5) Construction of Standing Wave
- (6) Formation of Square Wave
- (7) Dispersion of Light Wave
- (8) Polarization of Light Waves

Course Outcomes

At the end of the course students will be able to

CO1. Apply numerical methods to solve problems related to mechanics, wave and optics

CO2. Analyze numerical data and their physical meaning

CO3. Plotting data using various graphic tools

18PHY591

Mini Project

2 cr

The aim of mini project work is to give first exposure to students on research methodology. This can include literature survey, review, data collection, theoretical / experimental work on small part of research area chosen by the faculty guiding the mini project work.

Course Outcomes:

On completion of the course the students will be able to:

CO1. Apply basic knowledge in physics and mathematics; learn to use modern experimental

tools to address the real world problems and challenges that need solutions

CO2. Understand the vast array of literature in the field of interest and exposed to various research challenges

CO3. Gain knowledge of designing and execution of a research problem

CO4. Enhance the presentation and communication skills

18PHY511

Quantum Mechanics II

3 1 0 4

Objective

The course emphasizes the students to familiarise the application of quantum mechanical postulates on single, multi body problems and method of approximations etc.,

UNIT 1:

Spin

Introduction, Nature of Spin, Kinematics of Spin, Spin Dynamics, Return of Orbital Degrees of Freedom.

UNIT 2:

Addition of Angular Momenta

Example, The General Problem, Irreducible Tensor Operators, Explanation of Some "Accidental" Degeneracies.

Variational and WKB Methods

The Variational Method, The Wentzel-Kramers-Brillouin Method.

UNIT 3:

Time-Independent Perturbation Theory

The Formalism, Some Examples, Degenerate Perturbation Theory

Time-Dependent Perturbation Theory

The Problem, First-Order Perturbation Theory, Higher Orders in Perturbation Theory, A General Discussion of Electromagnetic Interactions, Interaction of Atoms with Electromagnetic Radiation.

UNIT 4:

Scattering Theory

Introduction, Recapitulation of One-Dimensional Scattering and Overview, The Born Approximation (Time-Dependent Description), Born Again (The Time-Independent Approximation). The Partial Wave Expansion, Two-Particle Scattering.

UNIT 5:

The Dirac Equation

The Free-Particle Dirac Equation, Electromagnetic Interaction of the Dirac Particle, More on Relativistic Quantum Mechanics.

Course Outcomes

After completion of the course student should be able to:

- CO1. Understand different aspects of the angular momentum, spin algebra and solve Problems related to angular momentum.
- CO2. Apply the main approximation methods for stationary and time-dependent quantum mechanical problems.
- CO3. Understand scattering theory and solve problems related to scattering.

TEXT BOOKS:

1. *R Shankar, Principles of Quantum Mechanics, Pearson India (LPE), 2E 2005*
2. *JJ Sakurai, Modern Quantum Mechanics, Pearson, 1E, 1994*

REFERENCE BOOKS:

1. *S Gasiorowicz, Quantum Physics, Wiley India, 2E*
2. *L I Schiff, Quantum Mechanics, TMH, 3E, 2010*
3. *David Griffiths, Introduction to Quantum Mechanics, Pearson India (LPE), 2E, 2005*

18PHY512

Mathematical Physics II

3 1 0 4

UNIT 1:

GROUP THEORY Part – 2:

Irreducible Representations of the Point Symmetry Groups, Abelian groups, Nonabelian groups, Characterables for the crystal point groups, Operations with Group, Representations, Product representations (Kronecker products), Symmetrized and antisymmetrized products, The adjoint representation. The complex conjugate representation, conditions for existence of invariants, Real representations, The reduction of Kronecker products. The Clebsch-Gordan series, Clebsch-Gordan coefficients, Simply reducible groups, Three-j symbols.

Physical Applications :

Classification of spectral terms, Perturbation theory, Selection rules, coupled systems. The Symmetric Group, The deduction of the characters of a group from those of a subgroup, Frobenius' formula for the characters of the symmetric group. Graphical methods, Lattice permutations, Young patterns, Young tableaux, Graphical method for determining characters, Recursion formulas for characters, Branching laws, Calculation of characters by means of the Frobenius formula, The matrices of the irreducible representations of S_n .

Yamanouchi symbols, Hund's method, Group algebra, Young operators, The construction of product wave functions of a given symmetry, Fock's cyclic symmetry conditions, Outer products of representations of the symmetric group, Inner products. Clebsch-Gordan series for the symmetric

group, Clebsch-Gordan (CG) coefficients for the symmetric group.
Symmetry properties, Recursion formulas.

Unit – II

Continuous Groups:

Summary of results for finite groups, Infinite discrete groups, Continuous groups, Lie groups, Examples of Lie groups, Isomorphism. Subgroups. Mixed continuous groups, One-parameter groups, Infinitesimal transformations, Structure constants, Lie algebras, Structure of Lie algebras, Structure of compact semisimple Lie groups and their algebras, Linear representations of Lie groups, Invariant integration, Irreducible representations of Lie groups and Lie algebras, The Casimir operator, Multiple-valued representations. Universal covering group.

Axial and Spherical Symmetry, The rotation group in two dimensions, The rotation group in three dimensions, Continuous single-valued representations of the three-dimensional rotation group, Splitting of atomic levels in crystalline fields (single-valued representations), Construction of crystal eigenfunctions, Two-valued representations of the rotation group, The unitary unimodular group in two dimensions, Splitting of atomic levels in crystalline fields, Double-valued, representations of the crystal point groups, Coupled systems, Addition of angular momenta. Clebsch-Gordan coefficients.

Unit – II

Linear Groups in n-dimensional Space:

Irreducible Tensors, Tensors with respect to $GL(n)$, The construction of irreducible tensors with respect to $GL(n)$, The dimensionality of the irreducible representations of $GL(n)$, Irreducible representations of subgroups of $U(n)$, $SU(n)$, The orthogonal group in n dimensions, Contraction, Traceless tensors, The irreducible representations of $O(n)$, Decomposition of irreducible representations of $SO(n)$ with respect to $O(n)$, The symplectic group $Sp(n)$, Contraction, Traceless Tensors, The irreducible representations of $Sp(n)$, Decomposition of irreducible representations of $U(n)$ with respect to its symplectic subgroup.

Applications to Atomic and Nuclear Problems (Optional) 1#

The classification of states of systems of identical particles according to $SU(n)$, Angular momentum analysis, Decomposition of representations of $SU(n)$ into representations of $O(3)$, The Pauli principle, Atomic spectra in Russell-Saunders coupling, Seniority in atomic spectra, Atomic spectra in jj -coupling, Nuclear structure, Isotopic spin, Nuclear spectra in L-S coupling, Supermultiplets, The L-S coupling shell model, The jj -coupling shell model, Seniority in jj -coupling.

COMPLEX VARIABLES:

COMPLEX NUMBERS :

The Real Number System, Graphical Representation of Real Numbers, The Complex Number System, Fundamental Operations with Complex Numbers, Absolute Value, Axiomatic Foundation of the Complex Number System, Graphical Representation of Complex Numbers, Polar Form of Complex Numbers, De Moivre's Theorem, Roots of Complex Numbers, Euler's Formula, Polynomial Equations, The n th Roots of Unity, Vector Interpretation of Complex Numbers,

Stereographic Projection, Dot and Cross Product, Complex Conjugate Coordinates, Point Sets.

Unit –IV

FUNCTIONS, LIMITS, AND CONTINUITY:

Variables and Functions, Single and Multiple-Valued Functions, Inverse Functions, Transformations, Curvilinear Coordinates, The Elementary Functions, Branch Points and Branch Lines, Riemann Surfaces, Limits, Theorems on Limits, Infinity, Continuity, Theorems on Continuity, Uniform Continuity, Sequences, Limit of a Sequence, Theorems on Limits of, Sequences, Infinite Series.

COMPLEX DIFFERENTIATION AND THE CAUCHY–RIEMANN EQUATIONS:

Derivatives, Analytic Functions, Cauchy–Riemann Equations, Harmonic Functions, Geometric Interpretation of the Derivative, Differentials, Rules for Differentiation, Derivatives of Elementary Functions, Higher Order Derivatives, L'Hospital's Rule, Singular Points, Orthogonal Families, Curves Applications to Geometry and Mechanics, Complex Differential Operators, Gradient, Divergence, Curl, and Laplacian.

Unit – V

COMPLEX INTEGRATION AND CAUCHY'S THEOREM:

Complex Line Integrals, Real Line Integrals, Connection Between, Real and Complex Line Integrals, Properties of Integrals, Change of Variables, Simply and Multiply Connected Regions, Jordan Curve Theorem, Convention Regarding Traversal of a Closed Path, Green's Theorem in the Plane, Complex Form of Green's Theorem, Cauchy's Theorem, The Cauchy–Goursat Theorem, Morera's Theorem, Indefinite Integrals, Integrals of Special Functions, Some Consequences of Cauchy's Theorem. Cauchy's Integral Formulas, Some Important Theorems

INFINITE SERIES TAYLOR'S AND LAURENT'S SERIES:

Sequences of Functions, Series of Functions, Absolute Convergence, Uniform Convergence of Sequences and Series, Power Series, Some Important Theorems, Taylor's Theorem, Some Special Series, Laurent's Theorem, Classification of Singularities, Entire Functions, Meromorphic Functions, Lagrange's, Expansion, Analytic Continuation.

THE RESIDUE THEOREM EVALUATION OF INTEGRALS AND SERIES:

Residues, Calculation of Residues, The Residue Theorem, Evaluation of Definite Integrals, Special Theorems Used in Evaluating Integrals, The Cauchy Principal Value of Integrals, Differentiation Under the Integral Sign. Leibnitz's Rule, Summation of Series, Mittag–Leffler's Expansion Theorem, Some Special Expansions.

CONFORMAL MAPPING (Optional) 2#

Transformations or Mappings, Jacobian of a Transformation, Complex Mapping Functions, Conformal Mapping, Riemann's Mapping Theorem, Fixed or Invariant Points of a Transformation, Some General Transformations, Successive Transformations, The Linear Transformation, The Bilinear or Fractional Transformation, Mapping of a Half Plane onto a Circle, The Schwarz–Christoffel Transformation. Transformations of Boundaries in Parametric Form, Some Special

Mappings,

PHYSICAL APPLICATIONS OF CONFORMAL MAPPING (Optional) 3 #

Boundary Value Problems, Harmonic and Conjugate Functions, Dirichlet and Neumann Problems, The Dirichlet Problem for the, Unit Circle, Poisson's Formula, The Dirichlet Problem for the Half Plane, Solutions to Dirichlet and Neumann Problems by Conformal Mapping, Applications to Fluid Flow, Basic Assumptions, The Complex Potential, Equipotential Lines and Streamlines, Sources and Sinks, Some Special Flows, Flow Around Obstacles, Bernoulli's Theorem, Theorems of Blasius, Applications to Electrostatics, Coulomb's Law, Electric Field Electro-static Potential, Gauss' Theorem, The Complex Electrostatic, Potential, Line Charges, Conductors, Capacitance, Applications to Heat Flow, Heat Flux, The Complex Temperature.

SPECIAL TOPICS (Optional) 4#

Analytic Continuation, Schwarz's Reflection Principle, Infinite Products, Absolute, Conditional and Uniform Convergence of Infinite Products, Some Important Theorems on Infinite Products, Weierstrass' Theorem for Infinite Products, Some Special Infinite Products, The Gamma Function, Properties of the Gamma Function, The Beta Function, Differential Equations, Solution of Differential Equations by Contour Integrals, Bessel Functions, Legendre Functions, The Hypergeometric Function, The Zeta Function, Asymptotic Series, The Method of Steepest Descents, Special Asymptotic Expansions, Elliptic Functions.

Note: The topics #1, #2, #3, and #4 may be taught if time permits.

Course Outcomes

After completion of the course, students will be able to

- CO1. Solve second order differential equations with series solutions
- CO2. Understand the basics and applications of Legendre polynomials
- CO3. Understand the concepts of complex analysis
- CO4. Apply the methods of complex analysis to evaluate definite integrals and infinite series
- CO5. Familiarize various mathematical methods used in advanced physics topics to solve associated problems.

Text Books:

1. *Murray R Spiegel, Seymour Lipschutz, "Schaum's Outline of Vector Analysis, 2ed (Schaums' Outline Series)"* second Edition.
2. *Murray Spiegel, Vector Analysis And An Introduction To Tensor Analysis, Tata Mcgraw Hill.*
3. *Morton Hamermesh, Group Theory and its Application to Physical Problems, Addison-Wesley Publishing Company Inc. 1962.*
4. *Arfken & Weber, Mathematical Methods for Physicists, Elsevier Indian Reprint, 6E, 200.*

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*

18PHY513

Statistical Mechanics

3 1 0 4

UNIT 1

Review of thermodynamic variables and thermodynamic potentials. Review of probability functions-random walk problem.

UNIT 2

Foundations of statistical mechanics-specification of states of a system-contact between statistics and thermodynamics-classical ideal gas-entropy of mixing and Gibb's paradox

UNIT 3

Micro canonical ensemble - phase space - trajectories and density of states - Lowville's theorem - canonical and grand canonical ensembles-partition function - calculation of statistical quantities - Energy and density fluctuations.

UNIT 4

Statistics of indistinguishable particles - Maxwell- Boltzman, Fermi Dirac and Bose Einstein statistics-properties of ideal Bose and Fermi gases-Bose-Einstein condensation

UNIT 5

Phase transitions- phase diagram for a real gas- Analogy of fluid and magnetic systems- Cluster expansion of classical gas - Landau theory of phase transition - critical indices - scale transformation and dimensional analysis.

Course Outcomes

At the end of the course, students will be able to

- CO1. Apply basic knowledge of Thermodynamics co-ordinates and potentials to systems
- CO2. Understand the statistical nature with specific examples of binomial and poisson's distributions
- CO3. Understand the concept of micro canonical ensembles and relations between partition function and thermo dynamical potentials
- CO4. Apply statistical relations in phase transition problems of Liquid – Vapor phase
- CO5. Application of statistical relations to study para, Ferromagnetism and Superconducting phase transitions

Text Books:

F Reif, *Foundations of Statistical and Thermal Physics*, TMH, IE, 2011

Reference Books

1. Silvio Salinas, Introduction to Statistical Physics, Springer Indian Reprint, IE, 2006
2. Statistical Mechanics - R K Pathria
3. Statistical and Thermal Physics – Landau and Lifshitz
4. Statistical Physics- An Introductory course, Daniel J Amit and Yosef Verbin- World Scientific Co Pvt Ltd, 1995

18PHY514

Advanced Electrodynamics

3 1 0 4

Course Objective:

Having successfully completed this module, the student will be able to demonstrate knowledge and understanding of: The connection between Electromagnetic phenomena and light, Wave equations for electromagnetic waves, Reflection and Transmission in dielectric media, Reflection and Transmission in conducting media, Waveguides, Radiation, Power radiated by a point charge, The physical basis of radiation reaction. Special theory of relativity and its connection to Electrodynamics, Applications of electrodynamics in modern experimental techniques, Basic charged particle optics, Theory of linear accelerators.

Unit 1

The wave equation, Sinusoidal waves, Boundary conditions: Reflection and Transmission Polarization, The wave equation for E and B, Monochromatic plane waves, Energy and Momentum in Electromagnetic Waves, Propagation in linear media, Reflection and Transmission at Normal Incidence, Reflection and Transmission at Oblique Incidence.

[14 hrs]

Unit 2

Electromagnetic Waves in Conductors, Reflection at a Conducting Surface, The frequency dependence of Permittivity, Wave Guides, The waves in a Rectangular Wave Guide, The Coaxial Transmission Line.

[12 hrs]

Unit 3

Definition of radiation, Electric dipole radiation, Magnetic dipole radiation, Radiation from an arbitrary source, Power radiated by a point charge, Radiation reaction, The physical basis of radiation reaction.

[10 hrs]

Unit 4

Einstein's postulates, Geometry of relativity, The Lorentz transformations, The Structure of space time, Proper time and proper velocity, Relativistic energy and momentum, Relativistic kinematics, Relativistic dynamics, Magnetism as a relativistic phenomenon, How the fields transform, The field tensor, Electrodynamics in tensor notation.

[14 hrs]

Unit 5

Applications of electrodynamics in modern experimental techniques, Basic charged particle optics,

Theory of linear accelerators, Wancroft accelerators, pulsed drift tubes, rf linacs, circular accelerators and synchrotron radiation. Basic beam line equipment and design.

[10 hrs]

Course Outcomes

After completion of the course, students will be able to

CO1 : Understand energy and momentum associated with electromagnetic waves and the propagation of electromagnetic waves in linear medium

CO2: Apply the concept of propagation of em waves in wave guides to understand the Designing aspects of a simple microwave wave guide.

CO3. Understand the physical basis of simple dipole radiation and radiation reaction

CO4. Apply the concepts of relativistic principles to understand electrodynamics

CO5. Apply the concepts of electrodynamics in modern experimental techniques

Textbooks

1. Introduction to electrodynamics – David J Griffiths, 4th edition, Pearson publication

Reference books

1. J.D. Jackson, Classical Electrodynamics, 3E, Wiley, 2007
2. W, Greiner, Classical Electrodynamics, 1E, Springer, 2006
3. The Physics of Particle Accelerators: An Introduction - Klaus Wille, Oxford University Press, 2000

18PHY515

EXPERIMENTAL TECHNIQUES

3 1 0 4

Expected Outcomes:

- (a) Build up on existing idea of probability to analyse continuous distribution functions
- (b) Review error propagation and linear/non linear regression analysis
- (c) Introduction and definite level of understanding in principles of diffraction, and spectroscopy

Unit I:

Error and data analysis:

Review of error analysis – estimate confidence intervals – statistical inferences – linear and non linear regression analysis including analysis of fits (χ^2 test), correlation analysis (R^2)

Unit II:

Review of Fourier Transforms:

Time domain and frequency domain spectra, Implementing Fast Fourier Transforms.

Unit III:

X-ray diffraction and detectors

Production of X-rays, Scattering from an electron, atom and unit cell (calculation of structure factors), Powder X-ray diffraction and determination of crystal structures from diffraction data, particle and photon detectors: GM counter, Scintillation detector, Proportional counter

Unit IV:

Microscopy

Scanning electron microscopy and transmission electron microscopy – Discussion of electron sources, Secondary and Back scattered electrons, analytical electron microscopy, electron diffraction, amplitude and phase contrast microscopy.

Unit V:

Spectroscopy

Review of IR, EPR and NMR spectral lines including selection rules, calculation of g -factor, instrumentation for IR, EPR and NMR

Course Outcomes:

At the end of the course students will be able to

- CO1. Understand the existing idea of probability to analyze continuous distribution functions
- CO2. Apply error analysis and quantification of error propagation in linear/non-linear systems
- CO3. Understand and apply Fourier transforms and their relevance in extracting signals from time domain and displaying in frequency domain
- CO4. Understand the principles of diffraction, and various types of spectroscopy.
- CO5. Interpret 1D X-ray diffraction data, understand imaging modes in microscopes and interpretation of signals from various spectroscopic instruments

Text Books:

For Error analysis (Unit I):

1. Bevington and Robinson, Data Reduction and Error Analysis for the physical sciences, 3rd Ed., McGraw-Hill Education, 2002.
2. John. R Taylor, An introduction to error analysis: The study of uncertainties in physical measurements, 2nd Ed., University Science Books, 1997.

For Fourier Transforms (Unit II):

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Ed., Wiley, 2015.
2. J. F James, A students guide to Fourier Transforms, 3rd Ed., Cambridge University Press, 2012.

For X-ray diffraction and detection (Unit III):

1. S S Kapoor and V S Ramamoorthy, Nuclear Radiation detectors, New Age International, 1993.
2. Ramakanth Hebbar, Basics of X-ray diffraction and its applications, 1st Ed., I. K. International Publishing House, 2011.
3. B E Warren, X-ray diffraction, New edition Ed., Dover Publications Inc. 1990.

For Microscopy (Unit IV):

1. Ray F Egerton, Physical Principles of Electron Microscopy: An introduction to SEM, TEM and AEM, Springer, 2005.

For Spectroscopy (Unit V):

1. Colin Banwell, Elaine Mccash, Fundamentals of Molecular spectroscopy, McGraw Hill Education, 4th Ed., 1994.
2. “Instrumental methods of analysis” by Williams, Merrit, Dean and Settle (*Chemistry section of our library*)

Reference books:

1. Schaums Series on Probability and Statistics
2. “Elements of X-ray diffraction”, B. D. Cullity
3. “Transmission electron microscopy” by Williams and Carter
4. “X-ray diffraction : In crystals, Imperfect crystals and amorphous bodies” by A Guiner
5. “X-ray diffraction” by West

18PHY583

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.

Course Outcomes

At the end of the course students will be able to:

- CO1. Apply the technical knowledge gained from electronics courses that they have studied in design and analysis of circuits
- CO2. Analyze and design simple circuits using diodes and transistors as well as higher level Circuits employing integrated-circuit operational amplifiers according to the required specifications and also to evaluate combinational and sequential logical digital circuits
- CO3. Program and construct applications using a microcontroller (Arduino),

TEXTBOOK/ REFERENCES:

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

18PHY601

Atomic Molecular and Optical Physics

3 1 0 4

Course Objective:

Having successfully completed this module, the student will be able to demonstrate knowledge and

understanding of: Origin of line widths and shapes in atomic spectra, Quantum number and their physical significance, Quantum mechanical states of the hydrogen atom, Effect external electric and magnetic fields on atoms, Origins of fine structure in atomic spectra, Hyperfine structure and Lamb shifts, Origin of molecular spectra, Bonding and antibonding orbitals, Molecular symmetry, Vibration spectroscopy, Einstein A and B coefficients and the relationship between them and various line broadening mechanisms.

Note:

Existing title is an obsolete usage. The new title is suggested in the brackets. Also, the existing syllabus is bit too lengthy and it has been modified with relevance to the ongoing research areas of our campus.

Unit 1

One electron atoms -1:

Brief Review of Quantum mechanics. One electron atoms: Operators and observables, Angular momentum, Schrodinger equation for one electron atoms, energy levels, eigen function of the bound states, Expectation values and the Virial theorem.

Unit 2

One electron atoms -2: Fine structure of Hydrogen like atoms, Zeeman Effect, Stark effect, Lamb shift, Hyperfine structure and isotope shifts.

Unit 3

Molecular structure and Spectra:

Nature of Molecular structure, Electronic structure of Molecules, Building principle: determination of term manifold, LCAO approximation, Molecular Orbital theory treatment of H_2^+ and H_2 electronic energy levels, σ and π – bonds, Formation of bonding and anti-bonding orbitals from atomic orbitals in simple diatomic molecules.

Unit 4

Molecular symmetry and vibrations: Properties of Symmetry, Point groups, Characters and representation groups, Reducible and irreducible representations, Normal co-ordinates and normal modes of vibration, Infrared and Raman spectra, Selection rules, Application of group theory to molecular vibrations

Unit 5

Absorption and emission of radiation: Interaction of radiation with matter, Einstein's A and B coefficients, Beer's law for normal absorption, electric dipole approximation, width and shape of spectral lines, Homogenous and inhomogeneous broadening, natural broadening, Doppler broadening, Doppler broadening: estimation of half-widths, external effects – collision broadening and pressure broadening.

Course Outcomes:

- CO1. Students would be able to apply the quantum theory of angular momentum to problems on atomic spectroscopy.
- CO2. Students would be able to analyze the effect of electric and magnetic fields on atomic spectra.
- CO3. Students would be able to interpret molecular spectra of certain standard molecules.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3												3			
CO2		2											2			
CO3				2	2								2			
CO4																
CO5																

Text books

1. B. H. Bransden and C. J. Joachain, Physics of Atoms and Molecules, 2nd Ed., Prentice Hall, 2003.
2. C.J. Foot, Atomic Physics, 1st Ed., Oxford Master Series in Physics, 2004.

Reference books

1. Peter W. Atkins and Ronald S. Friedman, Molecular Quantum Mechanics, 5th Ed., Oxford University Press, 2012.
2. Demtröder, Wolfgang, Atoms, Molecules and Photons: An Introduction to Atomic-Molecular- and Quantum Physics, Springer-Verlag Berlin Heidelberg, 2010.

18PHY602

Condensed Matter Physics

3 1 0 4

Prerequisites:

This course requires the basics of solid state physics, electrodynamics, quantum mechanics and statistical physics.

Course outcome:

This course gives an extended knowledge about crystalline structure and defects, electronic band structure, electrical, thermal and magnetic properties of solid state systems and their technological applications.

UNIT 1

Review on crystal physics: Crystal Structure and symmetry, Point and Space groups, Crystal systems, planes and direction, Structure Property-Relations, Diffraction of waves by crystals, Scattered wave amplitude: Fourier analysis, Reciprocal Lattice vectors, Diffraction conditions, Laue equations, Brillouin zones: Reciprocal lattice to SC, BCC and FCC lattice, Fourier analysis of Basis: Structure and atomic Form factor.

Crystal defects: Classification of defects - Points defect - The Schottky defect - The Frenkel defect - colour centers - F center - other colour centers - Dislocations - Slip and plastic deformation - Shear strength of single crystals - Edge dislocation - Screw dislocation - Stress field around an edge dislocation. (5 hrs)

UNIT 2 Metals I : The Free-Electron model

Free electron gas in three-dimension, Heat capacity of the free electrons, Electrical conductivity; effects of Fermi surface, Motion in magnetic fields; cyclotron resonance and the Hall effect, Thermal conductivity in metals

Unit 3:

Energy Bands in Solids and Fermi surfaces: Nearly free electron model: Origin of Energy Gap, Brillouin zones, Bloch functions, Construction of Fermi surfaces, Tight binding method for energy bands, Wigner-Seitz method, Cohesive energy, Pseudopotential methods, Experimental methods in Fermi surface studies; Quantization of Orbits in a Magnetic field, De Haas-van Alphen Effect, Landau levels

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

UNIT 4 Semiconductors

Semiconductors: energy band structure, intrinsic and extrinsic semiconductors, Fermi levels of intrinsic and extrinsic semi-conductors, Direct and indirect gap semiconductors, Effective mass, Hydrogenic model of impurity levels and p-n junctions: theory of I-V characteristics, Schottky-barrier.

UNIT 5 Magnetism

Langevin theory of diamagnetism and paramagnetism, Quantum theory of Diamagnetism of Mononuclear systems, Quantum theory of paramagnetism: Rare Earth Ions, Hund Rules, Iron group ions, Crystal field splitting, Cooling by Isentropic Demagnetization, Paramagnetic susceptibility of conduction electrons, Ferromagnetism and antiferromagnetism: Ferromagnetic order, Curie point and exchange integral, Temperature dependence of saturation magnetization, Ferrimagnetic order: Curie temperature and susceptibility of ferrimagnets, antiferromagnetic order, susceptibility below Neel temperature, Ferromagnetic domains.

Course Outcomes:

On completion of the course students will be able to

CO1. Acquire knowledge on Bravais lattices, symmetry, defects in crystals and the concepts of reciprocal lattice and diffraction

CO2. Comprehensive understanding on the basic approaches to the formation of electronic Band structure of materials and the Fermi surfaces

CO3. Understand the different theories of superconductivity and its applications

CO4. Describe the behaviour of the carriers in semiconductors, doping, formation of

Junctions and their characteristics.

CO5. Acquire complete knowledge on the classical and quantum theories of the different

types of magnetism and elucidate the exchange interaction and domain theories of ferromagnetism.

Text Books/ References:

1. N.W. Ashcroft and N.D. Mermin, Solid State Physics, Brooks Cole, 1 E12003.
2. Ibach and Luth, Solid State Physics, Springer India, 3E, 2002.
3. M.Marder, Condensed Matter Physics, Wiley Intersciences, 1E, 2000.
4. Charles Kittel, *Introduction to Solid State Physics*, Wiley, 8th Edition, Reprint: 2016
5. M. Ali Omar, Elementary Solid State Physics: Principles and Applications, Pearson Education India.
6. Adrianus J. Dekker, Solid State Physics, Library of Congress Catalog Card No.: 57-8688, 1958.

18PHY603

Nuclear and Particle Physics

3 1 0 4

Unit I

Basic Concepts: History and Overview, Units and Dimensions, Nuclear Properties, Radius, Mass and Abundance of nuclides, Binding energy, Angular Momentum, Spin and Parity, Electromagnetic moments and Nuclear excited states

Unit II

Nuclear Structure: The Deuteron, Nucleon-Nucleon Scattering, Proton-Proton and Neutron-Neutron Interactions, Properties of Nuclear Forces, The Exchange Force Model, Nuclear Models, Liquid-Drop Model, Shell Model, Collective Model of the Nucleus

Unit III

Radioactive Decay: Alpha Decay, The Q-value of alpha decay, Gamow's theory of alpha decay, Beta decay, Fermi theory of beta decay, Parity violation in beta decay, Gamma Decay, Internal conversion, Nuclear Isomers

Unit IV

Nuclear Reactions: The Optical Model, The Compound Nucleus and Direct Reactions, Resonance Reactions, Heavy-Ion Reactions, Nuclear Fission, Characteristics of Fission, Energy in Fission, Nuclear Fusion, Characteristics of Fusion, Solar Fusion

Unit V

Particle Physics: Particle Interactions and Families, Symmetry and Conservation laws, Standard Model, Quark Dynamics, Grand Unified Theories

Course Outcomes

After completion of the course student should be able to:

CO1: Understand the key ideas and terminologies of nuclear physics.

CO2: Understand various nuclear models and solve various problems related to nuclear structure.

CO3: Analyze and solve problems related to nuclear reactions.

CO4: Understand basic aspects of particle physics

Text Book:

S. Krane, Introductory Nuclear Physics, 2nd Ed., Wiley India Pvt Ltd, 2013.

Reference Book:

V. Devanathan, Nuclear Physics, Narosa Publishing House, 2012.

18PHY681

SPECTROSCOPY LAB

0062

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

Course Outcomes:

On completion of the course students should be able to:

CO1. Enhance instrumentation skills by constructing simple instruments related to spectroscopy

- CO2. Understand the principles of spectroscopic instruments.
CO3. Obtain and analyze atomic spectra of different elements.

18PHY696

DISSERTATION

18 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.

Course Outcomes

At the end of this course, students will be able to

- CO1. Understand and practice scientific recording and reporting.
CO2. Apply and put to use the methods of analytical, logical and scientific reasoning that
Have been taught in the various subjects to address a relevant real time problem with clear objectives, depth and a well articulated roadmap.
CO3. Gain better knowledge of the use of analytical, theoretical and experimental tools to solve/design/study a problem/system.
CO4. Enhance presentation and communication skills.

18PHY697

Viva-voce

1 cr

A comprehensive viva-voce will be conducted to assess the general understanding of the student in the basic courses that he/she has studied. It will not be topic-specific, but will cover both basic and PG level of physics. This is meant to evaluate the student's grasp on the subject, and also to help students face interviews.

ELECTIVES

18PHY331

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.

Course Outcomes:

On Successful completion of the course, the student will able to

- CO1: Understand the technical details of modern medical ultrasound devices and explain the principles underlying ultrasound propagation and echo imaging
- CO2: Acquire knowledge on the physics and technology of medical x-ray system, the design parameters that determine image contrast, spatial resolution and patient radiation dose
- CO3: Gain knowledge on physics of nuclear radiations and concepts relevant to the profession of Nuclear Medicine and the radiation safety measures
- CO4: Understand the fundamentals of magnetic resonance technology and describe the physics of magnetic resonance, image formation and the components of modern day magnetic resonance imaging
- CO5: Elucidate the characteristics of Lasers, technical aspects in laser radiation and gain knowledge on the use of laser in surgery and as diagnostic tool

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	1			2				1			3	3		2
CO2	3	3	1			2				1			3	3		2
CO3	3	3	1			2				1			3	3		2

CO4	3	3	1			2				1			3	3		2
CO5	3	3	1			2				1			3	3		2

TEXTBOOK:

1. *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)*

18PHY333 INTRODUCTION TO NANOPHYSICS AND APPLICATIONS 3 0 0 3

Unit 1

Introduction: relation of nano to other sciences - chemistry, biology, astronomy, geology, nano in nature.

Unit 2

Properties of nanomaterials: size effect, particle's size, shape, and density, melting point, surface tension, wettability, surface area and pore, composite structure, crystal structure, surface characteristics; mechanical, electrical, properties, and optical properties.

Unit 3

Synthesis of nanoparticles: Classification of fabrication methods – top-to-bottom and bottom-to-top approaches, physical and chemical methods of preparation: CVD, controlled precipitation, sol-gel method, PLD etc; Confinement of particles - low dimensional structures - quantum wells, wires and dots.

Unit 4

Characterisation of nanoparticles: X-Ray diffraction, examples of XRD, Debye-Scherrer formula; FTIR: principle, methodologies and accessories; SEM: basics and primary mode of operation, applications; TEM: basic principles; STM: basic principles and instrumentation; AFM: basics, modes of operation and applications; Photoluminescence: basic principles.

Unit 5

Application of nanophysics: Carbon nanostructures: Fullerenes, CNTs and their applications; MEMS and NEMS devices; Quantum Cascade Lasers, Smart materials, GMR and Spintronic, multiferroics.

Course Outcomes

- CO1. Understand the fundamental physical principles, which govern properties of the condensed matter and in particular the role of dimensionality on the mechanical, thermal, optical, electrical and magnetic properties of materials.
- CO2. Understand the physical basis of new phenomena that appear when the linear dimension of an object or device shrinks below a micrometer
- CO3. Be familiar with the methods for fabrications of nanostructures
- CO4. Understand and be able to explain the principles of newly characterization techniques for imaging and analysis of nanostructures and Nanomaterials.
- CO5. Understand and be able to explain the principles of operation of nanoelectronic and nanophotonic devices and be able to apply their knowledge for understanding further developments in this rapidly emerging area.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	
CO1	3								
CO2		2	2						
CO3	2								
CO4	1			2					
CO5	1				1				

References:

1. Charles P Poole Jr. & Frank J Owens, Introduction to Nanotechnology, 1E, Wiley, 2007
2. W.R Fahner (Ed.), Nanotechnology and Nano electronics, Springer, 2006
3. M Hosokawa, et al, Nanoparticle Technology Handbook, Elsevier Publishers, 2007
4. S.V. Gaponenko, P.L Knight & A. Miller, Optical Properties of Semiconductor Nanocrystals, CUP, 1E, 2005
5. T Pradeep, Nano: The Essentials, TMH, 1E, 2007

18PHY335

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 H₂O₂, nucleic acid structure, monomers, polymers, double helical structure of DNA, Polymorphism and nanostructure 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.

Course Outcomes:

On Successful completion of the course, the student will able to

- CO1: Understand the various physico-chemical techniques used to study the biomolecules.
- CO2: Understand and explain the different spectroscopic techniques required to analyze the biomolecules
- CO3: Gain the fundamental knowledge of the molecular modeling and macromolecular structures such as DNA, RNA and Proteins
- CO4: Understand the basics of energy pathways in biology, biomechanics and the biophysics of nervous system.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2		2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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.

Unit 1

Astronomy, an Observational Science: Introduction - Indian and Western Astronomy– Aryabhata - 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 – Blackbody 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 – Radioreceivers - 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.

Course Outcomes:

After completion of the course students should be able to

CO1: Learn theoretical methods and observational tools in astronomy.

CO2: Apply theoretical models to solve astronomical problems.

CO3: Develop critical/logical thinking and scientific reasoning in the area of astronomy.

CO-PO Mapping:

	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3	PS O4
CO1	3												3			
CO2		3												3		
CO3		3														1

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

18PHY338**COMPUTATIONAL METHODS FOR PHYSICISTS****3 0 0 3****Unit 1****Differentiation:**

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

Unit 2**Integration:**

Newton-cotes expression for integral, trapezoidal rule, Simpson'srule, Gauss quadrature method.

Unit 3**Solution of Differential Equations:**

Taylor series method, Euler method, RungeKutta 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 elimination method, pivotal condensation method, Gauss-Seidel 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.

Course Outcomes:

At the end of the course, students will be able to

CO1: Learn basic concepts of numerical methods for differentiation and integration.

CO2: Learn numerical methods for solving algebraic and differential equations.

CO3: Apply to solve basic and advanced physics.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3												3			
CO2	3														2	
CO3		3													2	

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)

18PHY339 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 Tunneling Diode, Quantum Cascade lasers, Single Electron Transistors - Operating principles and applications.

Course Outcomes

At the end of the course, students will be able to

- CO1. Understand the fundamental physical principles, which govern properties of the condensed matter and in particular the role of dimensionality on the mechanical, thermal, optical, electrical and magnetic properties of materials.
- CO2. Understand the physical basis of new phenomena that appear when the dimension of an object or device shrinks below a micrometer
- CO3. Familiarize the various methods for fabrication of nanostructures
- CO4. Understand and explain the principles of characterization techniques for the analysis of nanostructures and nanomaterials
- CO5. Understand and explain the principles of operation of nanoelectronic and nanophotonic devices.

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 & Sons, Inc., Publication
2. T. Pradeep, "Nano the essentials understanding nanoscience and nanotechnology", Professor Indian Institute of Technology, Madras, Chennai, India.

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.

Course out comes:

At the end of the course Students will be able to

- CO1. Understand and analyze the problems related to Laser parameter, lasing mechanism and their usage.
- CO2. Understand and analyze the basic parameters of optical fibers and signal transition through optical fibers.
- CO3. Understand and analyze the basic problems in usage of optoelectronic devices, its limitations and usage parameters.
- CO4. Understand and analyze the non linear behavior of light in different medium and its consequences.

CO-PO Mapping:

	PO 1	P O 2	PO 3	P O 4	P O 5	P O 6	PO 7	PO 8	PO 9	PO 10	PO 11	P O 1 2	P S O 1	P S O 2	P S O 3	P S O 4
CO1	3	3	2		2								3	3		
CO2	3	3	2		2								3	3		
CO3	3	3	2		2								3	3		
CO4	3	3	2		2								3	3		

REFERENCES:

1. *Photonics: Optical Electronics in Modern communication (6th Edition, 2007), Amnon 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*

18PHY342

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 - Threephoton 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.

Course outcomes

At the end of the course students

CO01: will gain understanding of the concepts that underly the study of dynamical systems

CO02: will be able to analyse the second and third nonlinear optical responses of the material using symmetry

CO03: will be able to apply the optical response principles to phenomena based on frequency conversion, electro-optic effect, nonlinear index of refraction, and four-wave mixing

CO04: describe ultrafast nonlinear propagation dynamics of ultra-short pulses in waveguides in the presence of dispersion including self-phase modulation, soliton propagation and stimulated Raman scattering

CO05: Gain understanding about the various materials that exhibit nonlinear properties in view of material science.

	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3											2	3		
CO2	3	3											2	3		
CO3	3	3											2	3		
CO4	3	3		1									2	3		
CO5	3	2		1									2	3		

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.*

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 Fresnel 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.

Course outcomes:

After completion of the course, students will have knowledge and skills to:

- CO 1. Comprehend the basics of geometrical and wave optics to explain interference, diffraction and polarization.
- CO 2. Understand the basic principles and operation of various optical and electro-optic devices.
- CO 3. Apply the optics knowledge to describe optical processes like holography, optical signal processing and optical communication.

CO 4. Analyze the working of various optical instruments.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	3	3				2	1			3	3		2
CO2	3	3	3	3	3				2	1			3	3		2
CO3	3	3	3	3	3				2	1			3	3		2
CO4	3	3	3	3	3				2	1			3	3		2

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*

18PHY344 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.

Course Outcome:

Upon successful completion of this course, the student will be able to:

- CO1. Gain knowledge related to the fundamentals of crystal structures and defects.
- CO2. Understand and describe the classical and quantum free electron theory and the band theory of solids.
- CO3. Acquire and comprehend knowledge on different types of semiconductors and determination of carrier concentration, carrier generation - recombination mechanisms.
- CO4. Understand the theory and operations of p-n junction diode, bipolar and field effect transistors.
- CO5. Apply the acquired semiconductor knowledge to understand the operations of optoelectronic semiconductor devices and solving problems.

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.

18PHY345 PRINCIPLES OF LASERS AND LASER APPLICATIONS 3 0 0 3

Unit 1

Review of basic concepts and principles 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-efficients. Active material. Population inversion – concept and discussion about different techniques. Resonant cavity.

Unit 2

Gain mechanism, Threshold condition for population inversion, Emission broadening-line width, derivation of 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 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 lasers: (i) Ruby laser – Principle, Construction, working and application. (ii) Neodymium (Nd) lasers. Gas laser: (i) He-Ne laser - Principle, Construction, working and application. (i) CO₂ laser - Principle, Construction, working and application.

Liquid Chemical and Dye lasers. Semiconductor laser: Principle, Characteristics, Diode lasers, homo-junction and hetero-junction lasers, high power semi-conductor diode lasers.

Unit 4

Applications in Communication field: Laser Communication: Principle, construction, types, modes of propagation, degradation of signal, Analogue communication system, digital transmission, fiber optic 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.

Course outcomes:

After completion of the course, students will have knowledge and skills to:

CO1. Comprehend the basic principles of geometrical, wave optics and laser radiation.

CO2. Apply the knowledge of optics and quantum mechanics to analyze the processes involved in light amplification and oscillation.

CO3. Understand the characteristics of laser radiation and working of various types of lasers.

CO4. Apply the knowledge of laser characteristics to understand its use in medical field, industry and communication.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	3	3				2	1			3	3		2
CO2	3	3	3	3	3				2	1			3	3		2
CO3	3	3	3	3	3				2	1			3	3		2
CO4	3	3	3	3	3				2	1			3	3		2

REFERENCES:

1. William T Silfvast, "Laser Fundamentals", 2nd Ed., Cambridge University Press, UK (2008).
2. BB Laud, "Lasers and Non-linear Optics", New Age International (P) Ltd., New Delhi. (2011)
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 (2009).
5. T Suhara, "Semiconductor Laser Fundamentals", Marcel Dekker (2004).

18PHY346

Laser Theory

3 0 0 3

Unit 1

Thermal radiation: factors influencing coherence. Radiation in Vacuum: intensity, energy density and pressure of radiation. Radiation in a cavity: Modes of oscillation, black body radiation.

Unit 2

Radiation and Matter: mass and atomic absorption coefficients, Einstein coefficients, photo excitation cross-section, lifetimes of excited states, amplification of radiation, spectral line shapes, and line broadening mechanisms, gain profiles, threshold condition, gain saturation.

Unit 3

Optical Resonators: Fresnel number, time constant and Q factor of an optical cavity. Geometric theory : plane and spherical mirror resonator configurations, general conditions of stability, matrix treatment. Wave theory II confocal multimode resonators and fields, non confocal resonators, circular mirrors, spherical annular mirrors, unstable resonators, mode degeneracy, ring resonators.

Unit 4

Gain and saturation effects: Theory of gain saturation. Gain narrowing. Effect of gain saturation on modes. Power output, single mode operation, mirror transition and power optimization. Hole burning effects. Lab dip. Mode pulling, frequency bandwidth of laser output.

Unit 5

Q-modulation : High inversion fast switching case. Arbitrary inversion fast switching case, giant pulse dynamics. Mode locking: Generation and measurement of ultra short optical pulses. dynamics of mode locking, efficiencies of mode locking. Cavity dumping. Pulse amplification: Limitations of peak power. Pulse shortening. Amplified spontaneous emission and mirror-less lasers.

Course outcomes:

After completion of the course, students will have knowledge and skills to:

- CO 1. Understand the behavior of radiation under various conditions.
- CO 2. Have a theoretical understanding of the processes involved in laser.
- CO 3. Apply the knowledge of electromagnetic radiation to understand the radiation behavior in optical resonators.
- CO 4. Understand the modification of laser output.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	3	3				2	1			3	3		2
CO2	3	3	3	3	3				2	1			3	3		2
CO3	3	3	3	3	3				2	1			3	3		2
CO4	3	3	3	3	3				2	1			3	3		2

References :

1. A. Maitland and M.H. Dunn, Laser Physics, North Holland (1970).
2. A. Yariv, Quantum Electronics, John Wiley (1975).
3. M. Sargent III, Marian O Scully, and W.E. Lamb, Laser Physics, Addison-Wesley (1974).
4. W.V. Smith and P.P. Sorokin, The Laser, McGraw-Hill (1966).
5. J. T. Verdeyen, Laser Electronics, Prentice Hall (1981).
6. A. Yariv, Optical Electronics, Holt Rinehart & Winston (1976).
7. Laser Theory, Encyclopedia of Physics, Vol. 25/20, Springer (1984).
8. D.C.O. Shea, W.R. Callen and W.T. Rhodes, Introduction to Lasers and Their Applications, Addison Wesley (1978).
9. O. Svelto, Principles of Lasers, Plenum (176).

18PHY347

Laser Applications

30 03

Unit 1

Characteristics of laser radiation. Propagation of Gaussian beams
Holography, HNDDT (Holographic Non -Destructive Testing) holographic storage, optical disk storage.

Laser speckle and speckle meteorology, SNTD (Speckle Non - Destructive Testing).

Unit 2

Optical computing and signal processing, fiber optical communication, Robotics, laser- based guidance and control.

Unit 3

Spectroscopic applications of lasers: saturation spectroscopy, excited state spectroscopy nonlinear spectroscopy, time domain and its applications.

Unit 4

Lasers and interaction with matter: materials processing, cutting, drilling, welding, alloying, glazing, oblation, laser chemical vapour deposition (LCVD), laser thermal deposition, hardening, annealing.

Laser fusion, Isotope separation, Medical applications, photo-chemical applications

Unit 5

Fiber-optic sensors: intensity, phase, polarization and frequency dependent techniques.

Laser Doppler Anemometry .principles, two-component measurement technique.

Lasers as frequency standards

Course outcomes:

After completion of the course, students will have knowledge and skills to:

- CO1. Understand the characteristics of laser radiation.
- CO2. Comprehend the use of laser radiation for holography, optical disk storage and metrology.
- CO3. Apply the knowledge of laser characteristics to understand optical computing and laser based guidance and control.
- CO4. Understand the application of laser radiation in industry, nuclear and medical applications.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	3	3				2	1			3	3		2
CO2	3	3	3	3	3				2	1			3	3		2
CO3	3	3	3	3	3				2	1			3	3		2
CO4	3	3	3	3	3				2	1			3	3		2

References :

1. Monte Ross (Ed.), Laser Applications, Vol.1,Academic Press (1971).
2. S. Dubois and F.T. Arecchi (Ed.), Laser Handbook, Vols. 1-4, Norlh Holland (1972).
3. K. Koebner (Ed.), Industrial Applications of Lasers, Wiley (1984)
4. J.T. Cuxon and D.E. Parker, Industrial Lasers and their Applications, Prentice Hall (1985).
5. B. Culshaw, Optial Fiber Sensing and Signal Processing, Peter Peregrinus Ltd. (1984).
6. F.C. Appard, Fiber Optics Handbook, McGraw-Hill (1989)

18CHY331

BATTERIES AND FUEL CELLS

3 0 0 3

Unit 1 Background Theory

(09 Hours)

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

(09 Hours)

The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells (comparative account).

Unit 3 Secondary Batteries

(09 Hours)

Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells (comparative account) Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 4 Fuel Cells

(09 Hours)

Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells. Membranes for fuel cells: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.

Unit 5 Fuels for Fuel Cells

(09 Hours)

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.

Outcomes:

- CO1: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics
- CO2: Learn the application of the electrochemical principles for the functioning and fabrication industrial batteries and fuel cells
- CO3: Analysis of practical problem solving in fabricating batteries and fuel cells
- CO4: Evaluation of comprehensive knowledge through problem solving

TEXTBOOKS:

1. Dell, Ronald M Rand, David AJ, 'Understanding Batteries', Royal Society of Chemistry, (2001).
2. M. Aulice Scibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India (2006).

REFERENCES:

1. Kanani N, 'Electroplating and electroless plating of copper and its alloy', ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).
2. Curtis, 'Electroforming', London, (2004).
3. F. Barbir, 'PEM fuel cells: theory and practice', Elsevier, Burlington, MA, (2005).
4. G. Hoogers, 'Fuel cell handbook', CRC, Boca Raton, FL, (2003).

18CHY353

FORENSIC SCIENCE

3 0 0 3

UNIT I INTRODUCTION

Origin of forensic science, need for forensic science, trace and contact evidence, marks and impression, examination of documents, blood stain analysis, microscope in analysis, explosives, chemical analysis of explosives, forensic laboratories and courses in India.

UNIT II NARCOTICS

Narcotics, classification of drugs, specific drugs- Psychotropic drugs, chemical screening of drugs, chemical extraction and sample preparation, chemical identification of drugs using analytical methods.

UNIT III FINGERPRINTING and FIREARM ANALYSIS

History of fingerprinting, principles of fingerprinting, constituents of latent finger marks, fingerprint detection, chemical methods of detection, firearm examination, chemical analysis of firearm, analysis of gunshot residue.

UNIT IV TOXICOLOGY

Introduction to Toxicology, alcohol and human body, testing of blood alcohol concentration, Toxins & Biological Poisons, Measuring Toxicity as LD50, sample and analysis, inorganic poisons, nerve agents, radioactive toxins, Pharmacokinetics and Toxicokinetics, tests for toxins, reported case studies.

UNIT V POSTMORTEM TOXICOLOGY

Introduction, tissue and fluid specimens, specimen collection and storage, extraction procedure, analytical techniques, interpretation, case studies

Course Outcomes:

CO1: Able to understand the different classification of drugs, their identification and its effect on human mind.

CO2:Develop good knowledge on the methods employed in the analysis of firearm and fingerprints.

CO3:Acquire adequate knowledge in different types of toxins and post-mortem.

CO-PO mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-

Reference Books:

1. Lawrence Kobilinsky, Forensic Chemistry Handbook, John Wiley & Sons, New Jersey, 2012
2. David E. Newton, Forensic Chemistry, Facts On File, Inc, New York, 2007
3. Jay A. Siegel, Forensic Chemistry fundamentals and applications, Wiley Balckwell.
4. Suzanne Bell, Drugs, Poisons, and Chemistry, Facts On File, Inc. New York, 2009.

18CHY348 ELECTROCHEMISTRY

3 1 0 4

Course Objective:

To provide comprehensive understanding on the applications of electrochemistry in energy production and storage systems and in industrial electrochemical processes.

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 – Nernstequation - 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.

Course Outcome

- CO1: To acquire a firm foundation in the fundamentals of electrochemistry
CO2: To develop knowledge on various energy production and storage systems like primary, secondary and reserve batteries, fuel cells etc.
CO3: To gain theoretical understanding of several electrochemical processes and their role in industrial development
CO4: To be able to identify types of corrosion and to implement controlling methods

CO-PO Mapping

CO	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	1	3	2	3	3	2	3	-	-	-	-	-	2	2	2	-
CO3	1	3	2	2	3	2	2	-	-	-	-	-	2	2	2	-
CO4	1	3	2	1	3	2	2	-	-	-	-	-	2	2	1	-

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).

18CHY631

Applied Electrochemistry

3-0-0-3

Unit 1 Electrodictics

(08 Hours)

Electron transfer under an interfacial electric field. A two way traffic across the interference: equilibrium and exchange current density. Dependence of the electrochemical reaction rate on over potential- quantitative version of the Butler-Volmer equation. Electrode kinetics involving the semiconductor/ solution interface. Techniques of electrode kinetics- preparation of electrode surface. Microelectrodes- applications

Unit 2 Industrial Cathodic Process

(09 Hours)

Electrodeposition of copper, nickel and chromium over mild steel – Zinc plating on MS – decorative plating of silver and cold- nano plating and microstructure of deposits – Test of adhesion, hardness, thickness, uniformity and corrosion resistance of the electro deposits- post plating passivation processes – barrel plating of small components- electroless deposition of nickel, copper, gold on metal components – making of waveguides and plated through hole boards

Unit 3 Industrial Anodic processes

(09 Hours)

Anodising of aluminium and its alloys – bath used, operating conditions and sequence determination of thickness- industrial applications- nano anodizing of titanium and tantalum- application to sensor filed. Electropolishing of ferrous and non-ferrous metals and alloys – mechanism of electropolishing – Electrochemical etching of ferrous and non-ferrous metals- Special processes: Electrolysis of water – electrowinning of aluminium and sodium – electrolysis of brine – photoelectrochemistry

Unit 4 Electrochemical Energy Systems

(10 Hours)

Primary batteries: Zinc-carbon (Leclanche type), zinc alkaline (Duracell), lithium primary cells- liquid cathode, solid cathode and lithium-ferrous sulphide 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) Advanced batteries for electric vehicles, requirements of battery – sodium-beta and redox batteries. Reserve batteries thermally activated batteries – remote activation – pyrotechnic materials: Fuel cells: Principle, proton exchange membrane (PEM), direct methanol (DMFC), molten carbonate electrolyte (MCFC) fuel cells and outline of biochemical fuel cells.

Unit 5 Electro chemical sensors

(09 Hours)

Potentiometric sensors, solid state Potentiometric chemical sensors, polymeric membrane sensors, ion selective field effect transistor, application, hydrovolumetric technique – hydrodynamic voltammetric application, voltammetric sensors- electrode modification application, optical sensors bioamperometric titration. Methods involving forced convection- hydrodynamic methods

Course Outcomes:

CO1: Understand the science of electrode solution interface and its application in different electrochemical processes.

CO2: Apply the knowledge of electrochemistry for designing electrochemical cells, chemical sensors and industrial electrochemical processes.

CO3: Develop skills in fabricating energy sources and chemical sensors based on fundamental concepts of electrochemistry.

CO-PO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	3	2	-	-	-	-	-	-	-	-	-	-	-

Text Books

1. Allen J Bard and Larry R. Faulkner, 'Text book for electrochemical Methods' 2 nd edition, Wiley, 2000.
2. Derek Pletcher and Frank C. Walsh, 'Industrial Electrochemistry', Blackie Academic and Professional, (1993)

References

1. Christopher M.A. Brett, 'Electrochemistry – Principles, Methods and Applications' oxford university, (2004).

18PHY632

Astrophysics

3 0 0 3

Unit 1

Astronomical units, Universal Law of Gravity - Derivation of Kepler's law of planetary motion,

The Sun – Structure and various layers, sunspots, flares, faculae, granules, solar wind and solar

Atmosphere, properties of solar system, solar neutrino problem, The Planets - Planetary orbits - Orbital inclination - Secondary atmospheres- The evolution of the earth's atmosphere.

Unit 2

The Hertzsprung–Russell Diagram, Saha and Boltzmann equations-derivation and interpretation, Stellar evolution, Novae, Supernova explosions, Interstellar Matter, Jean's criteria, 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.

Unit 3

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 –

Super clusters

Course Outcomes:

After completion of the course students will be able to

CO1: Learn theoretical methods and observational tools in astrophysics.

CO2: Apply theoretical models to solve astronomical problems.

CO3: Develop critical/logical thinking and scientific reasoning in the area of astrophysics.

TEXTBOOK:

B. W. Carroll and D. A. Ostlie, An Introduction to Modern Astrophysics, 2nd edition, Addison Wesley, 2006.

REFERENCE BOOK:

K. D. Abhyankar, Astrophysics: Stars and galaxies, Universities Press India Ltd, 2001.

18PHY633

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 genomocs and proteomics, semiconductor quantum dots for bio imaging, metallic nano-particles and nano-rods for bio-sensing. Photonics and biomaterials: Bacteria as bio-synthesizers for photonic polymers.

Course Outcome:

By the end of the course, students should be able to

- CO1: Understand the interaction of light with cells and tissues, photo-excitation and optical imaging.
- CO2: Acquire knowledge on the use of microscopic techniques for analyzing the biological materials and bio-imaging.
- CO3: Gain knowledge on photonic biosensors, laser activated therapy, optical tweezers and the modern biophotonic techniques

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	1			1				1			2	3		2
CO2	3	3	1			1				1			2	3		2
CO3	3	3	1			1				1			2	3		2

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)*

18PHY634

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.

Course Outcomes:

After completion of the course students should be able to

CO1: Learn basic physics principles to understand Earth's atmosphere.

CO2: Develop analytical skills to solve problems related to Earth's Atmosphere.

CO3: Develop critical/logical thinking and scientific reasoning in the field of Earth's atmosphere.

CO-PO Mapping:

	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3												2			
CO2		3												2		
CO3		3														1

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

18PHY635

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.

Course Outcomes:

After completion of the course students should be able to

CO1: Learn basic and advanced physics principles to understand Earth structure and its evolution.

CO2: Develop analytical skills to solve problems related to Earth structure.

CO3: Develop critical/logical thinking and scientific reasoning in the field of planetary science.

CO-PO Mapping:

	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3												2			
CO2		3												2		
CO3		3														1

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.

18PHY636

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, Sensor system performance: basic specifications, Intensity modulated sensors, reflective concept, micro-bend concept, evanescent fibers 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.

Course Outcome:

On Successful completion of the course, the student will be able to

- CO1: Understand and gain knowledge on the technical aspects of electro-optic modulators and different types of fiber optical sensors
- CO2: Acquire knowledge on the working principle of grating based and interferometric fiber optic sensors
- CO3: Understand the basic concepts of biomedical and distributed fiber optic sensors and their industrial applications

Course Articulation Matrix:

	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	P S O 1	P S O 2	P S O 3	P S O 4
CO1	3	3	1				2			1		1	3	2		1
CO2	3	3	1				2			1		1	3	2		1
CO3	3	3	1				2			1		1	3	2		1

TEXTBOOKS:

1. Francis T.S Yu, Shizhuo Yin (Eds), *Fiber Optic Sensors*, Marcel Dekker Inc., New York, 2002
2. Dakin J and Culshaw 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

18PHY637

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, hollow 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 – linear 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).

Course Outcome:

By completion of the course, the student will able to

CO1: Acquire knowledge on the fiber classification and characteristics of optical fibers.

CO2: Describe the optical fiber fabrication process, theory of different modes and the modulators.

CO3: Understand and Gain knowledge on the passive and active components of fiber optic technology and the methods to determine the fiber quality.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO1 1	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	1				2			1		1	3	2		1
CO2	3	3	1				2			1		1	3	2		1
CO3	3	3	1				2			1		1	3	2		1

TEXTBOOKS:

1. Gerd Keiser, *Optical Fiber communications*, McGraw Hill, 200
2. Maynbay, *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 Derikson, *Fiber optic test and measurement*, Prentice hall,1998.
3. David Bailey and Edwin wright, *practical Fiber optics*, Elsevier 2003.
4. Franz and Jain, *optical Fiber communication systems and Components*, Naros Publishers, 2004.
5. Ajoy Ghatak and K.Thyagarajan, *Introduction to Fiber optics: Cambridge university press*,1999.

18PHY638

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.

Course outcomes:

After completion of the course, students will have knowledge and skills to:

- CO 1. Understand the nanoscale interaction of photons and electrons and familiarize with near field optics and microscopy techniques.
- CO 2. Apply the knowledge of quantum confinement to understand nanostructures used in photonics.
- CO 3. Understand nanocontrol of excitation dynamics and various growth and characterization techniques of nanomaterials.
- CO 4. To comprehend the concept of photonic band gap in crystals to apply for various applications.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	3	3				2	1			3	3		2
CO2	3	3	3	3	3				2	1			3	3		2
CO3	3	3	3	3	3				2	1			3	3		2
CO4	3	3	3	3	3				2	1			3	3		2

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 Princeton University Press.

18PHY639

NONLINEAR DYNAMICS

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 multi-degree-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.

Course outcomes

At the end of the course students

CO01: will gain understanding about sources and propagation of optical electromagnetic waves

- CO02: will be able to find fixed points and determine their stability, analyze limit cycles and their stability.
- CO03: will be able to analyze the various types of bifurcations in one dimension (saddle node, transcritical, and pitchfork) and two dimensions (homoclinic, degenerate, and Hopf),
- CO04: Gain an understanding of the properties of the most important strange attractors in discrete and continuous time

CO-PO Mapping:

	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3											2	3		
CO2	3	3											2	3		
CO3	3	3											2	3		
CO4	3	3		1									2	3		

TEXTBOOKS:

1. Richard H. Rand, *Lecture Notes on Nonlinear Vibrations, version 52, 2005. Available online at <http://audiophile.tam.cornell.edu/randpdf/nlvibe52.pdf>*
2. S.H. Strogatz, *Nonlinear Dynamics and Chaos with Applications to Physics, Biology, Chemistry and 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.*

18PHY640

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-Wigner 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.

Course Outcomes:

After completion of the course students should be able to

CO1: Get familiarize with the key ideas and application of scattering theory.

CO2: Developed analytical skills to solve problem related to nuclear reactions.

CO3: Learn basic principles and techniques related to nuclear detector and their application.

CO-PO Mapping:

	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	P S O 1	P S O 2	P S O 3	P S O 4
CO1	3												3			
CO2		3												3		
CO3		3													2	

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*

18PHY641 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 diodes, lasers, photo detectors, solar systems in optoelectronic devices.operation and characteristics; Light emittingcells. Relevance of III-V and IV-VI material-

Unit 5

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

Course Outcomes:

On completion of the course, students will be able to

- CO1: Understand the nature of semiconducting materials, their growth and the energy bands
- CO2: Acquire knowledge on the carrier dynamics and the mechanism of absorption, photoluminescence and photoconductivity in semiconductors.
- CO3. Understand the theory of p-n junction and heterojunctions
- CO4. Gain knowledge on the theory and operation of optoelectronic devices, optical wave guides, optical switches and modulators.

TEXTBOOK:

1. 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.

18PHY642 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.

Course Outcomes:

At the end of the course students should be

CO1. Able to define the concept of temperature at the level of few atoms.

CO2. Able to distinguish between classical and quantum phenomena of multibody systems.

CO3. Able to demonstrate the usefulness of the cold atom and cold ion techniques in spectroscopy over conventional methods.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PO16
CO1	3												3			
CO2		3											2			
CO3		1											2			
CO4																
CO5																

TEXTBOOKS:

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

18PHY643 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. Sakurai: *Advanced Quantum Mechanics*
3. Lee: *Particle Physics and Introduction to Field Theory*

18PHY644

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. Dicke's theory. Photon echoes. Quantum beats. Quantum chaos and instability hierarchies of laser light, chaos and its routes. Squeezed states of light.

Course outcomes

1. Comprehend and articulate the connection as well as dichotomy between theory of radiation and their energy quantization.

- Learn to apply theory of coherence to compute the degree of coherence of light.
- Understand the concept and technique of statistical optics of photons, quantum counting of photon and their coherence properties.

Course Articulation Matrix:

	P O1	P O2	P O3	P O4	P O5	P O6	PO 7	P O8	PO 9	PO 10	PO 11	P O 12	P S O 1	P S O 2	P S O 3	P S O 4
CO1	3	3	2		2								3	3		
CO2	3	3	2		2								3	3		
CO3	3	3	2		2								3	3		

REFERENCES:

- L. Mandel and E. Wolf, Coherence and Quantum Optics, Plenum (1973). 41*
- H. Haken, Light. Vol.1 & 2, North Holland (1981).*
- S.M. Kay and A. Maitland, Quantum Optics. Academic Press (1970).*
- R. Loudon, Quantum Theory of Light, Clarendon Press (1979).*
- J. Fox, (Ed.), Optical Masers, Interscience Publishers (1963).*
- R.G. Brewer and A. Mooradian, Laser Spectroscopy, Plenum (1974).*
- Laser Theory: Encyl. of Phy. Vol. 25/2C, Springer-Verlag (1976).*
- M.O. Scully, W.E. Lamb and M. Sargent III, Laser Physics, Addison Wesley (1974).*
- J. Jacob, M. Sargent III, Laser Applications to Optics and Spectroscopy, Addison Wesley (1975).*
- R.H. Pantell and H.E. Puthoff, Fundamentals of Quantum Electronics Wiley (1969).*

18PHY645

THIN FILM TECHNOLOGY

3 0 0 3

Unit 1

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

Unit 2

Thickness measurement and Characterisation: electrical, mechanical, opticalinterference, 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 - Effectof 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.

Course Outcomes

At the end of the course, students will be able

CO1. To understand the principle, differences and similarities, advantages and disadvantages of different thin film deposition methods.

CO2. To evaluate and use models for understanding nucleation and growth of thin films.

CO3. To analyze thin film properties to apply for various applications.

CO4. To improve problem solving skills related to evaluation of different properties of thin films.

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

18PHY646 FUNDAMENTALS OF PLASMA PHYSICS 3 0 0 3

Unit 1

Introduction – Spatial scale of an unmagnetized plasma – Debye Length, time scale plasma period, gyro-radius and gyro-frequency of magnetized plasma, single particle motion in prescribed fields - $E \times B$, 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 (Hydro magnetic, 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, Alfvén Waves, MHD discontinuities.

Course Outcomes:

After completing the course, the student should be able to

- CO1. identify, using fundamental plasma parameters, under what conditions an ionised gas consisting of charged particles (electrons and ions) can be treated as a plasma
- CO2. distinguish the single particle approach, fluid and kinetic approach to describe different plasma phenomena
- CO3. determine the motion of charged particles moving in uniform or slowly varying electric and magnetic fields
- CO4. understand the physical mechanism and properties of the electrostatic and electromagnetic waves propagating in magnetised and non-magnetised plasmas
- CO5. familiarity with important plasma instabilities and the concept of Landau damping

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 01	PS O 02	PS O 03
CO1	3	3	2	3	2								3	2	
CO2	3	2	2	2	3								3	3	
CO3	3	3	3	3	3								3	3	
CO4	3	3	3	3	3								3	3	
CO5	3	3	3	3	3								3	3	

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. Gurnett & 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

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.

Course Outcomes:

After completion of the course students should be able to

CO1: Learn basic and advanced physics concepts in space physics.

CO2: Develop problem solving skills in the field of space physics.

CO3: Develop critical/logical thinking and scientific reasoning in the area of space physics.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3												3			
CO2		3												2		
CO3		3														1

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 Magnetospheres, 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

Objectives:

To introduce ultrafast lasers and some of their applications.

UNIT 1:

Ultrafast Light Sources:

Q-switching and modelocking, Nano second, Pico second and Femtosecond Lasers, Synchrotron source.

UNIT 2:

Applications in Time-Domain Spectroscopy:

Need of lifetime measurements in semiconductors/ organic materials. Various methods of lifetime measurements: Oscilloscope method, Time-correlated single photon counting, Fluorescence upconversion, pump-probe spectroscopy.

UNIT 3:

Applications in Nonlinear Optics:

Self-focusing and self-defocusing, Optical rectification, Z-scan and four wave mixing technique, measurement of second and third order optical nonlinear susceptibility, Idea of optical gates.

UNIT 4:

Applications in Fibre optic Communication:

Basics of optical fibre, photodetectors, fibre lasers, semiconductor lasers and optical communication, Group velocity dispersion and dispersion compensation

Unit 5:

Applications in Tunable Lasers and High Harmonic Generation:

White light continuum generation, Transient absorption, Optical parametric oscillators, Petta Watt lasers and other applications

Course outcomes:

After completion of the course, students will have knowledge and skills to:

- CO1. Understand the techniques involved in producing ultrafast laser radiation such as Q-switching and modelocking.
- CO2. Apply knowledge of ultrafast laser radiation to understand time-domain spectroscopy.
- CO3. Comprehend the application of ultrafast laser radiation in non-linear optics.
- CO4. Understand the application of ultrafast laser radiation in tunable lasers and high harmonic generation.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	3	3				2	1			3	3		2
CO2	3	3	3	3	3				2	1			3	3		2
CO3	3	3	3	3	3				2	1			3	3		2
CO4	3	3	3	3	3				2	1			3	3		2

Books and references:

1. Few-Cycle Laser Pulse Generation and its Applications, Franz X. Kärtner, SPRINGER, 2004
2. Pulse fluorometry using simultaneous acquisition of fluorescence and excitation, D. J. S. Birch, R. E. Imhof, and A. Dutch, Rev. Sci. Instrum. 55, 1255 (1984).
3. The Principles of Nonlinear Optics, Y. R. Shen, Wiley-Interscience , 2003
- 4.. Nonlinear Fibre Optics, G. P. Agrawal, Academic Press, 2001

18PHY649

Energy and Environment in the 21st Century

3 0 0 3

Abstract

The energy and related environmental problems, the physics principles of using energy and the various real and hypothetical options are discussed from a physicist point of view. The lecture is intended for students of all ages with an interest in a rational approach to the energy problem of 21st century.

Objective

Scientists and especially physicists are often confronted with questions related to the problems of energy and the environment. The lecture tries to address the physical principles of today's and tomorrow's energy use and the resulting global consequences for the world climate.

The lecture is for students which are interested to participate in a rational and responsible debate about the energy problem of 21st Century.

Unit – 1

Introduction: Energy types, energy carriers, energy density and energy usage. How much energy does human need/uses?

Energy conservation and the first and second law of thermodynamics

Unit – 2

Fossil fuels (our stored energy resources) and their use. Burning fossil fuels and physics of greenhouse effect.

Unit – 3

Physics basics of nuclear fission and fusion energy controlled nuclear fission energy today, the different types of nuclear power plants, uranium requirements and resources, natural and artificial radioactivity and the related waste problems from the nuclear fuel cycle.

Unit – 4

Nuclear reactor accidents and the consequences, a comparison with risks from other energy using methods. The problems with nuclear fusion and the ITER project.

Nuclear fusion and fission: "exotic" ideas.

Unit – 5

Hydrogen as an energy carrier: ideas and limits of a hydrogen economy. New clean renewable energy sources and their physical limits (wind, solar, geothermal etc.)

Energy perspectives for the next 100 years and some final remarks

Course Outcomes

At the end of the course the students will be able

- CO1. To demonstrate knowledge of new and renewable energy and their relationship with ecology & environment.
- CO2. To describe conventional and non-conventional energy scenario with respect to environment.
- CO3. To analyze synergy between energy and environment, global environment issues.
- CO4. To explain the Environmental Pollution and their effects on environment
- CO5. To apply awareness regarding environmental protection and application of renewable energy.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3														2	
CO2						2										2
CO3							3								2	
CO4							3									2
CO5							3									2

References

1. <http://ihp-lx2.ethz.ch/energy21/>
2. Die Energiefrage - Bedarf und Potentiale, Nutzung, Risiken und Kosten:
3. Klaus Heinloth, 2003, VIEWEG ISBN: 3528131063;
4. Environmental Physics: Boeker and Egbert New York Wiley 1999.

Unit I

Sun: Solar parameters: Mass, Radius, Distance and Luminosity, Spectral energy distribution, Construction of a Model, Conservation law, Equation of State, Nuclear Energy Source and Energy transport, Chemical composition of the Sun

Unit II

Tools for Solar Observation: High-Resolution Telescope, Spectrographs and Spectrometers, Filters and Monochromators, Polarimetry, Special purpose Instruments

Unit III

Sun's Oscillations and Rotations: Linear Adiabatic Oscillations of Non-Rotating Sun, Helioseismology, Excitation and Damping, The Angular Velocity of Sun, Models of Rotating Convection Zone

Unit IV

Magnetic properties of Sun: Fields and Conducting Matter, Flux tubes, Sunspots and Solar Cycle

Unit V

Chromosphere, Corona and Solar Wind: Empirical Facts, Consequence of High Temperature, Outer Atmosphere, Energy Balance, Explosive Events

Course Outcomes:

After completion of the course students should be able to

CO1. Learn theoretical methods and observational tools for solar system.

CO2. Apply theoretical models to solve problems related to solar system.

CO3. Develop critical/logical thinking and scientific reasoning of solar system.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3												3			
CO2		3												3		
CO3		3														1

Text Book:

Michael Stix, *The Sun : An Introduction, 2nd edition, Springer, 2012.*

Required Knowledge

Scholars are expected to have completed the course Quantum Mechanics, Mathematical physics, Electrodynamics and Atomic physics. They should be familiar with the motivations of quantum mechanics and its historical development such as the ultraviolet catastrophe; Young's double-slit experiment etc. They should be familiar with the concept of a wave function; wave function collapse, and the expression of observables as operators. They should be able to apply the Schrödinger Equation to simple potentials and also familiarity with mathematical concepts such as vector spaces and Fourier series. This course will have some overlap with Atomic Physics.

Intended Learning Outcomes

The aim of this course is to provide an introduction to the physics underlying properties of strongly correlated systems. The course also provides examples of how Quantum Mechanics, Mathematical physics, Electrodynamics and Atomic physics can be applied in order to understand phenomena emergent in complex systems. By the end of the course, students should be able to: describe the key physical principles of magnetism; demonstrate a knowledge and understanding of the theory and applications of ferromagnetism and the macroscopic behavior of ferromagnets. Also by the end of the course, students should have acquired the problem solving skills, such as

1. Calculation of susceptibilities for different magnetic orderings;
2. Calculate spin wave dispersions for different magnetic structures;
3. Estimate reduction of magnetization
4. Estimate energies of nucleating a domain and forming a magnetic domain wall etc.

Course Outline:

Details of the course content are listed below:

Unit 1**Magnetism of electrons**

Introduction:-A brief history of magnetism; Magnetism and hysteresis; Magnet applications; Magnetostatics:- The magnetic dipole moment; Magnetic fields; Maxwell's equations; Magnetic field calculations; Magnetostatic energy and forces

Orbital and spin moments; Magnetic field effects; Theory of electronic magnetism; Magnetism of electrons in solids; Magnetism of localized electrons on the atom: The hydrogenic atom and angular momentum; The many-electron atom; Paramagnetism; Ions in solids; crystal-field interactions

Unit 2**Ferromagnetism; Anti-ferromagnetism and other magnetic order**

Mean field theory; Exchange interactions; Band magnetism; Collective excitations; Anisotropy; Ferromagnetic phenomena

Molecular field theory of antiferromagnetism; Ferrimagnets; Frustration; Amorphous magnets; Spin glasses; Magnetic models

Unit 3

Micro and Nano-magnetism, domains and hysteresis

Micromagnetic energy; Domain theory; Reversal, pinning and nucleation.

Nanoscale magnetism; Characteristic length scales; Thin films; Thin-film heterostructures; Wires and needles; Small particles; Bulk nanostructures; Magnetic resonance:- Electron paramagnetic resonance; Ferromagnetic resonance; Nuclear magnetic resonance; Other methods

Experimental methods: Materials growth; Magnetic fields; Atomic-scale magnetism; Domain-scale measurements; Bulk magnetization measurements; Excitations; Numerical methods

Unit 4

Magnetic materials

Introduction; Iron group metals and alloys; Rare-earth metals and inter-metallic compounds; Interstitial compounds; Oxides with ferromagnetic interactions; Oxides with anti-ferromagnetic interactions

Applications of soft and hard magnets

Soft magnetic materials; applications:- Low-frequency and High-frequency applications

Magnetic circuits; Permanent magnet materials; Static and Dynamic applications with mechanical recoil; Dynamic applications with active recoil; Magnetic microsystems

Unit 5

Spin electronics and magnetic recording

Spin-polarized currents; Materials for spin electronics; Magnetic sensors; Magnetic memory; Magnetic recording

Special topics:- Magnetic liquids; Magneto-electrochemistry; Magnetic levitation; Magnetism in biology and medicine; Planetary and cosmic magnetism.

Course Outcomes

The aim of this course is to provide an introduction to the physics underlying properties of strongly correlated systems. The course also provides examples of how Quantum Mechanics, Mathematical physics, Electrodynamics and Atomic physics can be applied in order to understand phenomena emergent in complex systems.

By the end of the course, students should be able to:

- CO1. Describe the key physical principles of magnetism
- CO2. Demonstrate a knowledge and understanding of the theory and applications of ferromagnetism and the macroscopic behavior of ferromagnets
- CO3. Acquire the problem solving skills, such as

- (i) Calculation of susceptibilities for different magnetic orderings;
- (ii) Calculate spin wave dispersions for different magnetic structures;
- (iii) Estimate reduction of magnetization
- (iv) Estimate energies of nucleating a domain and forming a magnetic domain wall etc.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3													2		
CO2				3											3	
CO3		3													3	

Text books

1. Magnetism and Magnetic Materials; J. M. D. COEY; CAMBRIDGE UNIVERSITY PRESS.
2. Text Book Of Magnetism By R.K. Verma, DPH
3. Magnetism Fundamentals, edited by Etienne Du Trémolet de Lacheisserie, Damien Gignoux, Michel Schlenker, Springer
4. Magnetism: From Fundamentals to Nanoscale Dynamics By Joachim Stöhr, Hans Christoph Siegmann; Springer
5. Introduction to Magnetism and Magnetic Materials, Second Edition By David C. Jiles; Taylor and Francis
6. The Quantum Theory of Magnetism; By Norberto Majlis; World Scientific Publishing Co. Pte. Ltd

18PHY652 X-RAY DIFFRACTION AND ITS APPLICATIONS 3 0 0 3

UNIT I

X-RAY BASICS

The scattering of X-rays, Diffraction from a crystal

X-ray interaction with matter, X-ray sources, X-ray optics, X-ray detectors

UNIT II

X-RAY DIFFRACTOMETERS

High-Resolution Diffractometers; Powder Diffractometers

UNIT III

APPLICATIONS TO MATERIALS SCIENCE: STRUCTURE ANALYSIS; PHASE ANALYSIS; PREFERRED ORIENTATION (TEXTURE) ANALYSIS

UNIT IV

APPLICATIONS TO MATERIALS SCIENCE: LINE BROADENING ANALYSIS

Line Broadening due to Finite Crystallite Size; Line Broadening due to Microstrain Fluctuations; Williamson-Hall Method; The Convolution Approach Instrumental Broadening; Relation between Grain Size-Induced and Microstrain-Induced Broadenings of X-Ray Diffraction Profiles.

UNIT V

APPLICATIONS TO MATERIALS SCIENCE: RESIDUAL STRAIN/STRESS MEASUREMENTS

Strain Measurements in Single-Crystalline Systems; Residual Stress Measurements in Polycrystalline Materials.

IMPACT OF LATTICE DEFECTS ON X-RAY DIFFRACTION

Course Outcomes:

At the end of the course the students will be able

- CO1. To work with the fundamentals and applications of x-ray diffraction.
- CO2. To apply the knowledge on x-ray sources and optics to explain experimental arrangements in the field of modern x-ray physics.
- CO3. To apply the knowledge on x-ray interaction with matter to explain different types of analytical methods that use x-ray radiation as a probe.
- CO4. To acquire skills for independent research and presentation.

CO-PO Mapping

	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3												1			
CO2		3												3		
CO3					3										3	
CO4						3										3

Text books and References

1. Emil Zolotoyabko Basic Concepts of X-Ray Diffraction; John Wiley & Sons, 21-Apr-2014 - Science
2. M. M. Woolfson; An Introduction to X-ray Crystallography; Cambridge University Press
3. Werner Massa; Crystal Structure Determination; (March 31, 2004) ISBN-10: 3540206442
4. Crystal Structure Analysis by: Jenny Glusker and Kenneth Trueblood (August 1992) ISBN-10: 0195035313
5. Crystal Structure Analysis: Principles and Practice (International Union of Crystallography Monographs on Crystallography) by Peter Main, William Clegg, Alexander J. Blake, Robert O. Gould. (January 28, 2002) ISBN-10: 019850618X
6. The Determination of Crystals Structures by: H. Lipson & W. Cochran (June 1966) ISBN-10: 080140276X
7. Fundamentals of Powder Diffraction and Structural Characterization of Materials by: Vitalij Pecharsky and Peter Zavalij (March 3, 2005) ISBN-10: 0387241477
8. Structure Determination by X-ray Crystallography by: Mark Ladd and Rex Palmer (September 30, 2003) ISBN-10: 0306474549
9. X-ray Structure Determination by: George Stout and Lyle Jensen (April 24, 1989) ISBN-10: 0471607118
10. X-ray Analysis and the Structure of Organic Molecules by: Jack Dunitz (December 16, 1996) ISBN-10: 3906390144

Unit I

Introduction to Semi conductors: Types of semiconductors;, Density of States, electron and hole currents, Electron distribution function, Fermi Dirac Statistics, Drift and Diffusion currents, Semiconductor transport equations; Calculation of carrier and current densities, General solution for current density, Metal semiconductor junction, Semiconductor –semiconductor junctions, Analysis of the P-N-Junctions, p-n junction under dark and under illumination. The Solar Resource and types of solar energy converters, Requirements of an ideal photoconverter, Photovoltaic cell and power generation, Characteristic of the Photovoltaic Cell, Material and design issues; Shockley–Queisser limit, Beyond the limit. Optics in solar energy conversion, antireflection coatings, concentration of light: Light confinement, photon recycling, multiple exciton generation.

Unit II

Silicon Solar cell, Mono -crystalline and poly–crystalline cells, Metallurgical Grade Si, Electronic Grade Si, wafer production, Mono–crystalline Si Ingots, Poly–crystalline Si Ingots, Si–wafers, Si–sheets, Solar grade Silicon, Si usage in solar PV, Commercial Si solar cells, process flow of commercial Si cell technology, Process in solar cell technologies, Sawing and surface texturing, diffusion process, thin film layers, Metal contact.

Unit III

2nd generation solar cell, Thin film solar cell, Advantage of thin film, Thin film deposition techniques, Evaporation, Sputtering, LPCVD and APCVD, Plasma Enhanced, Hot Wire CVD, closed space sublimation, Ion Assisted Deposition, Substrate and Super -state configuration, Thin film module manufacturing, Thin film and Amorphous Si Solar cell, Cadmium Telluride Solar Cell, CIGS solar Cell, CZTS solar cell, New materials for thin film solar cell.

Unit IV

3rd generation Solar cell; **Advances in Photovoltaics**, Photochemical and photosynthetic energy conversion; DSSC, Solution processed thin film, Organic Solar Cell, Hydride Perovskite solar cell and multi junction tandem solar cells.

Solar PV modules: Series and Parallel connections, Mismatch between cell and module, Design and structure, PV module power output, PV system configuration, standalone system with DC / AC load with and without battery, Hybrid system, Grid connected systems.

Course Outcomes:

On completion of the course, the student will able to

- CO1: Understand the basics of semiconductor physics and working principle of solar photovoltaics.
- CO 2: Acquire knowledge on the fabrication of different types of solar cell and methods to enhance the efficiency of solar cell.
- CO 3: Understand recent trends and current research focus on the fabrication of solar cell.
- CO 4: Acquire basic practical knowledge for the use of solar cell and grid connectivity.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO1 1	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	2	2	2			3						3	3		2
CO2	3	2	2	2	3	3	3					3	3	3	3	2
CO3	3	1	2	2	3	3	3					3	3	3		2
CO4	1	3	3	3		3	3		3		2	3				

TEXT BOOKS / REFERENCES:

1. Physics of Solar cells-Jenny Nelson, Imperial College Press (2006).
2. Solar Energy Conversion (Second Edition):Richard C. Neville; Elsevier Science (1995).
4. Physics of solar cells: P. Würfel (Wiley-VCH, 2013).
5. Solar cell device physics;J. Fonash(AP, 2010).
6. Solar Energy: The Physics and Engineering of Photovoltaic Conversion, Technologies and Systems: UIT Cambridge, (2016).

18PHY654 **Fabrication of Advanced Solar cell: Understanding the device physics** 3 0 0 3

Unit- I

The Solar Resource and types of solar energy converters, Requirements of an ideal photoconverter, Principles of a solar cell design, material and design issues; Revisions of Semiconductor Physics, Physics of semiconductor Junctions; p-n junction under dark and under illumination, effect on junction characteristics, Other device structures. Photovoltaic cell and power generation, Characteristic of the Photovoltaic Cell.

Unit-II

Silicon Solar cell, Mono -crystalline and poly-crystalline cells, Metallurgical Grade Si, Electronic Grade Si, wafer production, Mono-crystalline Si Ingots, Poly-crystalline Si Ingots, Si-wafers, Si-sheets, Solar grade Silicon, Si usage in solar PV, Commercial Si solar cells, process flow of commercial Si cell technology, Process in solar cell technologies, Sawing and surface texturing, diffusion process, thin film layers, Metal contact.

Unit-III

2nd generation solar cell, Thin film solar cell, Advantage of thin film, Thin film deposition techniques, Evaporation, Sputtering, LPCVD and APCVD, Plasma Enhanced, Hot Wire CVD, closed space sublimation, Ion Assisted Deposition, Substrate and Super -state configuration, Thin film module manufacturing, Thin film and Amorphous Si Solar cell, Cadmium Telluride Solar Cell, CIGS solar Cell, CZTS solar cell, New materials for thin film solar cell.

Optics in solar energy conversion: antireflection coatings, concentration of light: Light confinement, photon recycling, multiple exciton generation.

Unit-IV

3rd generation Solar cell; **Advances in Photovoltaics**, Photochemical and photosynthetic energy conversion; DSSC., Solution processed thin film, Organic Solar Cell, Hydride Perovskite solar cell and multijunction tandem solar cells;

Solar PV modules: Series and Parallel connections, Mismatch between cell and module, Design and structure, PV module power output, PV system configuration, standalone system with DC / AC load with and without battery, Hybrid system, Grid connected systems.

Unit-V

Hand on experience on solar cell fabrication, DSSC fabrication, Perovskite solar cell fabrication, Thin film solar cell fabrication.

Course Outcomes:

On completion of the course, the student will able to

CO1: Understand the basics of semiconductor physics and working principle of solar photovoltaics.

CO 2: Acquire knowledge on the fabrication of different types of Si solar cell and methods to enhance the efficiency of solar cell.

CO 3: Understand recent trends and current research focus on the fabrication of solar cell.

CO 4: Acquire knowledge on the fabrication of different types of advanced solar cell

CO 5: Acquire basic practical knowledge for the use of solar cell and grid connectivity.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	2	2	2			3						3	3		2
CO2	3	2	2	2	3	3	3					3	3	3	3	2
CO3	3	1	2	2	3	3	3					3	3	3		2
CO4	3	1	2	2	3	3	3					3	3	3		2
CO5	3	3	3			3	3		3	3	3	3	3	3		2

TEXT BOOKS / REFERENCES:

1. Physics of Solar cells-Jenny Nelson, Imperial College Press(2006)
2. Crystalline Silicon Solar Cells, by A. Goetzberger, J. Knobloch, and B. Voss (Wiley, 1998)
3. Third Generation Photovoltaics: Advanced Solar Energy Conversion, by M. A. Green (Springer, 2006)

18PHY655

Astrophysics and Cosmology

3 0 0 3

Unit I

Introduction to Astrophysics: Mass, length and time scales in astrophysics, Magnitude scale, Source of astronomical information, Astronomical nomenclature, Theory of radiative transfer, Basic characteristics of thermodynamical equilibrium in stars

Unit II

Stellar Structure and Dynamics: Basic equations of stellar structure, Constructing stellar models, Stellar quantities, Stellar observational data, HR Diagram star clusters, Main nuclear reactions in stellar interior, Stellar evolution, Stellar Winds

Unit III

Compact Stars and Interstellar Matter: Supernovae, Degeneracy pressure of a Fermi gas, White Dwarf and Chandrasekhar mass limit, Neutron stars, Pulsars, Blackholes, Event Horizon and Schwarzschild radius, Phases of Interstellar Matter, Interstellar cloud and dust

Unit IV

Properties and Classification of Galaxies: The shape and size of our galaxy, Galactic rotation and Oort's constant, Missing mass problem and Dark matter, Morphological classification and physical characteristics of normal galaxies, Active galaxies, Unified model of active galaxies

Unit V

Cosmology: Hubble's law and the age of the Universe, Early Universe and Nucleosynthesis, Cosmic Microwave Radiation, Big Bang and Steady State model of the Universe, The horizon problem and inflation, Baryogenesis, Evidence and Nature of Dark matter and Dark energy

Course Outcomes

After completion of the course student should be able to

CO1. Acquaint scientific and observational tools in astrophysics and cosmology

CO2. Apply various mathematical models in astrophysics and cosmology

CO3. Develop critical/logical thinking, scientific reasoning, and problem solving skills in the area of astrophysics and cosmology.

Text Book:

1. "Astrophysics for Physicists" by Aramb Rai Choudhuri

Ref. Book:

1. "Introduction to Astronomy and Cosmology" by Ian Morison

Pre-requisites:

Electrodynamics & Intermediate Mechanics (both are compulsory Int. M.Sc. courses)

Level: **UG final year / PG I or II** – Elective or Core

Aim:

To have a comprehensive physical idea and mathematical understanding of Special theory of Relativity and its applications in Electrodynamics, Fluid Dynamics etc using four-dimensional covariant analysis.

UNIT 1**Classical Mechanics and Relativity:**

Galilean Relativity, Newtonian Mechanics, Electrodynamics and Galilean Relativity, Ether, Michelson–Morley experiment, Attempts by Lorentz & Poincare.

7 hrs

UNIT 2**Special Theory of Relativity:**

Einstein's postulates, Lorentz's transformation, Length contraction, Time dilation. Relativistic Kinematics, Doppler shift, Minkowski Diagrams, Boosts and Minkowski space.

14 hrs

UNIT 3**Four dimensional Space-Time geometry:**

Space-time continuum, Lorentz transformations as coordinate transformations, tensors, contravariant and covariant objects, four vectors

Relativistic Dynamics:

Four velocity, Four momentum, Four acceleration, Relativistic Collisions, Conservation of four-momentum, Equivalence of Mass and Energy. Central force problem in relativity.

14 hrs

UNIT 4**Electromagnetic Theory in covariant form:**

Maxwell's equations in covariant form, Four dimensional vector potential, Energy-Momentum Tensor and Conservation Laws, Lagrangian formulation of Electrodynamics, Radiation.

13 hrs

UNIT 5**Covariant formulation Fluid Dynamics:**

Perfect fluids, Pressure and proper density, Energy-Momentum tensor, Relativistic Euler equations, Equation of state, Speed of sound.

The Lorenz & Poincare groups:

The The Lorentz and Poincare algebras and their representations.

The Principle of Equivalence and preamble to General Theory of Relativity. 1

2 hrs

Course Outcomes:

After completing the course, the student should be able to:

- CO1. Demonstrate an understanding of the basic necessity and principles of the special theory of relativity in four dimensional Minkowski space-time.
- CO2. Apply tensor notation in relativity theory and perform basic calculations in relativistic kinematics and dynamics
- CO3. Understanding of covariant formulation of classical theories like electromagnetism & fluid dynamics

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 01	PS O 02	PS O 03
CO1	3	2	2	3	3								3	3	
CO2	3	3	3	3	3								3	2	
CO3	3	2	3	2	3								3	3	

Text Books:

1. N. M. J. Woodhouse, Special Theory of Relativity, Springer, 2003
2. Steven Weinberg, Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity, Wiley India, 2008

Reference Books:

1. Landau & Lifshitz, Classical Field Theory, University Science Books, 1E, 2004
2. Ashok Das, Lectures on Electromagnetism, Hindustan Book Agency – World Scientific, 2013
3. A. Einstein, Relativity: The Special and the General Theory

OPEN ELECTIVES

18OEL231

ADVERTISING

3 0 0 3

Unit 1

Evolution of advertising; Social and economic effects of advertising; Advertising agency system; advertising budget; Legal and ethical aspects of advertising;

Unit 2

Marketing; Market segmentation; Social marketing; Consumer behaviour; Factors influencing consumer behaviour, buying behaviour, buying decision process;

Unit 3

Planning advertising campaigns; Advertising copy, visualization, illustration, layout, headline, body, colour, trademarks, slogans; Television and Radio commercials; Media selection, newspaper, magazines, radio, television, Internet, outdoor, direct mail;

Unit 4

Industrial advertising; Retail advertising; Corporate advertising; Public service advertising;

Unit 5

Evaluation of advertising effectiveness, methods of measurement. Pre-testing and post – testing methods.

BOOKS RECOMMENDED:

1. B.S. Rathor; *Advertising management*
2. Chunnawala; *Advertising theory and Practice*
3. Sandage and others; *Advertising: Theory and Practice*
4. Thomas Russell and Glenn Verrill: *Otto cleppner's advertising Procedure*
5. Manendra Mohan; *Advertising Management: Concepts and cases*
6. Philip Kotler; *Marketing Management*
7. David Aaker and George day; *Marketing Research*
8. Mahendra Mohan; *Advertising Management; Concepts and Cases*
9. Frank Jefkins; *Advertising Made Simple*

18OEL232

BASIC STATISTICS

3 0 0 3

Objectives: To develop an understanding of problem solving methods, to understand the basic concepts of statistics and to apply the results to real life problems.

Unit 1

Introduction to Statistics: Meaning and scope of statistics, limitations of statistics, purpose and scope of inquiry.

Unit 2

Methods of collecting data - primary and secondary data, classification of data, tabulation of data, frequency table.

Unit 3

Presenting data by diagrams and graphs - bar diagram - simple, multiple, component and percentage bar diagram, pie diagram, histogram, frequency polygon and frequency curve, less than ogive and greater than ogive.

Unit 4

Measures of central tendency: Arithmetic mean, median, mode.

Unit 5

Dispersion: Quartile deviation, standard deviation, coefficient of variation.

REFERENCES:

1. *P.R Vittal - Business mathematics and statistics, Margham Publications, Chennai.*
2. *Dr.C Satyadevi - Quantitative Techniques, S. Chand & Company Pvt. Ltd., New Delhi.*
3. *Dr. S.P Gupta - Statistical Methods, Sultan Chand & Sons, New Delhi.*

18OEL233

CITIZEN JOURNALISM

1 0 2 3

Objective: *The course is aimed at encouraging young educated rural men and women to highlight local issues and imparting the required skills to articulate them in the media.*

Unit 1

Introduction: Highlighting development problems of rural areas; pathetic condition of infrastructure in rural areas.

Unit 2

Lack of connectivity – bad roads or lack of roads.

Unit 3

Lack of potable water – women having to trek distances to fetch drinking water for the family.

Unit 4

The story of electrification of villages – Official claims and reality, Schools without teachers, primary health centres without doctors.

Unit 5

Farmers caught in between labour shortage, high wages, rising cost of inputs and indebtedness due to crop failure and middlemen taking the profit from farm products.

Outcomes:

By the end of the course the students will be able to:

- CO1: Define Citizen Journalism and explain the genre.
- CO2: Explain the boundaries of the genre
- CO3: Develop an understanding of the platforms available for citizen activism and intervention
- CO4: Critically reflect on the aspects of safe media practices involved in citizen reporting
- CO5: Identify appropriate strategies and tools to reach a defined target audience

REFERENCES:

1. Allan, S. (2009). *Citizen journalism: Global perspectives (Vol. 1)*. Peter Lang.
2. Thorsen, E., & Allan, S. (2014). *Citizen Journalism: Global Perspectives - Volume 2*. Peter Lang International Academic Publishers.
3. Wall, M. (2012). *Citizen Journalism: Valuable, Useless, Or Dangerous?*. International Debate Education Association.
4. Allan, S. (2013). *Citizen witnessing: Revisioning journalism in times of crisis*. John Wiley & Sons.

18OEL234

CREATIVE WRITING FOR BEGINNERS

1 0 2 3

Overview of the Course: *The course focuses on those elements of writing that enhances the vivid and effective writing skill among students across genres like fiction, poetry, essay and drama drawing their attention to significant details, lyrical language and memorable images; inventive metaphor and simile; authentic voice, dialogue and characterization.*

Objectives: *To develop students talent for creative writing in English in order to enable them to use language effectively; to introduce the concept of creative writing; to acquaint students with the basic principles and techniques involved in writing poetry, fiction and drama.*

Unit 1

Introduction to Creative Writing – meaning and context of using creative writing, Difference between creative writing and functional writing.

Importance of reading – Reading practice for closer observation of the elements of creative writing.

Unit 2

Imaginative writing – idiomatic expression, use of imagery, figurative language, playing with words.

Reading from poetry and short stories – illustration of the use of imagery, allusion, figures of speech, allegory and fables.

Unit 3

Narrating anecdotes, blog writing, and discussion through SMS / WhatsApp.

Unit 4

Short story writing – Narration and description – setting the plot, rising action, climax, falling action, resolution.

Unit 5

Poetry writing – rhythm and rhyme, Types of poems – Narrative, Dramatic, Lyric.

REFERENCE BOOKS:

1. Janet Burroway, *Imaginative Writing: The Elements of Craft*, Longman, 1st Ed. ISBN: 0321081919
2. Anjana Neira Dev, Anuradha Marwah Swati Pal, *Creative writing : A Beginner's Manual*, Delhi, Pearson Longman, 2009
3. Robert Scholes, Nancy R Comely, Carl H. Klaus, Michael Silverman, *Elements of Literature : Essay, Fiction, Poetry, Drama Film*, Delhi, OUP, 2007
4. *Write from the Heart: Unkenling the power of your creativity*, Hal Zina Bennet, California Wew World Library, 2001

18OEL235 DESKTOP SUPPORT AND SERVICES

1 0 2 3

Objectives: *To create an awareness in Non Computer science background students to enable them; to generate the Computer Hardware Professionals; to Train the lower order Technicians; to generate man power at different level to enable the country to face the challenge of world modern I.T. and Instrumentation.*

Unit 1

Fundamentals of computers

Data & Information, Computer Architecture, CPU & Memory Organization, History of Computer, Generation of Computer, I/O Devices, Number System, Logic Gates.

Unit 2

Internal devices - Study of PC ATATX System Pentium Core, Core 2 Cord, Core2 Duo, I3, I5, I7 Processor, Mother Board, MB Types, Expansion Slots, Processor, Memory, Hard Disk, CD-R, RW, DVD-RW. SMPS.

Unit 3

External Devices - Dot Matrix Printer, Inkjet Printer, Laser Printer, Modem, Ports and Connectors, Batteries, Power supply, Pen Drives. Scanner: Photo Scanner, Documents Scanner, Bar Code Scanner Introduction of Expansion Card, Assembling of Personal Computer.

Unit 4

Operating System

Basics & Installation - Introduction to OS, Types of Operating systems, System files FAT and NTFS, Dos 6.22, Windows, XP, Windows Vista, Windows 7 and Windows 8 and RedHat Linux and Multi Boot Operating System.

Unit 5

Trouble shooting - Complete introduction & Troubleshooting, Antivirus free and paid version, Downloading the Drivers from Internet, Installation of Drivers.

REFERENCES:

- * *PC AND CLONES Hardware, Troubleshooting and Maintenance B. Govindarajalu, Tata Mc-graw-Hill Publication*
- * *PC Troubleshooting and Repair Stephen J. Bigelow, Dream tech Press, New Delhi*

LAB Requirements

1. *Required Accessories for Hardware Course*
2. *Basic Measuring Instruments Multi-meters*
3. *Minimum two nos. Computer for Hardware Practice.*
4. *All generations Motherboard, Processor, Ram.*
5. *Expansion Card and Cables.*
6. *All Ports, SMPS and UPS.'*
7. *Hard disk, Floppy disk, Pen drive, CD ROM, DVD writer.*
8. *Printer, Monitor, Speakers.*
9. *Keyboard, Mouse, Modem.*
10. *Installation Kit (Bootable CD, Windows CD, All Software CD.)*
11. *Tool Kit.*
12. *Secure Driver with all bit.*
13. *Soldering with Solder and Paste.*
14. *De-soldering Pump.*
15. *Digital and Analog Multi-Meter.*
16. *Screw driver set*
17. *Internet connectivity.*

Unit 1

Large-scale migration from rural to urban areas: causes and consequences. Statistics, unemployment, education, health, insurgency (lack of security), lack of infrastructure.

Unit 2

‘Pull’ and ‘Push’ factors: Urban centres provide better scope for earning livelihood through employment in industries, transport, construction, trade, services etc. They act as magnets by offering modern facilities and ‘pull’ people from the rural areas, while unemployment, hunger and starvation and lack of means of livelihood “push” people out of villages into towns and cities.

Unit 3

Migration from rural areas and their impact on agricultural production due to shortage of labour in those areas.

Unit 4

Mass migration into metropolitan cities – Delhi, Kolkatta, Mumbai and Chennai – and their impact on civic amenities in the cities – increasing slums, decline in standard of living and environmental degradation.

Unit 5

Nuclear family - A side effect of urbanization - Changes in family system brought about by urbanization.

Outcomes:

By the end of the course the students will be able to:

- CO1: Understand the dynamics and dimension of migration
- CO2: Become aware of the barriers, vulnerabilities and anxieties for the migrants.
- CO3: Understand how migration affects agriculture
- CO4: Understand migration in terms of civic engagement.
- CO5: Understand effects and social impacts of urbanization on the family.

REFERENCES:

Effects of internal Migration and Net Emigration on a City – Smriti Chand 4 Major causes of Migration in India – Smriti Chand Human Migration (Cause, Kinds and Theories) - Negi Mohita
UN state of the World Population Report - 2007

Objective: This course introduces the students to different aspects of photography and enable them to understand their role as a photographer.

Unit 1

Introduction to photography, role of photographer, Types of cameras - Film camera, Digital Camera, image file types.

Unit 2

SLR - Camera functions and Types of Lenses.

Unit 3

Rules of composition, Types of shots.

Unit 4

Lighting, Natural lighting, flash, studio lights, creative lighting etc.

Unit 5

Types of photographers, Post processing, image editing.

TEXTBOOKS:

1. *The Basic Book of Photography* by Tom Grimm and Michele Grimm, 4th Edition
2. *The Manual of Photography: Photographic and Digital Imaging* by Ralph E Jacobson, Sidney
3. *F Ray, Geoffrey G Attridge, Norman R Axford, 9th Edition*

REFERENCES:

1. *The Basic Photography, 1973, Focal press*
2. *Advanced Digital Photography* by Tom Ang, Mitchell Beazley

Unit 1

Emotional Intelligence: Intelligence Quotient - IQ, Concept of Emotional Intelligence, History and origin of Emotional Intelligence, Science of Emotional Intelligence, Scope of Emotional Intelligence

Unit 2

Components of Emotional Intelligence: Importance of emotions, Self-awareness, Self-regulation, Self-motivation, Social awareness, Social skills.

Unit 3

Models of Emotional Intelligence: The Ability-based Model, The Trait Model of Emotional Intelligence, Mixed Models of Emotional Intelligence.

Unit 4

Emotional Intelligence at Work place: Importance of Emotional Intelligence at Work place Cost – savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies

Unit 5

Measuring Emotional Intelligence: Emotional Intelligence Tests, Research on Emotional Intelligence, Developing Emotional Intelligence

REFERENCES:

1. Daniel Goleman (1996). *Emotional Intelligence - Why it can Matter More than IQ.* Bantam Doubleday Dell Publishing Group
2. Geetu Bharwaney (2008). *Increase your Emotional Intelligence - Strategies for EI Living, Jaico Publishing House*
3. Jyotsna Codaty (2012). *Understanding Emotional Intelligence - Pustak Mahal.*

18OEL239 ESSENCE OF SPIRITUAL LITERATURE 3 0 0 3

Objectives: *To eradicate superstition to establish moral and ethical values; to check unscrupulous exploitation of nature; bring to fruition Amma's dream of the world as one village; an overview of spirituality the world over.*

Unit 1

Indian Spirituality - Bhagvath Gita: Chapter 10; Upanishad – Isavasyopnishad; Vedic Hymns.

Unit 2

Western Spirituality - The Bible.

Unit 3

Oriental Spirituality - Chinese: Confucianism - Japanese: Shinto-Buddhism.

Unit 4

Others - Jewish-Sufism – Zoroastrianism.

Unit 5

Yoga and Meditation - The Power of Meditative practices - How to Practise the power of transcendental awareness - Revising Negative trends into positive - Scientific nature of Sadhana - Spiritual Psychology - Human energy systems – Chakras.

REFERENCES:

1. Max Muller, *The Upanishad, Max Muller, Vedic Hymn*
2. Swami Chinmayanada - *Bhagavath Gita*
3. *The Gospel of Jesus Christ.*
4. Legge James, *Confusionism*
5. Kushner, Lawrence, *Jewish Mystical Spirituality*
6. Rahula, Walpola, *What the Buddha Taught*
7. Lings Martin, *What is Sufism*
8. Iyenga B.K.S, *Light on Yoga*
9. Harish Johari, *Chakras: Energy Centers of Transformation*

18OEL240

FILM THEORY

2 1 0 3

Objective: The objective of this paper is to help student to have basic understanding of cinema, study different aspects of cinema world thereby enabling him to develop the analyzing skill in visual world.

Unit 1

Introduction - Basic stages of cinema production, Pre-production, Production, Post-production, Introduction to Lighting.

Unit 2

Indian Cinema - Early Indian cinema, History of Malayalam cinema, Key directors in Malayalam cinema, Key technicians in Malayalam cinema

Unit 3

Theoretical Perspective - Expressionism, Realism, neo-realism, new wave, Auteur theory, Narrative theory.

Unit 4

Different Genres in Cinema and its Features - westerns, musicals horror, fictions, historical, Documentary.

Unit 5

Film Screening - Citizen Kane, Nanook of the north, Children of heaven, Modern times, Psycho, Dreams, Home (Documentary), Samsara (Documentary).

TEXTBOOKS:

1. *Film Art: An Introduction* - David Bordwell, Kristin Thompson
2. *Malayala Cinemayude Katha* - Vijayakrishnan

REFERENCES:

1. *The Art and Science of Cinema* - Anwar Huda
2. *Key Concepts in Cinema Studies* - Susan Hayward
3. *Film as Art* - Rudolf Arnheim
4. *Chalachithrathinte Porul* - Vijayakrishnan
5. *Movies and Meanings* - Stephen Prince

18OEL241 FUNDAMENTALS OF NETWORK ADMINISTRATION 2013

Objectives: *To understand the basic networking components and installations; to have an in-depth knowledge on network topologies; to understand the network layers and protocols implementation.*

Unit 1

Network Components:

Introduction of Network Cable like UTP, STP, Fiber Optics, Hub, Unmanageable Switch, Manageable Switch, Router, Modem, Wi-Fi, Access Point, PCI Wireless Card, USB Wireless Device, Print Server, USB Network Sharer, Backup Device, Server Hardware etc.

Unit 2

Basic Network Introduction & Installation - Introduction About Network, Installing Network Operating System - Windows Server versions, Cable Crimping, Network Sharing and user Permission, Internet Connection, E-Mail, Google Drive, Dropbox etc.

Unit 3

Transmission Media and Topologies - Media types: STP cable, UTP cable, Coaxial cable, Fiber cable, Base band and Broadband transmission, Cables and Connectors, Physical and logical topologies, Bus, Star, Ring and Mesh topologies.

Unit 4

Network protocols - HTTP, FTP and other Different types of protocols, OSI Model, Media Access Method, DNS services, DHCP services, web services, Proxy Services etc.

Unit 5

IP addressing - Introduction to TCP/IP and Sub-netting, configuring IP address and Network, Routing protocol basics.

REFERENCES:

1. *Networking Complete, BPB Publication*
2. *Computer Networking - Andrew S. Tanenbaum*

18OEL242

GENDER STUDIES

3 0 0 3

Objective: To sensitize students with the contemporary discourses on gender with special emphasis on India.

Unit 1

Women Writing in India 600 B.C. to the Present: Volume I: 600 B.C. to the Early Twentieth Century (Introduction) - Susie Tharu and K Lalitha

Unit 2 Fiction

Othappu: The Scent of the Other Side - Sara Joseph and Valsan Thampu.

Unit 3 Fiction

One Part Woman - Perumal Murugan

Unit 4 Drama

Dance like a Man - Mahesh Dattani

Unit 5 Short story

Quilt - Ismat Chughtai

18OEL243 GLIMPSES OF INDIAN ECONOMY AND POLITY

3 0 0 3

Unit 1

General Introduction, Primitive Man and his modes of exchange – barter system, Prehistoric and proto-historic polity and social organization. Early India – the Vedic society – the Varnashramadharma – socio-political structure of the various institutions based on the four purusharthas.

Unit 2

The structure of ancient Indian polity – Rajamandala and Cakravartins – Prajamandala Socio-economic elements from the two great Epics – Ramayana and Mahabharata Sarasvati - Sindhu Civilization and India's trade links with other ancient civilizations - states and cities of the Indo-Gangetic plain

Unit 3

The rise of Magadha, emergence of new religions – Buddhism and Jainism – and the resultant socio-economic impact. The emergence of the empire – the Mauryan Economy and Kautilya's Arthashastra. Of Politics and trade – the rise of the Mercantile Community. Elements from the age of the Kushanas and the Great Guptas. India's maritime trade. Dharma at the bedrock of Indian polity – the concept of Digvijaya: dharma-vijaya, lobha-vijaya and asura-vijaya. Glimpses into the South Indian Economies: political economies of the peninsula – Chalukyas, Rashtrakutas and Cholas. Medieval India – agrarian economy, non-agricultural production and urban economy, currency system.

Unit 4

The Indian Market and Economy before the arrival of the European traders. Colonisation – British attitude towards Indian trade, commerce and economy and the resultant ruining of Indian economy and business – man-made famines – the signs of renaissance – the evolution of the modern banking system. Glimpses into British administration of India and administrative models. The National Movement and nationalist undertakings in business and industry. Modern India: the growth of large-scale industry – Irrigation and Railways – Money and Credit – Foreign Trade. Towards Partition – birth of two new nations – division of property.

Unit 5

The writing of the Indian Constitution – India becomes a democratic republic – a new polity is in place. India since Independence – the saga of socio-political movements. Indian Economy since Independence – the Fiscal System – the Five Year Plans – Liberalisation – the GATT and after Globalisation and Indian Economy. Impact of science and (new/ emerging) technology on Indian economy. Histories of select Indian business houses and business entrepreneurship.

REFERENCES:

1. *The Cultural Heritage of India*. Kolkata: Ramakrishna Mission Institute of Culture.
2. *Kautilya. Arthashastra*.
3. *Altekar, A.S. State and Government in Ancient India*. New Delhi: Motilal Banarsidass.
4. *Sircar, D.C. Studies in the Political and Administrative Systems in Ancient and Medieval Times*. New Delhi: Motilal Banarsidass.
5. *Dutt, R.C. The Economic History of India*. London, 1902.
6. *Dharampal. Collected Works (Volumes IV & V)*.

Objectives:

To understand the basics of computer graphics; to understand the aspects of images and sound; to gain knowledge on designing aspects and to design web pages; to implement the web design using various tools and to learn about hosting websites.

Unit 1

Introduction to Computer Graphics Definition, Application, Pixel, Frame Buffer, Raster and Random Scan display.

Unit 2

Images – Bitmaps and Grey Scale Images, Image Types – Color Graphics – Color Schemes – Palette Compositions.

Unit 3

Sound – Analog and Digital Sound – Quantization – Sampling – Sampling Rate – Sound Types.

Unit 4

Introduction to Adobe Photoshop – Image editing tools, Tracing, Static web page template designs creation – slicing – Various aspects of a static webpage.

Unit 5

Introduction to Dream viewer - tables and tools – Dynamic web page template design creation - Animations – 2D, 2 1/2 D and 3D perceptions with examples.

REFERENCES:

1. *Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, New Delhi.*
2. *Tay Vaughan, Multimedia: Making it Work, Ninth Edition. Tata McGraw-Hill, 2014.*
3. *Edward Angel, Interactive Computer Graphics: A top-down approach with OpenGL, Fifth Edition. Addison Wesley, 2008.*
4. *Alan Watt, 3D Computer Graphics, Third Edition, Addison-Wesley, 2000.*
5. *Foley, van Dam, Feiner, Hughes. Computer Graphics Principles and Practice, Second Edition in C. Addison Wesley, 1996.*

18OEL245

GREEN MARKETING

3 0 0 3

Objectives: This course shall examine the core principles required to create competitive advantage in the marketplace by implementing innovative green marketing strategies.

Unit 1 Introduction to Green Marketing

Meaning - Definition - Evolution of green marketing - Assumptions of green marketing - Reasons for adopting green marketing and benefits of green marketing.

Unit 2 Green Marketing Mix (GMM) and Sustainability

Meaning - concept of GMM – Strategies - Challenges. The concept of Sustainability and Green Marketing/ Consumers and pioneering efforts in India - Guiding principles of Sustainability and Green Marketing/ Consumers - Common assumptions and myths of green marketing.

Unit 3 Methods of implementation of Sustainability and Green Marketing

Method of bringing sustainability in green marketing in India and rest of the world.

Case study analysis.

Unit 4 Role of functional groups in Green Marketing

Functions within the market, Role of Wholesalers and Retailers, Role of banking institutions, funders and donors. Difference between general marketing and green marketing.

Unit 5 Governance and Legal Institutions

Role of governance in sustaining green marketing, Implications of governance.

TEXTBOOKS AND REFERENCES:

- 1. Green Marketing Strategies - Amitabha Ghose*
- 2. Green Marketing in Indian Retail Sector - Tanushree Purohit and A.K Das Mohapatra*
- 3. Green Marketing Management - Robert Dahlstrom*
- 4. Green Marketing, Theory, Practise and Strategies - Robert Dahlstrom*
- 5. Green Marketing Strategies and Consumer Behavior - Monica Loss*

18OEL246

HEALTHCARE AND TECHNOLOGY

3 0 0 3

Objective:

To provide students with a detailed understanding about technological applications in the healthcare sector with an objective to promote better management of information regarding identification of biomedical and hospital technology planning, procurement and operation requirements.

Unit 1

Health information technology, Types of technology: Electronic Health Record, Personal health records (PHRs) Computerized provider order entry (CPOE), Application of HIT – case studies, Visualization of Medical Data.

Unit 2

Healthcare Improvement Using Analytics, Healthcare Transformation - Challenges and Opportunities, Fundamentals of Healthcare Analytics, Components of Healthcare Analytics, Advanced Analytics in Healthcare.

Unit 3

Foundations of Information Technology, Technological Innovations, Opportunities, and Challenges, Information Technology Assurance and Security.

Unit 4

Introduction to medical informatics, necessity of standards for e-health, security and cyber laws, ethical and medico legal issues in patient information exchange; Introduction to medical databases, electronic medical records, Decision Support Systems, Artificial Intelligence.

Unit 5

Integrated Health information systems, cost effectiveness; Networks, PSTN, ISDN, VSAT, TI, information compression, storage and transmission standards, wireless telemetry, e-health and telemedicine and applications.

TEXTBOOKS/ REFERENCES:

1. *Shortlife E. H. and Cimino J J, Biomedical Informatics: Computer Applications in Health Care and Biomedicine, Third Edition, Springer-Verlag, 2006.*
2. *Norris A C, Essentials of Telemedicine and Telecare, John Wiley & Sons, 2002.*
3. *Diffusion and Value of Healthcare Information Technology, Bower, Anthony G. RAND Corporation 2005*
4. *Healthcare Analytics for Quality and Performance Improvement. Strome, T.L., John Wiley & Sons, 2013.*

18OEL247 HISTORY OF ENGLISH LITERATURE

3 0 0 3

Objective:

To introduce the evolution of English as a language and culture; to acclimatize the students with the history of English Literature; to make students aware of different movements and their effects on the society and literature.

Unit 1

The Social and Literary context: Medieval and Renaissance (Evolution of English Language and Literature).

Unit 2

Restoration to the Romantic Age (Social Background and its influences).

Unit 3

The Victorian Society and Literature (features, effects on the globe).

Unit 4

Modernism and after (Social transformation, Science, World Wars).

Unit 5

Assignment, Seminar Discussion & Term Test

REFERENCES:

1. William J Long - *English Literature*, FQ Books Publication
2. Pramod K Nayar - *A Short History of English Literature*, Cambridge University Press
3. Ifor Evans - *A Short History of English Literature*, Penguin Books
4. George Sampson - *The Concise Cambridge History of English Literature*, Cambridge University Press

18OEL248INDIAN WRITING IN ENGLISH

3 0 0 3

Objectives:

To trace the rise, growth and development of Indian poetry, fiction and drama in English; to provide an overview of the various phases of the evolution of Indian writing in English, to introduce the students to the rich and varied literature available in regional languages; to expose them to the Indian mind both ancient and modern; to inculcate a sense of appreciation for the literary genius; to understand the fabric of Indian society and the cultural unity of its people.

Unit 1

Introduction to Indian writing in English - development and growth of poetry, fiction and drama - trends of Indian writing in English.

Unit 2 Poetry

Nissim Ezekiel: Goodbye party for Miss Pushpa T.S;

Kamala Das: An Introduction

A.K.Ramanujan: A River

Unit 3 Short Stories

Rabindranath Tagore: My Boyhood Days

Khushwant Singh: The Portrait of a Lady

Unit 4 Fiction

R.K.Narayan: The Vendor of Sweets

Unit 5 Drama

Girish Karnad: Nagamandala – Play with a Cobra

REFERENCES:

1. *K.R.Sreenivasa Iyengar - Indian Writing in English, Sterling: Delhi.*
2. *Poetry down the Ages: Orient Blackswan.*
3. *Best of Rabindranath Tagore: Gitanjali, My boyhood days, The Post Office, The Gardner Mashi and Other Stories.*
4. *Khushwant Singh - The Portrait of a Lady: Collected Stories.*

18OEL249 INDUSTRIAL RELATIONS AND LABOUR WELFARE 3 0 0 3

Objectives:

On successful completion of this course, the students should have understood the Legislations relating to Industrial Disputes and Labour welfare.

Unit 1

Industrial relations - industrial disputes - causes - handling and settling disputes - employee grievances - steps in grievance handling - causes for poor industrial relations - remedies.

Unit 2

Collective Bargaining: - Concept - Principles and forms of collective bargaining - Procedure - conditions for effective collective bargaining - worker's Participation in management.

Unit 3

Factories Act 1948 - The Workman's Compensation Act, 1923.

Unit 4

The Industrial Disputes Act 1947 - The Trade Union Act, 1926.

Unit 5

The Payment of Wages Act, 1936 - The Employee's State Insurance Act, 1948

REFERENCE BOOKS:

1. *P.C.Tripathi - Personnel Management & Industrial Relations, Sultan Chand*
2. *C.B.Mamoria - Dynamics of Personnel Management, Himalaya Publishing*
3. *N.G.Nair & Latha Nair - Human Resource Management, Sultan Chand & Sons.*
4. *P. Subbarao - Essentials of Human Resource Management and Industrial Relations, Himalaya Publishing*

YOGIC AND VEDIC WISDOM**Objectives:**

To understand the importance of adapting a healthy lifestyle; to realize the significance of ancient Indian wisdom; to help in understanding the goal of human life

Unit 1

Ayurvedic, Yogic and Vedic Lifestyle: Introduction to Ayurveda, Yoga and Veda, life and lifestyle, daily routine according to Ayurveda, Yoga and Veda like ablution and food system.

Unit 2

Over view of Indian Philosophy: Introduction to Indian Philosophies, difference between Indian Philosophies and western Philosophies, Basic idea on various Indian Philosophies.

Unit 3

Human mind: States of mind, virtues & vice, causes for distraction, ways to gain one pointed mind.

Unit 4

Eight Limbs of Yoga: Introduction to Yoga Philosophy, benefits of Yoga, goal of yoga, explanation on Eight Limbs of Yoga.

Unit 5

Bhagavadgita: Glory of the Bhagavadgita, Human life according to the Bhagavadgita, solution for sufferings, self management.

REFERENCE BOOKS:

1. *Bhagavad Gita – Commentary by Swami swarupananda, Advaita Ashrama*
2. *Paatanjala Yogasutra – Commentary by Swami Gambhirananda, Ramakrishna mission*
3. *Yogopanishath*
4. *Ayurvijnana Ratnakaraha – Yogendranath, Rashtriya Samkrita Samsthanam*

Objective:

The course aims to give a general understanding of the basic parts of computer and how a computer works.

Unit 1

Hardware Basics – Generation of computers, Types of computers, Parts of a computer, and Functions of System Modules, Front and rear panel view of system, Safety information while disassembling PC – Internal structure of PC.

Unit 2

Motherboards: Components and Architecture, features, components, form factor, processor support, BIOS, IDE and SATA Connectors, External interfaces and connectors, troubleshooting and maintenance of Mother Boards.

Unit 3

Popular CPU Chips and their Characteristics, Processor Architecture - Processor specifications - installing and uninstalling processor - CPU Overheating issues – common problems and solutions.

Unit 4

Memory and Storage: Memory features – Types of memory – working - Installing and uninstalling memory modules – maintenance and troubleshooting – common problems and solutions.

Storage devices – Hard disk details – Working and parts of hard disks – Installing hard disks – maintenance and troubleshooting.

Unit 5

Power supply – SMPS – features – types – installing SMPS – Specification for SMPS.

Maintenance and Troubleshooting: Preventive Maintenance and Safety Procedures - Managing Replaceable Components.

TEXTBOOKS/REFERENCE BOOKS

1. James K L, "Computer Hardware: Installation, Interfacing Troubleshooting and maintenance", PHI Learning Press (Eastern Economy Edition, 2013)
2. Manahar Lotia, Pradeep Nair, Payal Lotia, "Computer Hardware Course", BPB Publications

18OEL252

INTRODUCTION TO EVENT MANAGEMENT

3 0 0 3

Unit 1

Why Event Management, Requirement of Event Manager, Analyzing the events, Scope of the Event, Decision-makers, Technical Staff, Developing Record-Keeping Systems, Establishing Policies & Procedures.

Unit 2

Preparing a Planning Schedule, Organizing Tasks, Assigning Responsibility, and Communicating, Using the Schedule Properly, The Budget, Overall Planning tips, Checklists, Expert Resources, Computer Software Required.

Unit 3

Who are the people on the Event, Locating People, Clarifying Roles, Developing content Guidelines, Participant Tips, Reference Checks, Requirement Forms, Introduction, Fees & Honorariums, Expense Reimbursement, Travel Arrangements, Worksheets.

Unit 4

Types of Events, Roles & Responsibilities of Event Management in Different Events, Scope of the Work, Approach towards Events.

Unit 5

Introduction to PR – Concept, Nature, Importance, Steps, Limitations, Objectives Media – Types of Media, Media relations, Media Management PR strategy and planning – identifying right PR strategy, Brain Storming sessions, Event organization, writing for PR.

REFERENCES:

- 1. Devesh Kishore, Ganga Sagar Singh - Event Management: A Blooming Industry and an Eventful Career, Har-anand Publications Pvt. Ltd.*
- 2. Swarup K. Goyal - Event Management, Adhyayan Publisher - 2009*

18OEL253

INTRODUCTION TO MEDIA

3 0 0 3

Unit 1

Introduction – Media Business - Media Classification - Mass Media – Niche Media - Addressable Media and Interactive Media - Media-Intrusiveness.

Unit 2

Print – Media – Newspaper - Principles of Newspaper Business - Classified Ads, Display Ad's Display Ad's – Coverage and Audience Measurement - Sales and Pricing – magazines. Directories.

Unit 3

Broadcast Media – Radio – Television - out of Home Media - out door Advertising - Cinema and Video Non-Traditional Media.

Unit 4

An overview of Media planning - problems of media planning – Developing media plan – Market Analysis and Target - Interactive and Digital Media.

Unit 5

Establishing media objectives - Developing and Implementing – Evaluation and Follow up - Computers in Media Planning - Characteristics of Media.

REFERENCE BOOKS:

1. Tom Duncan - “Principles of Advertising and IMC”, Tata McGraw Hill
2. Kruti shah and Alan D’souza - “Advertising and Promotion” – An IMC Perspective, Tata McGraw Hill.
3. Mehra – “Newspaper Management”

18OEL254 INTRODUCTION TO RIGHT TO INFORMATION ACT 3 0 0 3

Unit 1

Introduction to RTI Act

The evolution of the Right to Information in India - the important terms and concepts used in the Act - the salient features of the Act.

Public Authorities and their Obligations under the Act

1. What is a Public Authority?
2. Who are the Public Authorities covered under the Act?
3. Which Public Authorities are exempted from the ambit of the Act?
4. Obligations of Public Authorities.

Unit 2

Role of Public Information Officers: PIOs and APIOs - Accepting Information Request, Processing and Disposing

The requirement for designation of Information Officers - PIOs / APIOs - in public authorities

- The specific Duties & Responsibilities of Information Officers.
- The liabilities of a PIO for non-compliance with the provisions of the Act.
- How to accept information requests and assist citizens in making information requests?
- What is the process for disposal of requests?
- The time limits for disposal of information requests.
- The fees and costs to be charged for providing information.
- The grounds on which requests can be rejected and the procedure for such rejection.

Unit 3

Exemptions from Disclosure of Information, Partial Disclosure and “Third Party” Information

1. Specific provisions of the Act which exempt certain kinds of information – the classification of such exempted information.
2. Application of public interest test with respect to exempted information.
3. *Grounds that* allow for partial disclosure of information.

The concept of 'Third Party' and the issues and considerations revolving around its involvement.

Unit 4

The roles and responsibilities of Appellate Officers within Public Authorities.

1. The process involved in making first appeals to designated Appellate Officers.
2. Timelines for making a first appeal and disposal of the appeal
3. First Appeals and Appellate Officers - Important Provisions

Unit 5

Information Commission: Powers and Functions

- The Role and Responsibilities of the Information Commissions.
- The relevant provisions in the RTI Act dealing with Complaints to the Information Commission and the specifications thereof.
- The "Second Appeal" process and the Commissions' mandate for the same.
- The power of Information Commissions with regard to enforcing compliance of public authorities with the provisions of the RTI Act, imposing penalty/ recommending disciplinary action against erring PIOs etc.

REFERENCES:

1. *S P Sathe - Right To Information, Lexisnexis India Publication*
2. *Sarbjit Sharma - Right To Information, Authors Press Publication*

18OEL255

INTRODUCTION TO TRANSLATION

3 0 0 3

Objectives:

Introduce students to translation studies as separate discipline of knowledge; to introduce translations in diverse fields; to impart training in translation; increase students' awareness related to social functions of translation; develop students' contrastive knowledge and their critical thinking skills

Unit 1

What is Translation - History of translation - The rise and development of translation - Linguistic and Philological definition of translation.

Unit 2

Translation and Communication - Information and message; Communication channel - The sender and the receiver of the message Forms and types of translation.

Unit 3

Translating for the Media: print media – electronic media - Translating various News reports – Advertisements – editing – interviews – writing Screen Plays and Scripts for radio and T.V. – spoken media - symposia, conference, platform speech etc.

Unit 4

Translating for business: Translating Business Correspondence – Translating literature on consumer products – Technical writing.

Unit 5

Introducing various types of translation - Machine Translation - Computer aided translation etc. – Revising and rewriting – Proof reading – editing – submitting manuscript for publication – summary.

REFERENCE BOOKS AND SOURCES:

1. Bassnett, Susan - *Translation Studies, London and New York, 1980 (revised edition 1991)*,
2. Routledge Bell, Roger T. - *Translation and Translating, Theory and Practice, Longman, 1991*
3. Callow, Kathleen - *Man and Message: A Guide to Meaning-Based Text Analysis, 1998,*
4. *Cumulative Index of United Nations Legal Materials Produced and Applied in Kosovo 1999-2004,*
5. *Central European and Euroasian Law Institute, USAID Duff, Alan, Translation, OUP, 1997*
6. Gërmizaj, Shykrane - *Translation Theory in the Classroom, Prishtina, 2005*

Websites: (newspaper Selection of websites)

<http://www.fortunecity.com/business/reception/19> <http://accurapid.com/journal/29accom.htm>
<http://>

www.ethnologue.com/show_products <http://cslu.cse.ogi.edu/HL.Tsurvey/chnode4.html> <http://fiat.gslis.utexas.edu/~palmquis/courses/project98/translation/mtlinks.htm> <http://www.fortunecity.com/business/reception/19> <http://language.home.sprynet.com/lingdex/pwood1.ht>

18OEL256LINGUISTIC ABILITIES

3 0 0 3

Objectives: To encourage students to develop lifelong skills, including: the ability to communicate clearly, accurately and effectively; the use of a wide range of vocabulary and correct grammar, spelling and punctuation; a personal style and an awareness of the audience being addressed.

Unit 1

Listening – Importance of listening - Types of listening - Basic skills of listening - Barriers of listening – Activities - listening to radio, TV or Internet - Transcript.

Unit 2

Speaking - body language – Pronunciation - Introducing yourself – storytelling - speak on any topic - social etiquette.

Unit 3

Reading - Different types of reading – comprehensive test - Vocabulary building.

Unit 4

Writing – structure – letter – circular – memo - Note making - Paragraph Writing précis - Writing – essay.

Unit 5

Practical Module - Creative writing - Play reading - Role play - Dialogue.

REFERENCES:

- 1. O' Brien Terry - Modern Writing Skills, Rupa Publication*
- 2. O' Brien Terry - Effective Speaking Skills, Rupa Publication*
- 3. Olson Judith F. Writing Skills - Success in 20 Minutes a Day, Goodwill Publishing House*
- 4. Meyers Judith N. - Vocabulary and Spelling, Goodwill Publishing House*

18OEL257LITERARY CRITICISM AND THEORY 3 0 0 3

Objectives:

*To introduce basic theories of literary and cultural criticism, with emphasis on interdisciplinary.
Target students: Students with no background in literary studies.*

Unit 1

Feminism: Indian waves - Chandra Talpade Mohanty. 'Under Western Eyes: Feminist Scholarship and Colonial Discourses'.

Unit 2

Cultural studies: Bacon's 'Of Travel' - Indian context - Travel Culture of Kerala - Introducing seminal texts - forms of travel narratives - Road movies.

Unit 3

Post colonialism: Edward Said - Introduction of 'Orientalism'.

Unit 4

Comparative Indian Literature: Methodology - Literature and other disciplines - G. Arunima. 'Who is a Malayali Anyway? Language, Community and Identity in Precolonial Kerala' - A.K. Ramanujan. 'Three Hundred Ramayanas: Five Examples and Three Thoughts on Translation'.

Unit 5

Psychoanalysis: Freud - Critical tool in literary analysis - Norman N Holland.

'The Mind and the Book: A Long Look at Psychoanalytic Literary Criticism'.

REFERENCE BOOKS:

1. Trilling, Lionel - "Freud and Literature". *The Liberal Imagination: Essays on Literature and Society*. London: Martin Secker and Warburg,
2. Richman, Paula. Ed. - *Many Ramayanas: The Diversity of a Narrative Tradition in South Asia*. University of California Press
3. Satish Saberwal, Mushirul Hasan - *Assertive Religious Identities: India and Europe*.
4. Bassnett, Susan - *Comparative Literature: A Critical Introduction*. Oxford: Blackwell, 1993.

18OEL258

MACRO ECONOMICS

3 0 0 3

Unit 1

Introduction to Macroeconomics and National Income

Macro Economics – Goals – Government Policies – Components – Definition of National Income – Concepts – Methods of Measuring National Income – Uses – GDP and Welfare – Investment Theory.

Unit 2

Government Budget and the Economy

Government Budget – Meaning, Objectives and Components – Classification of receipts – Revenue and Capital Receipts – Classification of Expenditure - Revenue and Capital Expenditure – Measures of Government deficits – revenue, fiscal and primary deficit meaning.

Unit 3

Money and Banking

Money – Keynesian Approach – Money Market Equilibrium – Supply of Money – Money creation by the Commercial Banking system – Central Bank and its functions – Controller of Credit through CRR – SLR – Repo and Reserve Repo.

Unit 4

Macro Economic Problem

Introduction – Determinants of Consumption, Saving and Investment - Unemployment
– Types - Definition and Characteristics of Trade Cycles - Different phases of trade cycles -
Definition and types of Inflation and Deflation - Causes and consequences of Inflation.

Unit 5

Public Finance

Meaning - Scope of Public Finance - Role and Types of Direct and Indirect Taxes in India - Role of Monetary and Fiscal Policies in maintaining real economic growth with stability – International Trade.

REFERENCE BOOKS:

1. *Principles of Economics – Deviga Vengedasalam and Karunagaran Madhavan, Third Edition – Oxford Publication Press.*
2. *Economics - Samuelson, Paul Anthony and William D. Nordhaus, 1998, Ed. 6, Tata McGraw Hill Publishing Company Ltd, New Delhi.*

18OEL259

MANAGING FAILURE

3 0 0 3

Objectives:

To prepare the individual/ student to face challenges of life; to impart insights for understanding the self and adjusting with work scenario in organizations so as to become a responsible global citizen.

Unit 1

Understanding the self - self awareness - Individual psychological processes - sculpting a unique socially desirable personality - spiritual/ ethical orientation.

Unit 2

SWOT analysis at the individual level - Developing individual competencies - surviving in a competitive environment - environment and sustainable development.

Unit 3

Emotional Intelligence - life skills - inter-personal relations - Social adjustments - Soft skills.

Unit 4

Managing at work situations - Profile of today's organization - Strategic context - environment challenges - Individual challenges and responsibilities.

Unit 5

Managing failures: Envisioning the future - managing change - unleashing creative and intuitive skills to meet failures - Remodeling individuals and organizations - Indian ethos for managing self and organizations ethically.

BOOKS FOR REFERENCE:

- 1) *Soft Skills and Professional Communication* - Francis, Mcgraw Hill
- 2) *Personality Development and Soft skills* - Barun Mitra, Oxford University Press
- 3) *Social and Personality development* - David R. Shaffer, Cengage learning.
- 4) *Ethics in Management and Indian Ethos* - Ghosh BB, Vikas publishing.

18OEL260

MEDIA MANAGEMENT

3 0 0 3

Objective:

The paper is aimed at giving an understanding of the media industry with the way the organization functions. This course is an introductory course aimed at students of varied domains.

Unit 1

Introduction

Introduction to principles and practice of management - Business Models and Function - Mass Media Industry Structure Media Markets - Ownership - Monopolies, Oligopolies, Conglomerates, Mergers, and Acquisitions - Media Sales Promotion and Marketing Mix.

Unit 2

Types of Media Ownership – Features Advantages & Disadvantages

Sole proprietorship – Partnership - private limited companies - public limited companies - trusts, co-operatives - religious institutions (societies) - Franchisees (Chains).

Unit 3

Ownership Patterns of Mass-Media in India

Organizational structure of newspaper and magazine - Organizational structure of Radio - Organizational structure of Television.

Unit 4

Planning & Production

Planning and execution of programme production - production terms - control practices and procedures.

Unit 5

History & Law

Historical perspective of mass media laws in India -

Basic Legal concepts Constitutional provisions for Freedom of Speech and Expressions - Article 19(1) (a) Reasonable restrictions - Article 19(2) - Freedom of the press in India Law of Defamation, Obscenity, Cinematography Act - Official Secrets Act 1923 - Copyright Act - • Contempt of Court Act - Legislative Privileges and Contempt of Legislature - Working Journalist Act.

REFERENCE BOOKS:

1. Aggarwal S.K. - *Press at the crossroads in India*, UDH Pub House
2. William and Rucker - *Newspaper Organization and Management, a State Pr. Publication*
3. Frank Thayer - *Newspaper Management - Appleton-Century Company; 1St Edition edition (1926)*

18OEL261

MICRO ECONOMICS

3 0 0 3

Unit 1

Introduction to Microeconomics

Definition of economics – Scope – Scarce and End resource – Welfare Definition - Differences between Micro and Macro economics – Basic Economic Concepts and Problems – Economic Systems.

Unit 2

Consumer's Equilibrium Demand and Supply

Consumer Equilibrium – Meaning of Utility – Law of Equi-Marginal Utility – Demand – Law of Diminishing Marginal Utility - Law of Demand – Determinants – Types of Demands – Supply – Law of Supply – Elasticity of Demand and Supply.

Unit 3

Theory of Production

Production – Production function – Law of Production – Return to Scale – Economics and Diseconomies of Scale - Classifications – Short-run production function – Long-run production function – Isoquant Curve.

Unit 4

Cost Function

Cost and Revenue – Short run costs – Total cost – Total Fixed Cost – Variable Cost – Average Fixed – Average Variable cost and Marginal Cost – Meaning and their relationship – Average and Marginal Revenue.

Unit 5

Market Structure and Price Determination

Market – Classification of Markets – Nature – Perfect Competition - Market Structure (Monopoly, Monopolistic, Oligopoly, Duopoly) – Price Determination under Monopolistic Market – Price Discrimination.

REFERENCE BOOKS:

1. *Principles of Economics – Deviga Vengedasalam and Karunagaran Madhavan, Third Edition – Oxford Publication Press.*
2. *Economics - Samuelson, Paul Anthony and William D. Nordhaus, 1998, Ed. 6, Tata McGraw Hill Publishing Company Ltd, New Delhi.*

18OEL262 MICRO FINANCE, SMALL GROUP MANAGEMENT AND 3 0 0 3 **COOPERATIVES**

Objective: Self Help Group and other micro-level innovative credit systems contributed significantly in Empowering underprivileged in India and abroad in recent times. Paper has two purposes—

- (a) to acquaint students with the various institutional arrangements as well as recent contribution of various innovative credit systems at the micro-level for financing rural development sector;
- (b) management of small groups involved in micro-finance for social and economic empowerment of their group members in particular and the society in general.

Unit 1

Financial institutions for rural development - Basic understanding of rural and development credit. Institutional structure for rural financing in India: policy and schemes of NABARD, recent financing scheme of the Government.

Unit 2

Development of cooperative banks in India with special reference to PACS, CCBs, LDBs. Rural financing through commercial banks - Policies and objectives before and after nationalization of banks, Branch expansion policy and programmes.

Unit 3

Emergence of RRBs policy, objectives, functions, progress and achievements. Micro finance at small group level: concept, emergence, objectives and thrust areas. Case studies of recent success stories.

Unit 4

Management of small groups, cluster and federation from credit and trade perspectives.
Role of facilitating agencies. Linkages between small group and Banks.

Unit 5

Convergence of with development programmes and implementing departments of government. Withdrawal strategy for facilitating organizations.

SUGGESTED READINGS:

1. *V S Somnath – Microfinance, Excel Books*
2. *Panda - Understanding Microfinance, Wiley India*
3. *Craig Churchill & Cheryl Frankiewicz - Making Microfinance Work, International Labour Office Publication*

18OEL263

NEGOTIATION AND COUNSELLING

3 0 0 3

Objectives:

The objective of this course is to provide knowledge of concepts and issues of negotiation and counseling such that to equip the students with valuable skills, techniques and strategies in counseling.

Unit 1

Negotiation: Nature, Characteristics, Strategy and Tactics of Distributive Bargaining, Strategy and Tactics of Integrative Negotiation; Strategy and Planning for Negotiation.

Unit 2

Negotiation Sub processes: Perception, Cognition and Emotion Communication: What is communicated during negotiation and how people communicate in Negotiation.

Unit 3

Best Practices in Negotiation – Fundamental Structure of negotiation and BATNA. Case I - Role Negotiation at Bokaro Steel Plant (Understanding Organizational Behaviour. By Udai Pareek, Oxford, Second Edition Page 410-415).

Unit 4

International and Cross Cultural Negotiation: Context and Concept, Influence of Culture on Negotiation: Case II - The Dabhol Debacle (Negotiation Made Simple, SL Rao, Excel Books pp.30-35 and pp. 196-197).

Unit 5

Emergence & Growth of Counselling: Factors contributing to the emergence, Approaches to Counselling: Behaviouristic, Humanistic Approaches and Rogers Self Theory Counselling Process: Steps in Counselling Process. Modern Trends in Counselling – Trends, Role of a Counsellor and Model of Counselling.

REFERENCE TEXTS:

1. Lewicki, Saunders & Barry – *Negotiation*, Tata McGraw Hill
2. B.D.Singh - *Negotiation Made Simple*, Excel Books, 1st Ed.
3. Rao S N - *Counseling and Guidance*, Tata Mc Graw Hill, 2nd Ed.
4. Singh Kavita - *Counselling Skills for Manager*, PHI, 1st Ed.
5. Welfel, Patterson - *The Counselling Process, A Multi theoretical Integrative Approach*, Thomson India, 6th Ed.
6. Pareek Udai - *Understanding Organisational Behaviour*, Oxford University Press

18OEL264

NEW LITERATURES

3 0 0 3

Objectives: To introduce the emergent body of literature; to examine the approach of different writers towards the local and global social issues; to consider how literature undertakes the challenge of rethinking the world around us.

Unit 1

Introduction to new literatures, experiments in style, narrative techniques, issues of identity, selfhood and location.

Unit 2

Fiction

Shyam Selvadurai – *Cinnamon Gardens*
Amitav Ghosh - *The Hungry Tide*

Unit 3 Poetry

Kamala Das – *An Introduction*
Derek Walcott – *A Far Cry From Africa*
Kishwar Naheed – *We Sinful Women*

Unit 4 Drama

Wole Soyinko – *The Road*

Unit 5

Assignments, Discussions, Term Test

REFERENCES:

1. G. H. Mair - *English Literature*, Discovery Publishing House
2. Kamaladas - *The Old Playhouse and other Poem*, Orient Blackswan
3. Derek Walcott - *Selected Poems*, Farrar, Straus and Giroux Publication
4. Judith Wright - *Woman to Man*, Angus and Robertson Publication

18OEL265

NON-PROFIT ORGANIZATION

3 0 0 3

Objectives:

To introduce the students to NGO Sector; to provide an overview of NGOs; to introduce the Basic Concepts; to provide basic managerial skills for NGO personnel.

Unit 1

NGOs – An Introduction, Concepts and Functions, evolution in India, Types of non-profits, Issues in NGO Management, challenges of NGO Management.

Unit 2

Legal procedures for establishment of NGOs – Trust and Society and their differences. Formation of Trust and Society. Registration procedure for NGO.
Corporate Social Responsibility and Social Marketing.

Unit 3

Development issues, Development indicators, Poverty (Exploitation, Vulnerability and Powerlessness) and Development. HIV/AIDS, Child labor, Education and Tribal welfare. (This is to increase the level of awareness among students on issues).

Unit 4

Strategy and planning for NGOs – Elements of Strategy, SWOT analysis, Process of Management – Planning, Organization, Delegation, Co-ordination, Core-Competency and Capacity Building

Unit 5

NGOs and changing trends of development. State, market and third sector, Self-Help Group (SHG) and Empowerment of Women, Role of NGOs in Civil Society.

REFERENCE BOOKS:

1. *Management of Non -Governmental Organizations towards a Developed Civil Society*, JM Ovasdi, ISBN 140392868 1 Macmillan India Lid,2006
2. *Managing the Nonprofit organizations: Principles and Practices* ,Peter F Drucker , ISBN –B : 9780060850049 Harper Collins publishers May 2006
3. *Nonprofit Management: Principles and Practices*, Michael, J Worth, The George Washington University, Sage publications, September 2008

18OEL266

PERSONAL EFFECTIVENESS

3 0 0 3

Unit 1

Personal growth - Meaning and concepts, Self-awareness and self-esteem, Life Roles, Social roles and Organizational roles. Nature and scope of personal growth. Feeling, thinking and behaviours, Personality theories, Carl Jung's theory of personality types and Myers Briggs Type Indicator test (MBTI), Trait theories - Guilford Peogut, Emotional intelligence.

Unit 2

Pedagogy and Androgogy. Adult Learning Process; learning styles and its relatedness to personality development.

Unit 3

Attitudes, beliefs, Values and their impact on behaviour. Personal change - meaning, nature and requisites. Social adjustments and habit formation. Habits of personal effectiveness. Seven habits of highly effective people.

Unit 4

Basic functions of mind - Creativity and innovation. Blocks to creativity. Creativity processes and tools - convergent and divergent thinking. Neuro Linguistic Programming - Interpersonal relations and personal growth. Interpersonal needs, motivation and behavior - FIRO-B and Johari Window. Defense Mechanism in groups.

Unit 5

Transactional Analysis - Ego states, types of transactions and time structuring. Life position, scripts and game Experience learning methodologies - T-group, sensitivity training, encounter groups and human process labs (students may go through three days personal growth lab for experiential learning)

REFERENCE BOOKS:

1. *John. W. Newstrom and Keith Davis - Organizational Behaviour: Human Behavior at work*, Tata McGraw Hill
2. *Robert N. Lussier - Human Relations in organizations*, Mc-Graw Hill Education
3. *Whetten & Cameron - Development Management Skills*, 7th Ed. Pearson, PHI.
4. *Calvin S Hall Et Al - Theories of Personality*, Wiley Publication

5. Stephen R Covey, *Simon & Schuster - Seven Habits of Highly Effective People, Simon & Schuster*
6. *Training in Interpersonal Skills – tips for managing People at work, Stephen Robbins, Et al, Pearson, PHI.*

18OEL267 PERSPECTIVES IN ASTROPHYSICS AND COSMOLOGY 3 0 0 3

Unit 1

Historical Introduction - Copernicus, Galileo - Solar system-Planets, Comets, meteorites, asteroids, satellites, Constellations and Astrology. Olvers paradox.

Unit 2

Constellations, Distance scales and measurements - Parallax methods - Moving cluster, Statistical and Spectroscopic and dynamic parallax methods.

Unit 3

Introduction to Celestial Mechanics – Kepler’s laws. Black body temperature of stars Hertzsprung Russel diagram - Stellar evolution - white dwarfs, red giants, neutron stars, pulsars, black holes.

Unit 4

Special Relativity – Minkowski space, Introduction to General Relativity - space-time curvature.

Unit 5

Cosmology - Red shift – Galaxies - CMBR Big bang, Various cosmic models - Horizon and Flatness problem Dark matter and Energy. Anthropic Principle. Relation to Biology.

REFERENCES:

1. *Arbab Rai Choudhuri, Astrophysics for Physicists, Cambridge University Press, 2010.*
2. *An Introduction to Astrophysics, BAIDYANATH BASU, TANUKA CHATTOPADHYAY, 2nd Edition, PHI Learning Pvt. Ltd.*
3. *The New Physics and Cosmology Zanjoc, Oxford 2004.*
4. *An Introduction to Modern Astrophysics, 2nd Ed. by Carroll Ostie, Pearson, Addison Wesley*

18OEL268 PRINCIPLES OF MARKETING 3 0 0 3

Objective:

To provide exposure to the students about principles of marketing and the knowledge of E-business.

Unit 1

Marketing, Introduction, Definition of market and marketing, Objects of marketing, features, Classification of markets, marketing and selling, Importance of marketing, modern marketing,

features, marketing management, characteristics of marketing management, marketing management and sales management, Green Marketing, Market Segmentation and Target Marketing, Marketing mix, definition, elements of marketing mix, Marketing process, marketing functions, functions of exchange, functions of physical supply, facilitating functions.

Unit 2

Marketing Research, market research and marketing research, marketing research and marketing information system, procedure of marketing research.

Unit 3

Product, classification, product policies, product line, product mix, product life cycle, different stages in product life cycle, Pricing, pricing objectives, factors affecting price decisions, price determination procedure, types of pricing.

Unit 4

Promotion, objectives, forms of promotion, sales promotion, tools of sales promotion, advertising, definition, kinds of advertising media, personal selling, features, personal selling process, channels of distribution.

Unit 5

Consumer behaviour: introduction, market analysis, marketing strategy, factors influencing consumer behaviour, individual determinants, external environmental factors affecting consumer behaviour.

TEXTBOOKS:

- 1. R.S.N. Pillai and Bagavathi – Modern Marketing Principles and Practices, S. Chand.*
- 2. Brahm Canzer – E-Business and Commerce: Strategic Thinking and Practice, Biztantra Publishers, New Delhi*

REFERENCE BOOKS:

- 1. Martin Khan – Consumer Behaviour, New Age International Publishers*
- 2. Philip Kotler – Marketing Management, Prentice Hall of India*
- 3. Stephen P Robbins, David A Decenzo – Fundamentals of Management of E-Business, Prentice Hall.*

18OEL269

PRINCIPLES OF PUBLIC RELATIONS

3 0 0 3

Unit 1

Purpose & Philosophy of PR, What PR Is, Objectives of Public Relations, the Primary Purpose of PR, Hostility, Prejudice, Apathy, Ignorance, Emergence of Public Relations, Public Relations Today, Public Relations and Propaganda, Defining Objectives and Planning a Programme.

Unit 2

Four Steps Public Relations Process, Defining PR Problems, Planning and Programming, Taking action and Communicating, Evaluating the Program, Elements of Public Relations, Human Relations, Empathy, Persuasion, Dialogue, Objectives of Public Relations.

Unit 3

Public Relations as a Profession, Overview, Profession, Codes of Professional Conduct, Functions of Public Relations Department, Policy, Publicity, Product Publicity, Relations with the Government, Community Relations, Shareholders Relations, Promotion Programmes, Donations, Employee Publications, Guest Relations, Establishment of Relations with the Public, The Need for Public Relations, Scope of Public Relations, Professional Code - Public Relations.

Unit 4

Ethics and Challenges of Public Relations, International Public Relations Association (IPRA) Code of Conduct, the European Code of Professional Conduct, All about Marketing, Advertising, Functions of Advertising, PR as a Component of Communication and Strategies, Strategic Management, Theories of Communication, Mass Communication Theory and Research. Functional Approach to Mass Communication Theory, Human Action Approach.

Unit 5

Models of Communication, Communication Models, The advantages of Models, Limitations of Models, Classical Communication Models, Transmission Model and its Criticism, Report Writing, Copyright and Other Legal Issues.

REFERENCE BOOKS:

1. Geroge E-Belch & Michael. A. Belch - "Advertising and Promotion", Tata McGraw Hill – Sixth Edition.
2. Kruti shah and Alan D'souza - "Advertising and Promotion", Tata McGraw Hill
3. Tom Duncan - "Principles of Advertising and IMC", Tata McGraw-Hill - Second Edition

18OEL270

SCIENCE, SOCIETY AND CULTURE

3 0 0 3

***Objectives:** This introductory paper is intended to acquaint the students with sociology as a social science and the distinctiveness of its approach among the social science. It is to be organized in such a way that even students without any previous exposure to sociology could acquire an interest in the subject and follow it.*

Unit 1

The nature of Sociology

The meaning of Sociology: Origin, Definition, Scope, Subject matter, Nature and relation of sociology with other social Sciences. Humanistic orientation to Sociological study.

Unit 2

Basic concepts

Society, community, Institution, Association, Group, Social structure, status and role, Human and Animal Society.

Unit 3

Institutions.

Family and kinship, religion, education, State.

Unit 4

The individual and Society.

Culture, Socialization, Relation between individual and society.

Unit 5

The use of Sociology.

Introduction to applied sociology - Sociology and social problems, Ecology and Environment: Pollution, Global warming and Greenhouse effect. Impact of Industrialization and Urbanization on Environment.

REFERENCE TEXTS:

1. Harlambos, M - *Sociology: Themes and perspectives*, Oxford University Press.
2. Inkeles, Alex - *What is Sociology*, Prentice-Hall of India.
3. Jaiaram - *What is Sociology*, Macmillan
4. Johnson, Harry M, *Sociology: A Systematic Introduction*, Allied Publishers.

18OEL271

STATISTICAL ANALYSIS

3 0 0 3

Objective:

To understand the concepts of statistical analysis and to apply the results in real life business problems.

Unit 1

Correlation Analysis: meaning and definition - positive correlation - negative correlation - no correlation - scatter diagram - Karl Pearson's correlation co-efficient - interpretation.

Unit 2

Regression Analysis: introduction – uses of regression analysis – regression lines - the two regression equations.

Unit 3

Time series Analysis: meaning – components of time series - methods of estimating trend – graphic method – semi-average method – moving-average method.

Unit 4

Probability: introduction - classical definition- relative frequency theory-subjective approach - Axiomatic approach to probability - Addition theorem - Multiplication theorem -- conditional probability.

Unit 5

Theoretical distributions: discrete and continuous distributions - Binomial distribution – Normal distribution.

REFERENCE BOOKS:

1. *S P Gupta – Statistical Methods, Sultan Chand & Sons, New Delhi.*
2. *Dr.P.R.Vittal & V.Malini -Statistical and Numerical Methods, Margham Publications; 1 edition (2012)*

18OEL272 TEAMWORK AND COLLABORATION

2 0 1 3

Unit 1

Leadership – Meaning, Concepts and Myths about Leadership, Components of Leadership - Leader, Followers and situation. Assessing Leadership & Measuring Its effects.

Unit 2

Focus on the Leader – Power and Influence; Leadership and Values. Leadership Traits; Leadership Behaviour; Contingency Theories of Leadership; Leadership and Change.

Unit 3

Groups, Teams and Their Leadership. Groups – Nature, Group Size, Stages of Group Development, Group Roles, Group Norms, Group Cohesion.

Unit 4

Teams – Effective Team Characteristics and Team Building, Ginnetts Team Effectiveness Leadership Model.

Unit 5

Leadership Skills – Basic Leadership Skills, Building Technical Competency, Advanced Leadership Skills, Team Building for Work Teams, Building High Performance Teams.

REFERENCE TEXTS:

1. Hughes, Ginnett, Curphy - *Leadership, Enhancing The Lessons of Experience*, Tata McGraw Hill, 5th Ed.
2. Yukl G - *Leadership in Organisations*, Pearson, 6th Ed.
3. West Michael - *Effective Team Work*, Excel Books, 1st Ed.
4. Sadler Philip – *Leadership*, Crest Publishing House

18OEL273 THE MESSAGE OF BHAGAVAD GITA

3 0 0 3

Unit 1

Introduction: Background of the Bhagavad Gita – The Epic of Mahabharatha.
Arjuna Vishada Yoga: Scene at Kurukshetra – Arjuna’s anguish and confusion.
Symbolism of the war within – Psychological analysis of the human condition.

Unit 2

Sankhya Yoga: Importance of Self-knowledge. Body–Mind-Intellect Chart, Concept of Pancha Kosas, Concept of Vasanas. Nature of the Self–Indestructibility of Consciousness.

Unit 3

Karma Yoga: Yoga of Action – Living in the Present – Dedicated Action without Anxiety over Results - Concept of Swadharma

Unit 4

Sthitaprajna: Qualities of a person established in wisdom. Dynamics of the Three Gunas: Tamas, Rajas, Sattva – Going Beyond the Three Gunas – Description of a Gunatheetha.

Unit 5

Other topics: Tuning the Mind – Quantity, Quality and Direction of Thoughts – Reaching Inner Silence. Yoga of Devotion – Form and Formless Aspects of the Divine – Inner Qualities of a True Devotee.

TEXTBOOKS/ REFERENCES:

1. Swami Chinmayananda, “*The Holy Geeta*”, Central Chinmaya Mission Trust, 2002.
2. Eknath Easwaran, “*The Bhagavad Gita*”, Nilgiri Press, 2007.

Objectives:

To create a basic knowledge on the growth and development of tourism, to have an understanding of various national and international tourism organizations.

Unit 1**Growth and Development of Tourism**

Tourism as an ancient phenomenon - pleasure travel - religion as a motivator Industrial revolution and development of tourism. Effects of Great World Wars on transport system - advent of jet and high speed trains. Causes of rapid growth - meaning, nature and components of tourism-basic travel motivations.

Unit 2

Need for Organization - factors influencing types of organization - the National tourist organization - tourist organization in India - International organization of Tourism International Union on Official Travel Organization (IUOTO) - World tourism Organization (WTO) – Pacific Area Travel Association (PATA) – International Air Transport Association (IATA) – American Society of Travel Agents (ASTA).

Unit 3**Measurement of Tourism**

Need for measuring tourism phenomenon - methods of measurement - importance of tourist statistics - types of tourist statistics. Definition of the terms tourist, domestic tourism and international tourism - tourism planning and development - planning for tourism. Assessment of tourist demand and supply - basic infrastructure - financial planning - human resources planning - tourism marketing - environmental and regional planning.

Unit 4**Tourism and Economic Development**

Economic and social significance of tourism - economic benefits - multiplier effect - infrastructure development - regional development – employment opportunities - cultural tourism - international understanding.

Unit 5**Role of travel agencies in tourism**

Thomas Cook and organization of travel - introduction of railway and air travel - travel agency - tour operator, Need for legislation - travel agencies in India – TAA.

TEXTBOOKS:

1. *Vara V V Prasad - Travel and Tourism Management, Excel books*
2. *Ghosh, Biswanath – Tourism and Travel Management, Vikas Publishing House*

REFERENCES:

1. Douglas Foster – *Travel and Tourism Management*, Palgrave MacMillan
2. B S Badan, Harish Bhatt – *Travel Agencies and Tourism Management*, Common Wealth Publishers

18OEL275VIDEOGRAPHY

1 0 2 3

Unit 1

Fundamentals of TV production techniques; Principle of video; TV camera, components of camera lens, basic shots and its composition, sound and lighting and its types, special effects,

Unit 2

Lighting for television - types of lights, Three point and Multi-point lighting; Sound - Types of microphones and characteristics of sound; Sound recording - tape and tapeless;

Unit 3

Stages of TV programmes - pre-production, rehearsal and set-up, actual production and post-production, graphics-CG and VG, animation, ENG-DSNG and OB broadcasting.

Unit 4

Type of editing - Assemble and Insert; Modes of editing - Online, Offline, Linea and Non – linear type software's and graphics early.

Unit 5

W riting for television - script writing - genres of TV programmes - news, documentary, talk shows, panel discussion, quiz, current affairs and special audience programmes - women, children, youth - post production, reviews, sports, musical and dance programmes, phone-in programmes.

BOOKSRECOMMENDED:

1. Allan Wurtzel: *Television Production*
2. Zettl Herbert: *Television Production*
3. Gerald Millerson: *The Technique of Television Production*
4. Hartwig, Robert: *Basic TV Technology, digital and Analog*
5. Chattedji P.C: *Broadcast News*
6. John Watkinson: *An Introduction to Digital Video*

18OEL276

VISTAS OF ENGLISH LITERATURE

3 0 0 3

Unit 1

1 Introduction – What literature is – enjoyment of literature – Holding a mirror to life

– Ages of literature – Different literatures

2 WH Auden – The Unknown Citizen

Unit 2

3 Rabindranath Tagore – The Child

4 RK Narayan – Sweets for Angels

5 Toru Dutt – Lakshman

Unit 3

6 Jane Austen – Pride and Prejudice (Chapter 1)

7 Sarojini Naidu – The Queen

8 AG Gardiner – A Fellow Traveller

Unit 4

9 Shakespeare – Macbeth: The Murder Scene

10 Oliver Goldsmith – The Man in Black

Unit 5

11 Robert Browning – My Last Duchess

18OEL277WEB-DESIGNING TECHNIQUES

1 0 2 3

Unit 1

Introduction to web technologies, How the website works?, Client and Server scripting languages, Difference between a web designer and web developer, Types of websites (Static and Dynamic), Web standards and W3C recommendations.

Unit 2

HTML: Introduction to Internet, Understanding Browsers, Starting with HTML, HTML Page Structure. Defining Web Layout(Head & Body), Head Tags, BODY tag with Background color, Background with image and text color. Text formatting, Text attributes. Importance of heading tags (H1–H6). Marquee text with or without background, Blink the text attributes. Divide section using <HR> line with width, align, size.

Knowing Images format for web: Working with images, Images attributes. Working with Tables: Table attributes, Colspan, Rowspan, Table Border, Align, Valign, Table background image, color to cell, Nesting tables.

Unit 3

Using list: Ordered list, Unordered list. Working with Links: Internal Links, External Links, Anchor Link, Email Link, Linking with text, Links with images. Working with controls. Working with forms: knowing get and post action.

Unit 4

CSS: Introduction to Cascading Style Sheets, Types of Style Sheets , Class Selector, ID Selector, Absolute Relative Positioning, Inline menu, DIV + CSS Layout Design, PSD to CSS Conversion.

Unit 5

JavaScript: Introduction to JavaScript, Understanding variables & functions, Working with alert, confirm and prompt, Understanding loop, arrays, Creating rollover image, Working with operators.

TEXTBOOK/ REFERENCES:

- 1. Ivan Bayross - Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP, BPB Publicationa*
- 2. Dionysios Synodinos, Michael Bowers, Victor Sumner - Pro HTML 5 and CSS 3 Design Patterns, Springer India Publication*
- 3. Jennifer Niederst Robbins - Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics, Shroff Publishers*
- 4. David Pitt - Modern Web Essentials Using JavaScript and HTML5, InfoQ Publications*

18OEL278

ORGANIC FARMING

1 0 2 3

Unit I

Introduction to Organic farming:

Definition, Basic principles of Organic farming, Chemical intensive farming versus Organic farming, Advantages and disadvantages.

Organic inputs:

Advantages of using organic inputs, Organic manures, Biofertilizers, Biopesticides, Organic growth promoters, Biocontrol agents.

Unit II

Basics of Organic Vegetable cultivation:

Selection of varieties, seeds or seedlings, Liming of soil, Potting mixture preparation and filling of grow-bags/pots, Precautions during planting and transplanting, Details of Organic inputs required for

cultivation and its application methods, 100 day schedule for organic vegetable farmers, Nutrient management and Plant protection measures.

Unit III

Land reclamation using green manuring crops:

Soil degradation due to chemical fertilizers, Crops used for green manuring, Benefits, ITK used by farmers in plant growth and protection.

Assessing the quality of organic inputs:

Quality of organic manures, Analysis-agencies involved

Quality standards, Governance and Legal Institutions Involved in Organic certification.

Unit IV

Introduction to organic livestock production:

Conventional farming versus Organic livestock production, Principles of Organic livestock production.

Safe egg and meat production in homesteads:

Selection of suitable poultry breeds, Housing requirements, Feeding management, Care and management, Vaccination and other routine medicines, Safe withholding periods, Common diseases and their management.

Unit V

Safe fish production in Homesteads:

Homestead fish farming methods, Location specific models, Stepwise Installation procedure, Species selection, Feeding and management, Culture-Package of Practice, Harvesting, storage and marketing.

Storage and Value addition of excess produce:

Refrigerated storage, Drying and dehydration, Pickles, Jam, Squash preparation, Home recipes.

Reference Books:

1. Palaniappan, Annadurai - Organic Farming: Theory and Practice, Scientific Publishers Journals Dept
2. Amitava Rakshit, HB Singh – ABC of Organaic Farming, Jain Brothers Publication
3. B. Subrahmanyeswari Mahesh Chander – Organic Livestock Farming, ICAR Publication
4. Handbook of Fishers and Aquaculture – ICAR Publication

18OEL279

**BASIC LEGAL AWARENESS ON PROTECTION OF WOMEN
AND RIGHTS**

3 0 0 3

Objective:

This course is intended to give the students a basic awareness on Women's rights and the legal frame work for the protection of their rights.

Unit 1

Introduction/Overview: The meaning of law, social security legislations, free legal aid to the poor, Indian Evidence Act, various modes of dispute settlement mechanisms- Lok Adalats, Family Courts, Mahila Courts, Crime Against Women Cells, NCW, NHRC, State Commissions.

Women and the Constitution: Fundamental Rights, Constitutional Remedies (Writs), Electoral Law, Voting Rights for Women, participation in Panchayats and governance.

Unit 2

Women & Family Laws: Marriage Law, Separation, Divorce, Maintenance, Adoption, Right to Property and Succession, Guardianship, unmarried mother and the legitimacy of her children.

Unit 3

Criminal Law and Women: Major offences against women, Women in Custody- Arrest, grounds of arrest, kinds of offences (bailable and non-bailable), arrest warrant, powers of police, rights of arrested persons including the right to bail, the immediate procedure to be adopted in case of violation of rights.

Unit 4

Procedure in Action: Procedure for seeking redressal, Complaints to Police Station, Courts, Lok Adalat.

Unit 5

Rights under different laws: Rights at work place Equal Remuneration / Minimum Wages Act / Rights under Factories Act, Maternity Benefit Act, Mines and Plantation Act, Rules of work - in such specific areas, Sexual harassment at work place, Reproductive Health Rights - Foeticide, Infanticide, Preconception and Prenatal Diagnostic Techniques (Prohibition of Sex Selection) Act 1994, The Medical Termination of Pregnancy Act 1971.

18OEL280

Ritual Performances of Kerala

3 0 0 3

Objectives:

To provide an overall view of Ritual Performances of Kerala in general and 'Padayani', 'Mudiyettu' and 'Theyyam' performances in particular. Land, people, social and political system and worldview are the deciding factors of ritual performances. The course aims to give a clear understanding of these performances and their unique features. The classes will be supported with PowerPoint and video clippings of the respective ritual performances.

Unit 1

Introduction:

Kerala – Land and People – social structure – Agrarian society – Kerala society today. Meta Physical World: mythology and religion and its relation to the festivals and rituals of Kerala – special reference to Kali.

Padayani:

Legend behind the dance ritual – description of performances – musical instruments and music of Padayani – rhythm of Padayani songs. Main Kolams in Padayani: – its artistic features of making marks – drawing on arecanut sheaths. Dance in Padayani: different Kolams and its dance features. Padayani as a Performance, Devotional Aspects, Eminent artists of this dance form.

Unit 2**Mudiyettu:**

Geographical area of Mudiyettu – land and people – main centers of performances – a complete folk drama – myth behind Mudiyettu – Kali – Darika fight – scenes in Mudiyettu and its contents. Characters in Mudiyettu: Naradan, Darikan, Danavendran, Kali, Kooli, Koimbadaran. Abhinaya in Mudiyettu: Aangikam, Vachikam, Aaharyam. Rituals in Mudiyettu: Mudiyettu itself is a ritual – ritual inside Mudiyettu – drawing of Kolam, Kolam Pooja, uzhiyal, etc. Devotional aspects of Mudiyettu.

Unit 3**Teyyam:**

Kolathunad – land and people – folk religion of Kolathunad and its features. Deities in Teyyam: Hindu Gods and Goddesses – heroine cult – deities defied after death – family deity – caste deity – local deity. Teyyam as a Ritual Performance – principles of bringing down deities – appease – bringing down – sending back. Ritual Acts: kodiyla vangal, kodiyla tottam, tottam/ vellattam, teyyam, mudiyazhikkal. Features of Tottam Songs – varavili, tottam songs – mumbsthanam. Ornaments and Decorations of Teyyam – thalachamayam kaikkaru, arachamayam kaikkaru. Mukhattezhattu and Mekkezhuttu. Devotional Aspects of Teyyam.

Comparative aspects of Padayani, Mudiyettu and Teyyam – theme, decorative elements and form, dance, enactment, faith and other aspects.

REFERENCE BOOKS:

1. *Kadammanitta Vasudevan Pillai, 'Palayile Kolangal', Kerala Bhasha Institute.*
2. *Kadammanitta Vasudevan Pillai, 'Padayani'.*
3. *Chummar Chhondal, 'Mudiyettu'.*
4. *M V Vishnu Namboodiri, 'Teyyam', D C Books, Kottayam.*
5. *Raghavan Payyanad, 'Methodology for Folkloristics', English Dept., Farook College, Farook, 2013.*
6. *C Achutha Menon, 'Keralathile Kali Seva', Madras University, 1943.*
7. *M D Raghavan, 'Folk plays and Dances of Kerala'.*
8. *Sreedhara Menon, 'Cultural History of Kerala'.*

Objective:

Visual documentation of key social issues: The student will write the script and shoot a documentary film of 5-10 minutes, highlighting a key issue.

Unit 1

Screening documentary films on various social issues – gender discrimination, women empowerment, dowry, female infanticide and skewed sex ratios, maternal and child care, role of technology in transforming societies, changing caste and class barriers etc. etc.,

Unit 2

Selecting the topic: Migration of labour from other regions to the southern states due to labour shortage and their integration in the society as local youth turn away from traditional occupations of their families and go in search of white-collar jobs, alcohol consumption and rising crime, drug addiction among students etc. etc..

Unit 3

Data collection on the ground, interviews and shooting schedule.

Unit 4

Pre-production, production and post-production processes with approval from the guide.

Unit 5

Preview of the film & analysis.

Outcomes:

By the end of the course the students will be able to:

- CO1: Develop critical thinking skills necessary to evaluate, organize and disseminate news
- CO2: Identify problem of common man
- CO3: Use data to create stories
- CO4: Express themselves fluently and appropriately in social and professional contexts
- CO5: Become able to produce documentaries using available data

REFERENCES:

1. Aufderheide, Patricia (1997) *Public Intimacy: The Development of First-Person Documentary*, New York: Afterimage-Rochester. 25, 16-18.
2. Nichols, B. (2010). *Introduction to documentary*. Indiana University Press.
3. Rosenthal, Alan (1990) *Writing, Directing, and Producing Documentary Films and Videos*. Carbondale: Southern Illinois University Press.
4. Walker, J., & Waldman, D. (1999). *Feminism and Documentary*. University of Minnesota Press

FILMS:

1. *Flaherty, Robert J (1922) Nanook of the North*
2. *Kauffman, R., and Briski, Z. (2005). Born into brothels. ThinkFilm.*
3. *Srinivasan, R R (2009) En Peyar Palaru*
4. *Srinivasan; R R (2000) Nadhiyin Maranam*

18OEL282

FABRICATION OF ADVANCED SOLAR CELL 3 0 0 3

Unit 1

The Solar Resource and types of solar energy converters, Requirements of an ideal photoconverter, Principles of a solar cell design, material and design issues; Revisions of Semiconductor Physics, Physics of semiconductor Junctions; p-n junction under dark and under illumination, effect on junction characteristics, Other device structures. Photovoltaic cell and power generation, Characteristic of the Photovoltaic Cell.

Unit 2

Silicon Solar cell, Mono -crystalline and poly-crystalline cells, Metallurgical Grade Si, Electronic Grade Si, wafer production, Mono-crystalline Si Ingots, Poly-crystalline Si Ingots, Si-wafers, Si-sheets, Solar grade Silicon, Si usage in solar PV, Commercial Si solar cells, process flow of commercial Si cell technology, Process in solar cell technologies, Sawing and surface texturing, diffusion process, thin film layers, Metal contact.

Unit 3

2nd generation solar cell, Thin film solar cell, Advantage of thin film, Thin film deposition techniques, Evaporation, Sputtering, LPCVD and APCVD, Plasma Enhanced, Hot Wire CVD, closed space sublimation, Ion Assisted Deposition, Substrate and Super-state configuration, Thin film module manufacturing, Thin film and Amorphous Si Solar cell, Cadmium Telluride Solar Cell, CIGS solar Cell, CZTS solar cell, New materials for thin film solar cell.

Optics in solar energy conversion: antireflection coatings, concentration of light: Light confinement, photon recycling, multiple exciton generation.

Unit 4

3rd generation Solar cell; **Advances in Photovoltaics**, Photochemical and photosynthetic energy conversion; DSSC., Solution processed thin film, Organic Solar Cell, Hydride Perovskite solar cell and multi junction tandem solar cells;

Solar PV modules:

Series and Parallel connections, Mismatch between cell and module, Design and structure, PV module power output, PV system configuration, standalone system with DC / AC load with and without battery, Hybrid system, Grid connected systems.

Unit 5

Hand on experience on solar cell fabrication, DSSC fabrication, Perovskite solar cell fabrication, Thin-film solar cell fabrication.

TEXTBOOKS/ REFERENCES:

1. *Physics of Solar cells-Jenny Nelson, Imperial College Press (2006)*
2. *Crystalline Silicon Solar Cells, by A. Goetzberger, J. Knobloch, and B. Voss (Wiley, 1998)*
3. *Third Generation Photovoltaics: Advanced Solar Energy Conversion, by M. A. Green (Springer, 2006)*
4. *Semiconductor Materials for Solar Photovoltaic Cells; Paranthaman, M.P. (et al.) (Eds.) (2016)*

18OEL283

BASIC CONCEPTS OF X-RAY DIFFRACTION

3 0 0 3

Unit 1

The geometry of the crystalline structure

Unit 2

X-RAY BASICS

The scattering of X-rays, Diffraction from a crystal

X-ray interaction with matter, X-ray sources, X-ray optics, X-ray detectors

Unit 3

X-RAYDIFFRACTOMETERS

High-ResolutionDiffractometers

Powder Diffractometers

Unit 4

Experimental Collection of Diffraction Data

The factors affecting the X-ray intensities

Unit 5

Determination of Space group and crystal structures

Accuracy and refinement process

REFERENCES:

1. *Emil Zolotoyabko; Basic Concepts of X-Ray Diffraction; John Wiley & Sons, 21-Apr-2014 - Science*
2. *M. M. Woolfson; An Introduction to X-ray Crystallography; Cambridge University Press*
3. *Werner Massa; Crystal Structure Determination; (March 31, 2004) ISBN-10: 3540206442*

Unit 1

Introduction

Introduction to Computing, Basic Fortran, Data Types, Constants and Variables, Naming Convention. Operation and Intrinsic Functions, Expressions and Assignment Statements, Logical Operators and Logical Expression.

Unit 2

Control Statements and I/O

IF statement and construct, nested if statement, GOTO, Case Construct, Do Loop, nested do loop, do while loop. Fortran I/O and External Files, Formatted Output, Formatted Input, File Processing.

Unit 3

Subroutines and Functions

Defining and referring subroutine and function, arguments, conditions on arguments, Dummy arguments or parameters and actual arguments, Scope of variables.

Unit 4

Arrays

Arrays and elements, Array properties, Array storage, Whole array assignment, Array section assignment, Array Operations, Array Processing, Mask Array, Allocatable Arrays, Functions Return Arrays.

Unit 5

Gnuplot

Introduction to gnuplot,function plot, data plot, analyse a function, various options in gnuplot, Scientific Graphic Library, Linking Fortran Programs to gnuplot Graphic Library.

TEXTBOOK:

1. *Stephen J. Chapman, "Fortran 95/2003 for Scientists and Engineers", McGraw-Hill (3rd edition).*

REFERENCES:

1. *Michael Metcalf and John Reid, "Fortran 90/95 Explained", Oxford University Press (2007).*
2. *Jeanne C. Adams, Walter S. Brainerd, Richard A. Hendrickson, Richard E. Maine, Jeanne T. Martin and Brian T. Smith, "The Fortran 2003 Handbook", Springer (2009).*
3. *Michael Metcalf, John Reid and Malcolm Cohen, "Modern Fortran Explained", Oxford University Press (2011).*
4. *William H. Press, Saul A. Teukolsky, William T. Vetterling and Brian P. Flannery, "Numerical Recipes in Fortran Vol. 1 & 2", Cambridge University Press (1996).*
5. *Documentation given with gnuplot software (2015).*
6. *Lee Phillips, "gnuplot Cookbook", Packt Publishing (2012).*

Unit 1

General introduction to porous materials

Introduction to porous materials, Classification based on the pore size: microporous materials, mesoporous materials and nanoporous materials; Classification based on materials: Zeolites, Transition metal oxides, Metal organic frame works and types-new era of porous materials.

Unit 2

Metal organic frameworks, Mesoporous materials and Zeolites

Introduction, significance of metal organic frameworks, covalent organic frame works and their evolving applications at lab scale and industrial scale. Zeolites: Definitions, Structure, Chemical composition and Types, Mesoporous Materials: SBA-15, MCM-41

Unit 3

Characterization of porous materials

Introduction to adsorption, classification-physical and chemical adsorption, surface area, factors affecting the surface area, gas adsorption for surface area analysis, adsorption isotherms and their classification, Langmuir and BET adsorption isotherms, pore analysis: calculation of pore size and pore volume, mercury porosimetry.

Unit 4

Synthesis of porous materials

Sol-Gel Processing for synthesis of porous materials: factors affecting the sol gel process, xerogels and aerogels, Template based methods for the synthesis of porous materials: Brief introduction to the synthesis of porous materials like MCM 41 and SBA 15 and hydrothermal methods for the synthesis of MOFs and zeolites

Unit 5

Applications

Applications of mesoporous materials in catalysis, gas adsorption and drug delivery; importance of zeolites in petroleum industry, application of MOFs

REFERENCE BOOKS:

1. Lowel, S., Shields, J. E., Thomas, M. A., Thommes, M., *Characterization of Porous Solids and Powders: Surface area, Pore size and Density*; SpringerPublications, 2004.
2. Liu, P.S., Chen, G.F., *Porous Materials: Processing and Applications, First Edition, Elsevier Publications, 2014.*
3. Ishizaki, K., Komarneni, S., Nanko, M., *Porous Materials Processing Technology and Applications, First Edition, Springer Publications, 1998.*
4. KICKELBICK, G., (editor) *Hybrid Materials: Synthesis, Characterization and Applications; First Edition, Wiley-VCH, 2007*

5. Bruce, D.W., O'Hare, D., Walton, R.I.,(editors) *Porous Materials (Inorganic materials series) First Edition, John Wiley and Sons, 2011*

18OEL286

FORENSIC SCIENCE

3 0 0 3

Unit 1

Introduction

Origin of forensic science, need for forensic science, trace and contact evidence, marks and impression, examination of documents, blood stain analysis, microscope in analysis, explosives, chemical analysis of explosives, forensic laboratories and courses in India.

Unit 2

Narcotics

Narcotics, classification of drugs, specific drugs- Psychotropic drugs, chemical screening of drugs, chemical extraction and sample preparation, chemical identification of drugs using analytical methods.

Unit 3

Fingerprinting and Firearm Analysis

History of fingerprinting, principles of fingerprinting, constituents of latent finger marks, fingerprint detection, chemical methods of detection, firearm examination, chemical analysis of firearm, analysis of gunshot residue.

Unit 4

Toxicology

Introduction to Toxicology, alcohol and human body, testing of blood alcohol concentration, Toxins & Biological Poisons, Measuring Toxicity as LD50, sample and analysis, inorganic poisons, nerve agents, radioactive toxins, Pharmacokinetics and Toxicokinetics, tests for toxins, reported case studies.

Unit 5

Postmortem Toxicology

Introduction, tissue and fluid specimens, specimen collection and storage, extraction procedure, analytical techniques, interpretation, case studies.

REFERENCE BOOKS:

1. Lawrence Kobilinsky, *Forensic Chemistry Handbook, John Wiley & Sons, New Jersey, 2012*
2. David E. Newton, *Forensic Chemistry, Facts On File, Inc, New York, 2007*
3. Jay A. Siegel, *Forensic Chemistry fundamentals and applications, Wiley Blackwell.*
4. Suzanne Bell, *Drugs, Poisons, and Chemistry, Facts On File, Inc. New York, 2009.*

Unit 1**Sun**

Solar parameters: Mass, Radius, Distance and Luminosity, Spectral energy distribution, Construction of a Model, Conservation law, Equation of State, Nuclear Energy Source and Energy transport, Chemical composition of the Sun.

Unit 2**Tools for Solar Observation**

High-Resolution Telescope, Spectrographs and Spectrometers, Filters and Monochromators, Polarimetry, Special purpose Instruments.

Unit 3**Sun's Oscillations and Rotations:**

Linear Adiabatic Oscillations of Non-Rotating Sun, Helioseismology, Excitation and Damping, The Angular Velocity of Sun, Models of Rotating Convection Zone.

Unit 4**Magnetic properties of Sun:**

Fields and Conducting Matter, Flux tubes, Sunspots and Solar Cycle.

Unit 5**Chromosphere, Corona and Solar Wind**

Empirical Facts, Consequence of High Temperature, Outer Atmosphere, Energy Balance, Explosive Events.

TEXTBOOK:

1. *The Sun: An Introduction second edition by Michael Stix*

Unit 1**Biowaste**

Agrowaste - Biopesticide from solid waste, biomass to bioethanol, biowaste as carbon source, other applications of agrowaste.

Animal waste – bio-digester - generation of renewable energy, biogas from animal waste-daily consumption, Equipment sizing and design.

Food waste-management, anaerobic digestion of food waste – kitchen waste composting.

Unit 2

Plastic & Rubber

Recycling plastic fibre and packaging waste – methods of recycling – Erema Process, Erema vented process for recycling plastics.

Recycling of rubber – Devulcanisation - thermal, mechanical and microbial process - characterization of devulcanized rubber - products from rubber waste.

Pyrolysis of plastics and rubber - Catalytic process of treatment- plastic waste to fuel, oil and wax.

Unit 3

Utilized Products recycling

Paper recycling - types of paper, Mechanical and chemical re-pulping,

Glass waste - bottle recycling, cullet recycling, process in glass recycling

Metals - Iron & steel, iron & steel remanufacturing, Aluminium remanufacturing

Unit 4

Electronic waste

Electronic wastes – printed circuit board, monitors and batteries, Processing - hydrometallurgical and pyrometallurgical route. Recovery of heavy metals from electronic waste.

Unit 5

Biomedical & Hazardous Waste

Biomedical waste and its category, Treatment - autoclaving, shredding, deep burial & chemical treatment of biomedical waste

Radioactive waste – Nuclear waste type and source, long lived and short lived radionuclide, treatment of radioactive waste - immobilization-cement based material for disposal of waste.

REFERENCES:

1. *Thomas H. Christensen, Solid Waste Technology & Management, Vol.1, Blackwell Publishing Ltd, 2011.*
2. *Elena Cristina Rada, Biological Treatment Of Solid Waste, CRC press, 2016.*
3. *Martin Forrest, Recycling and Re-use of Waste Rubber, Smithers Rapra Technology Ltd, 2014.*
4. *Jonathan W.-C. Wong, Rajeshwar D. Tyagi, Ashok Pandey, Current Developments in Biotechnology and Bioengineering, Elsevier, 2017.*
5. *John Scheirs and Walter Kaminsky, Feedstock Recycling and Pyrolysis of Waste Plastics, John Wiley & Sons Ltd, 2006.*
6. *Ramesha Chandrappa, Diganta Bhusan Das, Solid Waste Management: Principles and Practice, Springer, 2012.*
7. *Shinya Nagasaki, Shinichi Nakayama, Radioactive Waste Engineering and Management, Springer, 2011.*
8. *Ronald E. Hester, Roy M. Harrison, Electronic Waste Management, RSC publishing, 2009.*

9. Hugo Marcelo Veit, Andréa Moura, *Electronic Waste: Recycling Techniques*, Springer, 2015.
10. Lifeng Zhang, Gregory K. Krumdick, *Recycling of Electronic Waste II: Proceedings of the Second Symposium*, John Wiley & Sons, Inc, 2011.

18OEL289 ACTING AND DRAMATIC PRESENTATION

2023

Objective:

To cultivate communication skills of students through teaching of theory and skills of theatre and Dramatics.

Unit 1

Rasa theory in Bharata's Natyasastra. Classical theatre in India.

Practical: Warming-up exercises - Relaxation Exercises.

Unit 2

Greek drama and dramatic theories. Use of masks.

Practical: Voice modulation - Breath control.

Unit 3

Shakespearean theatre.

Practical: Practice in Monologues - Training in articulation of emotions through dramatic speech.

Unit 4

20th century theatre. Stanislavskian method, and Brechtian epic theatre.

Practical: Developing body and facial expressions in drama - Articulating narratives through body movements - Building up a repertoire of gestures.

Unit 5

Theatre semiotics and dramaturgy.

Practical: Building up units of action to create a Theatrical Ensemble - Plotting movements of different characters within a scene.

TEXTBOOK:

The Semiotics of Theatre and Drama by Keir Elam

REFERENCES:

1. *Theatre as Sign System: A Semiotics of Text and Performance By Elaine Aston, George Savona*
2. *Theatre Semiotics: Text and Staging in Modern Theatre By Fernando de Toro*
3. *Acting For Real: Drama Therapy Process, Technique, And Performance By Renee Emunah*
4. *Natyasastra by sage Bharata.*

18OEL290

COMPUTERISED ACCOUNTING

2 0 2 3

Objectives:

The course will provide an understanding of the Accounting practices including the final accounts, inventory keeping practices, financial reporting and printing. Tally is proposed to be used as the mail tool.

Unit 1

Business, meaning, Book Keeping, Accounting – meaning, functions and importance and objectives – users of accounting – branches of accounting – accounting terminologies – Accounting Concepts and Conventions – Accounting Standards in India, Accounting Systems – Double Entry System and Single Entry System – Account – types of accounts – Rules for Debit and Credit – Accounting Equation – Journal – Journal entries – journalizing – compound entries – Banking transactions.

Unit 2

Sub Divisions of Journal or Subsidiary Books: Advantages of Subsidiary Books and limitations of journal – Purchase Day Book – Purchase Returns Book – Sales Book – Sales Returns Book – Cash Book – Petty Cash Book – Imprest System.

Ledger: Meaning and importance – preparation of ledger accounts or posting – balancing an account – account balance – Trial Balance – objectives and functions of trial balance.

Unit 3

Final Accounts: Trading and Profit and Loss Accounts, Balance Sheet – simple adjustments like outstanding expenses, prepaid expenses, bad debts, accrued income, unearned income.

Depreciation: Meaning and definition – causes of depreciation – need for depreciation – Fixed Installment Method and Diminishing Balance Method.

Unit 4

Getting started with Tally – Company information - Tally accounting - Chart of accounts – Ledgers and Groups - financial and trading vouchers – Voucher creation and entry.

Unit 5

Tally Inventory – inventory vouchers - Display and reporting – reporting and printing

Reference Books:

1. *Goyal and Ruchi Goyal – Financial Accounting, Prentice Hall India*
2. *Jain and Narang – Advanced Accounts Volume 1, Kalyani Publishers*
3. *Tally for everyone – Roopa, Add to Cart Publishing*
4. *Nadhani – Tally ERP 9 Training Guide – BPB Publication*

18OEL291

KERALA MURAL ART AND PAINTING

2023

Objective:

Mural painting is an offshoot of the devotional tradition of Kerala. In the contemporary scenario Mural painting is not restricted to permanent structures and are being done even on canvas. Kerala Mural painting are the frescos depicting mythology and legends. Learning Mural painting through the theory and practical workshop is the objective of this course.

Unit 1

Introduction, history and evaluation, preparation method of pigments.

Unit 2

Technical details, methods and techniques of wall preparation, preparation of the colors and brushes.

Unit 3

Basics of mural drawing and traditional style, drawing anatomy and study of mural style.

Unit 4

Basics of mural painting.

Unit 5

Mural painting in acrylic colours, drawing and painting.

ReferenceBooks:

1. *Chithrasoothram - Translated by K.K. Warriar.*
2. *Chithralakshanam - K.K Warriar.*

18OEL292

PAINTING

2 0 2 3

Objective:

Painting and artistry has become an effective media to propagate the messages to the community. The methodologies of imparting artistic skills have become highly scientific and technical. Our objective is to cultivate the artistic skills of matured adults through teaching of theory and skills of painting using different media, techniques and tools.

Unit 1

Introduction to Materials and Medium: Water colours, Oil colours, Acrylic colours, Gouache, Oil Pastels and Dry Pastels, Additives and Solvents, Brushes, Paper-types and texture, Canvas types. Basic sketching with charcoal, pencil and pen.

Unit 2

Watercolour and Gouache Painting - Styles and techniques - wet on wet, wet on dry, ink and pen techniques, painting with water colour pencils, Wash techniques, Layer on Layer technique.

Unit 3

Oil Painting - stretching canvas, surface preparation with gesso; Styles and technique - Wet on wet, wet on dry, impasto, finishing touches.

Unit 4

Acrylic Painting - Acrylic on Paper; Acrylic on canvas, using acrylic retarders and medium, Wet on wet, wet on dry, impasto, finishing touches.

Unit 5

Oil and Dry Pastels, Pastels on Coloured Paper, Pre colouring, hatching and cross hatching, Blending techniques, Fixing techniques.

BOOKS RECOMMENDED:

1. *Reader's Digest - Complete Guide to Drawing and Painting ISBN-10: 0895779560
ISBN-13: 978-0895779564*

18OEL293

REPORTING RURAL ISSUES

3 0 0 3

Objectives:

News coverage of rural areas: Issues ranging from health, education and civic amenities to government welfare schemes and the state of agriculture with farming losing its sheen among rural youth and resultant urban migration. New trends like mechanization of farming due to shortage of labour, the growth of self-help groups and mushrooming cottage industries, changes in the social and political life of the rural communities, inter-caste and class dynamics and how technological penetration is changing rural life and aspirations, success stories, best practices in farming, growing consumerism and its impact on environment, rural businesses and innovations.

Unit 1

Reporting rural India - problems and prospects: Poor connectivity and infrastructure, electrification and drinking water supply, state of primary healthcare centres, growing literacy and education breaking down caste and class barriers

Unit 2

Role of women in rural areas, gender discrimination, female infanticide and patriarchy, women role models who have asserted themselves in social, political and economic life of the society overcoming all odds and helped breakdown social barriers.

Unit 3

Government development programmes for rural areas. Are they reaching the intended beneficiaries? Success and failure stories, women empowerment and youth upliftment programs.

Unit 4

Agriculture – shrinking areas under cultivation, drying irrigation sources, high cost of inputs, labour shortage and rising wages. Need to ensure fair prices for the farmers' produce by setting up agro-industries and cold storage chains in rural areas and introducing appropriate technology.

Unit 5

Role of media in highlighting rural issues so that authorities in the cities take note and take remedial measures.

Outcomes:

By the end of the course the students will be able to:

- CO1: Analyze and clarify the long term tendencies in the rural area and agricultural development in Croatia
- CO2: Participate in creating and implementing rural development and agricultural projects
- CO3: Interpret measures of agricultural policy
- CO4: Understand the Govt. projects and policies for the upliftment of Rural communities, women and children
- CO5: Develop communication skill and critical way of thinking
- CO6: Contribute towards the society as a mediator by analyzing their problems and creating

awareness

REFERENCES:

1. Bang, R., Khorgade, S., and Chinai, R (2010) *Putting Women First: Women and Health in a Rural Community*. New Delhi: Stree and Samya.
2. Fukuoka, M. (2009). *The One-Straw Revolution: An Introduction to Natural Farming*. New York: Review of Books.
3. Patra, S.C., and Vachhani, A. (2012). *Socio Economic Profile of Rural India: Series II, Volume II: North East India (Assam, Manipur, Tripura and Nagaland)*. New Delhi: Concept Publishing.
4. Patil, D.A. (2010). *Communication for Rural Development in India: From Green Revolution to 'E' Revolution*. New Delhi: Serials Publications
5. Pokharapurkar, R. (1993). *Rural Development Through Community Television (CISCED)*. New Delhi: Concept Publishing
6. Islam, N. (2006). *Reducing Rural Poverty in Asia: Challenges and Opportunities for Microenterprises and Public Employment Schemes*. New York, London, Oxford: Food Products Press

VIDEOS:

The Noer
Faces of Prestea
Hotville Alabama

WEB REFERENCES:

http://www.un.org/en/ecosoc/docs/pdfs/an_integrated_approach_to_rural_development.pdf
http://www.epw.in/frontpage?0=ip_login_no_cache%3D4806b5974dc3439b9a9343b7b5674286
<http://www.worldbank.org/en/news/feature/2012/05/17/india-agriculture-issues-priorities>
<https://www.youtube.com/watch?v=eCBICWAwOds>

18OEL294

A Study of Traditional Indian Paintings

1 0 2 3

Unit 1

Introduction to Indian Arts :- Architecture, Painting, Sculpture, Dance, Music and theatre
Theoretical introduction to Traditional Indian miniature, mural, scroll paintings and decorative.
Theoretical introduction to Ritualistic paintings

Unit 2

Introduction to Traditional Kerala Mural paintings: Theoretical, conceptual and contextual framework of Kerala Mural paintings. Colours, Forms and historic and mythological contexts. Surface preparation. Painting in Kerala Mural- from the textual narrative to execution

Unit 3

Introduction to Cheriya Scroll paintings: Theoretical, conceptual and contextual framework of Cheriya paintings. Colours, Forms and historic and mythological contexts. Surface preparation. Painting in Cheriya style- from the textual narrative to execution.

Unit 4

Introduction to Pahari paintings: Theoretical, conceptual and contextual framework of Cheriya paintings. Colours, Forms and historic and mythological contexts. Surface preparation. Painting in Cheriya style- from the textual narrative to execution.

Unit 5

Introduction to traditional Madhubani paintings: Theoretical, conceptual and contextual framework of Madhubani paintings. Colours, Forms and historic and mythological contexts. Surface preparation. Painting in Madhubani style- from the textual narrative to execution.

Text book

- a) BN Goswamy - The Spirit of Indian Painting

Reference books

- a) Bernard S. Myers - Encyclopaedia of Painting: Painters and Painting of the World from Prehistoric Times to the Present Day
- b) Partha Mitter - Indian Art (Oxford History of Art)
- c) Sherman E. Lee, George Montgomery - Rajput Painting

18OEL297

HISTORY AND PHILOSOPHY OF SCIENCE

3 0 0 3

Unit 1

Why History of Science? Astronomy in the ancient world - people, theory and instruments (4 hours) - Astronomy across civilizations of the old world, main discoveries, their contribution and instruments during those times.

Unit 2

The Dark ages in Europe - the Arabian influence - The Islamic science, translations and original contributions of Arabians, dark ages Europe, logic, literature and scientific method, early universities of Europe.

Unit 3

Indian tradition in Science and Technology - an overview - Indian contributions in science and technology - mathematics, astronomy and other sciences.

Unit 4

Texts that changed the course of history science - Elements of Euclid, Aryabhatiya of Aryabhata, BrahmasputaSidhanta of Brahmagupta, Yuktibhasa of Jyestadeva, PhilosophiaeNaturalis Principia Mathematica.

Unit 5

The Copernican revolution and the rise of modern science - The background of Copernican revolution, interaction between civilizations, the rise of modern sciences - when and why?

Text and Background Literature:

History and philosophy of science is yet to be established as full-fledged discipline. A suggested anthology of reading materials:

1. Essential reading on history of sciences (in-house publication)
2. <http://www.Open2.net/whattheancients/> (Documentaries)

18OEL298

EU HISTORY OF SCIENCE AND TECHNOLOGY

4 0 0 3

From Galileo to Einstein, from the split of science and religion to the discovery of machines and computers, science have played a major role in the history of European Union and largely contributed to the place of European Union in the world nowadays.

In this course we will review some major contributions in science and technology made in EU, in particular in Physics, which allowed cultural, philosophical and technical revolutions. We will try to put as best as we can the discovery in their historical context and present elements of biography of the some of the most prominent scientists involved in these discoveries. We will also look at past and present influence, in particular Indian influence on EU science and technology advances. These courses will outreach scientific concept of each discovery for bachelor students in science. The course will follow thematic line, which will be as much as possible historically ordered.

1. The Greek legacy: Eratosthenes, Ptolemy (2h):
 - a. Pre-Socratic period: the Pythagoreans school.
 - b. Classic period: Plato and Aristotle
 - c. Astronomy and Mathematics in the Hellenistic period: Ptolemy, Eratosthenes, Hipparchus, Euclid, Archimedes.
2. Elements of Indian Astronomy and Mathematics and their influence on Europe (6h):
 - a. Prehistory: the Vedic period, discoveries in mathematics, astronomy and medicine.
 - b. Middle age
 - c. Late middle age: science technology transfer with Europe.
3. The scientific revolution at renaissance. (6h)
 - a. Copernicus, Galileo, Kepler, Newton: motion in the solar system.
 - b. Separation between science and religion.
 - c. Technology major inventions: printing technics, navigation instrument: astrolabe, sextant.
4. Thermodynamics and thermal machine and the industrial revolution (6h).
 - a. Invention of thermal machine and industrial revolution in Europe.
 - b. XVIIe to XVIIIe: the birth of thermodynamic with chemistry and thermal machine
 - c. XIXe: Formalization of thermodynamic laws and principles (Carnot, Joule, Clapeyron, Kelvin)
 - d. Development of statistical mechanics (Boltzmann, Gibbs)
5. Light, Electricity and electromagnetism:

- a. Coulomb, Maxwell, Ampere (4h)
6. Einstein contribution (Photo electric effect, Relativity, etc.) (2h)
7. Radioactivity: Pierre et Marie Curie (2h).
 - a. Introduction on Mendeleev and periodic table.
 - b. Discovery of Radioactivity
 - c. Elements of biography of Marie Curie
8. Discovery of quantum mechanics:
 - a. Introduction on black body radiation (Planck), photo electric effect (Einstein) and wave-particle duality.
 - b. The Copenhagen interpretation: Bohr, Heisenberg, Pauli, Planck
9. Technology discovery in the context of the 2nd world war (4h)
 - a. Nuclear energy
 - b. Turing machine
 - c. Jet engine
10. A few remarkable recent advances in quantum mechanics (4h):
 - a. Violation of Bell's inequalities (A. Aspect)
 - b. Mesoscopic physics and quantum Circuits
 - c. Cold atoms (C. Cohen Tannoudji)
 - d. Quantum material: Graphene, topological insulators.

LANGUAGES

18HIN101

HINDI I

1-0-2[2cr]

Unit-1

- a) Introduction to Hindi Language, -other Indian Language's, Official Language, link Language Technical terminology..
- b) Hindi alphabet: Paribhasha Aur Bhed.
- c) Shabda: Paribhasha Aur Bhed, Roopanthar ki Drishti se
- d) Sangya -Paribhasha Aur Bhed, Sangyake Roopanthar-ling, vachan, karak
- e) Sarvanaam- Paribhasha Aur Bhed.

Unit-2

- a) Common errors and error corrections in Parts of Speech –with emphasis on use of pronouns, Adjective and verb in different tenses –gender & number
- b) Conversations, Interviews, Short speeches.

Unit -3

- a) Letter writing –Paribhasha Aur Bhed, Avedanpatra (request letter) & Practice
- b) Translation-Paribhasha Aur Bhed, English to Hindi

Unit- 4

Peom :

- a) Maithilisharangupth: sakhivemujsekahakarjaate
- b) Suryakanthtripatinirala :Priyatam
- c) Mahadevivarma- adhikaar
- d) Shiyaramsharangupth:ekphoolkichah

Unit- 5

Kahani

- a) Kafan - Premchand ,
- b) Rajasthan ki Ek Gaav kee theerthyatra - Beeshmasahni
- c) Raychandrabhai :By Mahathma Gandhi - Sathya ke prayog
- d) Rajani - Mannu Bhandari

Outcomes:

- CO1: To understand the nature & culture of the language.
CO2: Ability to understand the structure of the language in different contexts. .
CO3: To understand the functional skills of the language.
CO4: Enhance the social contribution of modern literature.
CO5: Develop research and secondary reading ability.

18HIN111 HINDI II

1-0-2[2cr]

Unit -1

- a) Visheshan- ParibhashaAurBhed.special usage of adverbs, changing voice and conjunctions in sentences.
- b) kriya- ParibhashaAurBhed, rupantharkidrushti se-kaal
- c) padhparichay.
- d) Vigyapan Lekhan (Advertisement writing), Saar Lekhan (Precise writing).

Unit -2

Communicative Hindi – MoukhikAbhivyakthi –understanding proper pronunciation, Haptics ...etc in Interviews ,short speeches .

Unit -3

Film review,Audio –Visual-Media in Hindi – Movies appreciation and evaluation.News reading and presentations in Radio and Tv channels in Hindi, samvaadhlekhan,

Unit -4

- a) Harishankarparasaiyi- SadacharkaThavis
- b) Jayashankarprasadh – Mamata
- c) Mannubandari- Akeli
- d) Habibtanvir- Karthus

Unit -5

Kavya Tarang

- Himadri thung shrung se (poet- Jayasankar prasad)
- Dhabba (poet- kedarnath sing) ,
- Proxy (poet- Venugopal),
- Machis(poet –Suneeta Jain) ,
- Vakth. (poet – Arun kamal)
- Fasal (poet- Sarveshwar Dayal Saxena)

Outcomes:

- CO1: Develop the creativity & language competence.
CO2: To improve the writing and analytical skillsTeaching
CO3: Enhancing critical thinking.
CO4: A good exposure with the different styles of literary writing.
CO5: To understand the post- modern trends of literature.

18KAN101

KANNADA I

1-0-2[2cr]

- 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

- Railway Nildanadalli – K. S. Narasimha Swamy
- Amma, Aachara Mattu Naanu – K. S. Nisar Ahamad
- Kerege Haara – Janapada
- Simhaavalokana – H.S. Shivaprakash

UNIT – 2

- Dhanwantri Chikitse - Kuvempu
- Mouni - Sethuram
- Meenakshi Maneya Mestru - Kuvempu

UNIT – 3

- Sukha –H.G Sannaguddayya
- Mobile Thenkara Jen Nonagala Jhenkara – Nagesh Hegade
- Namma Yemmege Maatu Tiliyitu – Goruru Ramaswamy Iyengar

UNIT – 4

Language structure

- Usage of punctuation marks
- Introduction to words (right usage)
- Reading skills
- Sentence formation (simple & complex)
- Translation- English to Kannada

References:

1. Kannada Samskruti Kosha – Dr. Chi. C Linganna
2. Kannada Sanna Kathegalu – G H Nayak
3. Lekhana Kale – N. Prahlad Rao
4. Kannada Sahithya Charithre – R. Sri Mugali

18KAN111

KANNADA II

1-0-2[2cr]

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

- Bettada Melondu Maneya Maadi – Akka Mahadevi
- Thallanisadiru Kandya – Kanakadasa
- Avva – P. Lankesh
- Neevallave – K. S. Narasimha Swamy

UNIT – 2

Gunamukha – Drama by P. Lankesh

UNIT – 3

Karvalo – Novel by Poornachandra Thejaswi

UNIT – 4

Letter Writing –

Personal (congratulation, invitation, condolence etc.)

- Official (To Principal, Officials of various departments, etc.,)

- Report writing
- Essay writing
- Precise writing

Prescribed text:

1. Gunamukha by P. Lankesh (Lankesh Prakashana)
2. Karvalo by Poornachandra Thejaswi (Mehtha publishing house)

Reference

1. Saamanyanige Sahithya Charitre (chapter 1 to 10) – Bangalore University Publication
2. Hosa Kannada Saahithya Charithre – L.S Sheshagiri Rao
3. Kacheri Kaipidi – Kannada Adhyayana Samsthe (Mysuru University)
4. Kannada Sahithya Charithre – R. Sri Mugali
5. H.S.Krishna Swami Iyengar – *Adalitha Kannada – Chetana Publication, Mysuru*

18SAN101

SANSKRIT I

1-0-2[2cr]

To familiarize students with Sanskrit language and literature.

To read and understand Sanskrit verses and sentences.

Self-study of Sanskrit texts and to practice communication in Sanskrit.

To help the students imbibe values of life and Indian traditions propounded by the scriptures.

To be able to speak in Sanskrit.

Semester I

Module I

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.

(7 hours)

Module II

Verbs- Singular, Dual and plural — First person, Second person, Third person.

Tenses – Past, Present and future – Atmanepadi and parasmaipadi-karthariprayoga.

(8hrs)

Module III

Words for communication and moral stories.

(4 hrs)

Module IV

Chanakya Neethi first chapter (first 15 Shlokas)

(6 hrs)

Module V

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

(5hrs)

18SAN111

SANSKRIT II

1-0-2[2cr]

Module I

Seven cases, Avyayas, sentence making with Avyayas, Saptha kakaras.

(5hrs)

Module II

Kthavathu' Prathyayam, Upasargas, Kthvatha, Thumunnantha, Lyabantha Prathyayam. Three Lakaras – brief introduction, Lot lakara

(5hrs)

Module III

New words and sentences for the communication, Slokas, moral stories(panchathantra) Subhashithas, riddles (Selected from the Pravesha Book)

(5hrs)

Module IV

Introduction to classical literature, classification of Kavyas, classification of Dramas - Important five Maha kavyas

(5hrs)

Module V

Translation of paragraphs from Sanskrit to English and vice versa

(5hrs)

Module VI

Bhagavad - Geeta fourteenth chapter (all 27 Shlokas)

(5hrs)

Essential Reading:

1. Praveshaha; Publisher : Samskrita bharti, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085
2. Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad
3. PrakriyaBhashyamwritten 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. SubhashitaRatnaBhandakara by Kashinath Sharma, published by Nirnayasagarpress