

**HINDUSTAN UNIVERSITY**  
**HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE**



**DEPARTMENT OF SCIENCE & HUMANITIES**

**M.Phil Programme**  
**(Full Time Programme-Two semesters)**

CURRICULUM & SYLLABI  
(Draft for approval)

**2008**

## **M.PHIL (MATHEMATICS)**

### **EDUCATIONAL OBJECTIVES**

To offer:

- **Advanced Knowledge of ODE/Topology/Functional Analysis /Dynamics**
- **Training of research activities in the related fields**
- **Project training extending to advanced research**

## CURRICULUM FOR M.PHIL (MATHEMATICS)

- Paper - I : **Advanced Applied Mathematics**  
Paper - II : **Research Methodology**  
Paper - III : **Special Paper (Any one of the following)**
- 1. Nonlinear Dynamics**
  - 2. Symmetries of Differential Equations**
  - 3. Graphs and Networked**
  - 4. Optimization Techniques**
  - 5. Spectral Theory**
  - 6. Banach Algebras and Galois Theory**

### Semester - I

<b>Subject Code</b>	<b>Subject Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
MA 0811	Advanced Applied Mathematics	4	0	0	4
MA 0812	Research Methodology	4	0	0	4
MA0813-MA0818	Special Papers	4	0	0	4
MA 0819	Seminars	3	0	0	3
<b>Total</b>		<b>15</b>	<b>0</b>	<b>0</b>	<b>15</b>

### Semester - II

<b>Subject Code</b>	<b>Subject Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
MA0822	Dissertation	0	0	0	15

## SYLLABUS - M. PHIL - MATHEMATICS

<b>Paper - I MA 0811(Advanced Applied Mathematics)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**Unit - I: Calculus of Variation** **12**

Concept of variation and its properties - Euler's Equation - Functional dependant on first and higher order derivatives - Functional dependant on functions of several independent variables - Isoperimetric problems - Direct methods - Ritz and Kantrovich methods.

**Unit - II: Transform Methods** **12**

Laplace transform methods for one dimensional wave equation - Displacements in a long string - Longitudinal vibration of an elastic bar - Fourier Transform methods for one dimensional heat conduction problems in infinite and semi infinite rod.

**Unit - III: Elliptic Equations** **12**

Laplace equation - Properties of Harmonic functions - Solutions of Laplace equation by means of Fourier transform in a half plane in an infinite strip and in a semi infinite strip.

**Unit - IV: Power Spectral Density** **12**

Random process - Classifications - Stationary Random process - Auto correlation cross correlation - Power spectral density - Linear system with random input - Gaussian process.

**Unit - V: Wavelet Transforms** **12**

Introduction - Continuous wavelet Transforms and Examples - Basic Properties of Wavelet Transforms - Discrete Wavelet Transforms - Orthonormal Wavelets - Time - frequency signal Analysis - Examples of Wigner-Ville Distribution - Basic Properties of the Wigner - Ville distribution - The Wigner-Ville distribution of Analytic signals and Band-limited signals. Definitions and Examples of the woodward ambiguity functions - Basic properties of Ambiguity functions - The Ambiguity Transformation and its properties - Discrete Wigner-Ville distributions - Cohen's class of Time Frequency Distributions.

**TOTAL 60hrs**

**References:**

1. ELSGOLTS. L, Differential Equation & Calculus Variation, MIR Publications.
2. A. S. Gupta, Calculus of variations with applications, Pretice Hall of India P (LTD), 1997.
3. Jain & R. K. Iyengar SRK Advanced Engineering Mathematics, Narosa Publications, 2003.
4. Sankara Rao .K, Introduction to P.D.E, Prentice Hall of India, New Delhi, 1995.

**Paper – II: MA 0812: Research Methodology**

**Unit – I: Linear Elliptic Theory** **12**

Elliptic Operators on a Torus – Estimates and Regularity on Domains – Maximum Principles – Solvability.

**Unit – II: Fixed Point Methods** **12**

Schauder fixed Point Theory – Semi-groups and Dynamics

**Unit – III: Systems of Conservation Laws** **12**

Local Existence for Hyperbolic Systems – Quasilinear Systems of Conservation Laws – Systems of Two Conservation Laws.

**Unit – IV: Linear and Nonlinear Diffusion** **12**

Parabolic Maximum Principles – Local Existence and Regularity – Global Behaviour – Applications of Navier – Stokes.

**Unit – V: Linear and Nonlinear Waves** **12**

Symmetric Hyperbolic Systems – Linear Wave Dynamics Semi linear Wave Dynamics

**TOTAL 60hrs**

**Treatment as in:**

Partial Differential Equations: Methods and Applications by R. C. McOwen, Second Edition, Pearson Education , 2005.

Unit – I: Chapter 8, Unit – II: Chapter 9, Unit – III: Chapter 10, Unit – IV: Chapter 11, Unit – V: Chapter 12.

**References:**

1. L.C. Evans, Partial Differential Equations, American Mathematical Society, 1998.
2. M. Renardy and R. C. Rogers, An Introduction to partial Differential Equations, Springer, 2004.

## **Paper – III: MA 0813 - Special Paper 1 - Nonlinear Dynamics**

### **Unit – I: The Dynamics of differential Equations**

**12**

Integration of linear second order equations – Integration of nonlinear second order equations – Dynamics in the phase plane – Linear Stability analysis – Non autonomous systems.

### **Unit – II: Hamiltonian Dynamics**

**12**

Lagrangian formulation of Mechanics – Hamiltonian formulation of Mechanics Canonical transformations – Hamilton – Jacobi equation and action – angle variables – integrable Hamiltonians.

### **Unit – III: Classical Perturbation Theory**

**12**

Elementary perturbation theory – Canonical perturbation theory – Many degrees of freedom and the problem of small divisors – The Kolmogorov – Arnold Moser theorem.

### **Unit – IV: Non linear Evolution Equations and Solutions**

**12**

Basic properties of the Kdv equation – The inverse Scattering transforms: Basic principles, KdV equation – Other solution systems – Hamiltonian structure of integrable systems.

### **Unit – V: Analytic Structure of Dynamical Systems**

**12**

Ordinary differential equations in the complex domain – Integrable systems of ordinary differential equations – Painleve property of partial differential equations.

**TOTAL 60hrs**

#### **Treatment as in:**

**Chaos and Integrability in Nonlinear Dynamics by M. Tabor, John Wiley and Sons, New York, 1989.**

- Unit – I : Chapter 1 Sections 1.1 – 1.4, 1.6
- Unit – II : Chapter 2 Sections 2.1 – 2.5
- Unit – III : Chapter 3 Sections 3.1 – 3.4
- Unit – IV : Chapter 7 Sections 7.1 – 7.6
- Unit – V : Chapter 8 Sections 8.2 – 8.4

## **Special Paper - 2: MA 0814 - Symmetries of Differential Equations**

### **Unit - I:**

Lie Groups of Transformations and Infinitesimal Transformations: Lie Groups of Transformations - Infinitesimal Transformations.

### **Unit - II:**

Extended Transformations (Prolongations) Multi - Parameter Lie Groups of Transformations; Lie Algebras.

### **Unit - III:**

Ordinary Differential Equations: Introduction - Invariance of an ordinary Differential Equation - First Order ODE's.

### **Unit - IV:**

Second Higher Order ODE's - Invariance of ODE's - Invariance of a Partial Differential Equation - Invariance for Scalar PDE's.

### **Unit - V:**

**Partial Differential equations:** Introduction - Invariance of a Partial Differential Equation - Invariance for Scalar PDE'S

**TOTAL 60hrs**

Treatment as in:

Symmetries and Differential Equations by G.W. Bluman and S. Kumei, Applied Mathematical Sciences Vol. 81, Springer - Verlag, New York, 1989.

Unit - I : Chapter 2 (2.1 - 2.2)  
Unit - II : Chapter 2 (2.3 - 2.4)  
Unit - III : Chapter 3 (3.1 - 3.2)  
Unit - IV : Chapter 3 (3.3 - 3.4)  
Unit - V : Chapter 4 (4.1 - 4.2)

Reference Books:

1. G.W. Bluman and S.C Anco, Symmetries and Integration Methods for Differential Equations, Applied Mathematical Sciences Vol. 154, Springer - Verlag, New York, 2002.
2. P. J. Olver, Applications of Lie Groups to Differential Equations, 2<sup>nd</sup> Edition Springer - Verlag, New York, 1993.

### **Special Paper – 3: MA 0815 - Graphs and Networks**

#### **Unit – I: Connectivity and Networks**

K - Connected Graphs - 2 - connected graphs - Connectivity - Digraphs - K - connected graphs and K-edge connected graphs - Applications of Menger's Theorem. Network flow problems. Maximum network flows - Integral flows - Supplies and demands.

#### **Unit – II: Perfect Graphs**

The Perfect graph theorem - Chordal graphs revisited - other classes of perfect graphs - Imperfect graphs - the strong perfect graph conjecture.

#### **Unit – III:**

Hereditary systems and examples - Properties of Matroid - the span function and duality - minors and planar graphs - Matroid intersection and Matroid union.

#### **Unit – IV: Random Graphs**

Existence and Expectation - Properties of almost all graphs - Threshold functions - Evolution and properties of Random Graphs - Connectivity, Cliques and coloring-martingales.

#### **Unit – V:**

Decompositions and Labeling Factorizations and Decompositions of graphs - Labeling of Graphs.

**TOTAL 60hrs**

Treatment as in

1. Introduction to graph theory by B. W. Douglas, Prentice Hall of Indian, 1999.

Unit – I : Chapter 4 - Section 4.2 and 4.3 (Paper 144 - 172)

Unit – II : Chapter 8 - Section 8 (Paper 288 - 328)

Unit – III : Chapter 8 - Section 8.2 (Paper 3204- 347)

Unit – IV : Chapter 8 - Section 8.5 and 4.3 (Paper 405 - 429)

2. Graphs and Digraphs by G. Chartrand and L.Leshiak, Chapman and Hall, 1996

Unit –V : Chapter 9 - Sections 9.2and 9.3

## **Special Paper - 4: MA 0816 - Optimization Techniques**

### **Unit - I : MA 0816 Dynamic Programming**

Elements of the DP model: The capital Budgeting – More on the definition of the state – Example of DP models and computations – Problems of Dimensionality in Dynamic programming – Solution of Linear Programs by Dynamic programming.

### **Unit - II: Decision Theory and Games**

Decisions under Risk – Decision trees – Decisions under uncertainty – Game Theory.

### **Unit - III: Inventory Models**

The ABC inventory system – Generalized inventory Models – Deterministic models – Just in Time (JIT) manufacturing Systems.

### **Unit - IV: Queueing Models:**

Role of Poisson and Exponential Distribution – Processes Birth and Fousson and Death – Queues with Canbihed arrival and departures – Nan – Poisson Queues – Queues with Priorities for Service – Random or serves Queues.

### **Unit - V: Non Linear Programming**

Unconstrained external problems – Constrained External Problems – Nonlinear programming Algorithm – Unconstrained Nonlinear Algorithms – Constrained Non linear Algorithms.

### **References:**

1. D. Phillips A, Ravindran, Solberg, Operations Research: Principals and Practice, John Wiley & Sons, 1976.
2. S. S. Rao, Engineering Optimization, (3<sup>rd</sup> Edition, 1996)

## **Special Paper - 5 : MA 0817 Spectral Theory**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
4	0	0	4

Geometry of Hilbert Spaces - inner products - orthonormal sets - Bessel's inequality - Parseval's identity - Approximation and optimization projection theorem - Riesz representation theorem - Bounded operators - Sesquilinear functionals - Adjoint - Normal self adjoints - Normal self adjoint unitary operators - Spectrum of an operators - Numerical Range of Operator - Spectral theorem for compact self adjoint operators - orthogonal projections - resolution of identity - Normalized resolutions of ideality, spectral theorem for bounded self adjoint operators.

Text Book:

B.V. Limaye: Functional Analysis, Wiley Eastern limited.

**Special Paper 6 - MA 0818 (Banach Algebras and Galois Theory)**

L	T	P	Cr
4	0	0	4

**Unit - I:  $L^p$  Spaces**

**12hrs**

Convex functions and inequalities -  $L^p$  spaces Approximation by continuous functions.

**Unit - II: Banach Algebras.**

**12hrs**

Banach Algebras - Complex homeomorphisms, Gleason - Kahane - Zelazko theorem - Basic Properties.

**Unit - III**

**12hrs**

Spectrum of an element. Gelfand - Mazur theorem, Group of invertible elements - ideals and homomorphisms quotient algebras - Gelfand transform, involutions, Gelfand - Naimark theorem - Applications to non commutative algebras positive functionals.

**Unit - IV**

**12hrs**

Ideal of a ring, simple ring: Commutative simple ring with 1 is a field, non commutative simple ring: sum, intersection and product of ideals, quotient ring, first isomorphism theorem, prime ideal maximal ideal.  $R$  - a commutative integrals domain with  $I$  associates irreducible elements, prime elements, greatest common divisor of two elements.

#### **Unit - V**

**12hrs**

Euclidean domain and its properties- Principal ideal domain and its properties- Unique factorization domain and properties-Any principal ideal domain is a unique factorization domain-Polynomial rings and properties- Eisentein's criterion, Gauss lemma. If  $R$  is UFD then  $R[x]$  is a UFD.

#### **Text Book:**

- Unit - I** : **W. Rudin - Real and Complex Analysis Third Edition - Tata McGRaw Hill**
- Unit II & III** : **W. Rudin - Functional Analysis 1<sup>st</sup> Edition - Tata McGRaw Hill**
- Unit IV & V** : **N. S. Gopalakrishnan: University Algebra, Wiley Eastern Limited.**

**Paper - IV: MA 0822 - Projects**

## **M.Phil.(English)**

### **EDUCATIONAL OBJECTIVES**

- To orient the learners into research and develop a scientific attitude towards the language and familiarize them with the methodology of research.
- To familiarize the learners with the developments in the field of English Language Teaching (ELT) and the implication of ELT in the framing of language courses.
- To sensitize the learner with the sociology of language, language variations, evolution of social linguistic and its impact on modern English language teaching.
- To encourage students to apply various critical approaches to different forms of literature.

## CURRICULUM FOR M.PHIL (English)

### Semester - I

Sub. Code	Subject Title	L	T	P	C
EL 0811	English Language Teaching	4	0	0	4
EL 0812	Research Methodology	4	0	0	4
EL 0813	Sociolinguistics	4	0	0	4
EL 0814	Seminar	0	0	6	3
Total Credit					15

### Semester - II

Sub.Code	Paper Name	L	T	P	C
EL 0822	Project	0	0	30	15

## Syllabus-M.Phil. English

	L	T	P	C
EL 0811 - RESEARCH METHODOLOGY AND ACADEMIC WRITING	4	0	0	4

- 1. THE PHILOSOPHY AND MEANING OF RESEARCH** **12hrs**  
The nature of inquiry in the physical sciences and the social sciences, researcher – temperament and qualities, identification and choice of the research problem – the hypothesis
- 2. KINDS OF RESEARCH** **12hrs**  
a) Theoretical / Basic b) Practical / Applied / Action c) Interdisciplinary / Multidisciplinary, case study, experimental method, ethnography, classroom observation and research, introspective methods, elicitation techniques, interaction analysis, programme evaluation.
- 3. LITERATURE SURVEY AND ANALYSIS** **12hrs**  
Library, collection of materials, note making, plagiarism, preparing working bibliography, literature survey, reviews, current literary methods, reference skills
- 4. PLANNING THE THESIS** **12hrs**  
Thesis style: order, logic, mode; Rhetoric of the paragraph, sentence and word, documenting sources – parenthetical documentation, endnotes and footnotes.
- 5. DRAFTING THE THESIS** **12hrs**  
Writing of literary thesis, writing of technical / literary papers, the format of the thesis. Use of quotations, abbreviations, use of dictionaries, and reference books. Revising the thesis and proofreading – use of proofreading symbols

### REFERENCE:

#### L:60

1. Handbook for writers of Research Papers. Affiliated East-West, New Delhi, 1998.
2. Anderson, Durston and poole. Thesis and Assignment Writing. John Wiley and Sons, Sydney, 1987.
3. Klarer, Mario, An introduction to Literary Studies. Routledge, London, 2000.
4. Bateson, F.W. The scholar Critic. Routledge & Kegan Paul, London 1972.
5. Seligar Herbert W & Shohany Elara. Second Language Research Methods. Oxford University Press, Oxford, 1989.
6. Nunan, David. Resaerch methods in Language Learning. Cambridge University Press, Cambridge, 1972.
7. [www.valt.helsinki.fi/staff/mnattila/emethods.html](http://www.valt.helsinki.fi/staff/mnattila/emethods.html)

8. [www.huntington.org/ResearchDiv/LitRes.html](http://www.huntington.org/ResearchDiv/LitRes.html)

	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>EL 0812 - ENGLISH LANGUAGE TEACHING</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

- 1. ELT -AN OVERVIEW** **12hrs**  
ELT since 1900, in India: Current trends in ELT. Approaches and methods in language teaching.
- 2. THEORIES OF LANGUAGE LEARNING** **12hrs**  
Behaviorism, Cognitivism, Humanism; Theories of second language acquisition; Differences between first language acquisition and second language learning. Fluency and Accuracy.
- 3. THE ELT CURRICULUM** **12hrs**  
Principles of syllabus design: Kinds of syllabus, structural syllabus; functional/notional syllabus; communicative syllabus.
- 4. ASPECTS OF LANGUAGE TEACHING** **12hrs**  
Language through literature; Language skills teaching (LSRW); Remedial Teaching.
- 5. LANGUAGE TESTING** **12hrs**  
Principles and types of language testing, materials production, Evaluation - formative evaluation and summative evaluation.

Total: 60hrs

## REFERENCES

- Howatt, A.P.R. A History of English language teaching. Oxford University Press, Oxford, 1984.
1. Ellis, R. Understanding Second language Acquisition. OUP, Oxford, 1985.
  2. White, R.V. The ELT Curriculum: Design Innovation and Management. Basil Blackwell Ltd. Oxford 1988.
  3. Prabhu, N.S. Second Language Pedagogy. OUP, Oxford, 1987.
  4. Littlewood, William. Communicative Language Teaching - An Introduction. Cambridge University Press, Cambridge, 1981.
  5. Tradgil, Peter. Sociolinguistics. Penguin, 1983.
  6. Hudson. R. A. Sociolinguistics.

	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>EL 0813 - SOCIOLINGUISTICS</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**1. SCOPE OF SOCIOLINGUISTICS**

**12hrs**

Dialectology and sociolinguistics; Rhetoric and sociolinguistics: Aims and problems in sociolinguistics; The relationship between linguistics and sociolinguistics; The sociology of language ; Ethnography of communication; Verbal and non-verbal communication language and world view – Whorfian Hypothesis.

**2. BINARY CONCEPTS**

**12hrs**

Competence and performance. Language and parole; Linguistics and communicative competence. Language in contact – Bilingualism trilingualism and multi-lingualism; Bilingualism and biculturalism; Diglossia, bilingualism with diglossia; Diglossia without bilingualism; Pidginisation and code switching; Code mixing.

**3. LANGUAGE VARIATIONS**

**12hrs**

Functional language types; Standard language; Classical language; Dialect accent, idiolect, register; Restricted and elaborated codes; Interlanguage; Native and non-native varieties.

**4. SPEECH ACT THEORIES**

**12hrs**

Speech situation; Speech event. Setting and participants; Small group interaction; Language in face to face communication. Speech function: Referential, expressive, connotative and phatic.

**5. LANGUAGE POLICY AND PLANNING**

**12hrs**

Language problems of developing nations, language planning in India, English in India – language and media.

Total: 60hrs

**REFERENCES**

1. Pride, J.B.& J. Holmes. Eds.sociolinguistics.penguin,Harmondsworth, 1972.
2. Hudson, R.A. Sociolinguistics. 2<sup>nd</sup> ed. Cambridge University Press, Cambridge, 2001
3. Chomsky, Noam. Aspects of the theory of Syntax. MIT Press, Massachusetts, 1965.
4. Hymes, Dell. Language in Culture and Society. Harper and Row, New York, 1964.
5. Wootton, A.J. Interaction and the Development of Mind. Cambridge University Press, Cambridge, 2000.
6. Milroy, Lesley, and Matthew Gordon. Sociolinguistics: Method and Interpretation. Blackwell, Oxford, 2003.



## CURRICULUM FOR M.PHIL (PHYSICS)

### Semester - I

S.No.	Sub.No	Subject Title	L	T	P	Cr
1	PH 0811	Research Methodology	3	1	0	4
2	PH 0812	Condensed Matter Physics	3	1	0	4
3		Elective	3	1	0	4
4	PH0817	Seminar	0	0	6	3

### Semester - II

S.No.	Sub. No	Subject Title	L	T	P	Cr
1	PH 0822	Project	0	0	30	15

#### Electives offered for M.Phil (Physics)

1. PH 0813 - VIBRATIONAL SPECTROSCOPY
2. PH 0814 - MEDICAL APPLICATIONS OF LASER
3. PH 0815 - ULTRASONICS
4. PH 0816 - ADVANCED MATERIALS SCIENCE

## Semester - I M.Phil. Physics

	L	T	P	Cr
PH 0811 - Research Methodology	3	1	0	4

### Unit - 1

12hrs

Principles of Thesis writing - assignment writing- Research paper presentation and publication- Statistical analysis - LDA, PLS technique- distribution - error analysis- hypothesis testing.

### Unit -II

12hrs

Numerical methods - roots of equation - methods of successive approximation - Newton Raphson method. Matrix algebra- Simultaneous equations - elementary operation of matrices - Gauss Jordon Elimination method - matrix inversion - Eigen values and Eigen vectors- real symmetric matrix - Linear vector spaces.

### Unit -III

12hrs

Numerical integration- trapezoidal and Simpson's rule - Beta function and Gamma function.

### Unit- IV

12hrs

Interpolation - Lagrange's interpolation - Newton Gregory method. Solution of Differential Equations - Euler's method - Runge-Kutta method.

### Unit V

12hrs

C language programming - Basis and structure- application for Newton Raphson method, Gauss - Jordon elimination, simpson's Rule, Runge \_ Kutta method.

### Books for reference

1. Shastry s. s., " Introductory methods of numerical analysis", Prentice Hall, New Delhi, 1984
2. M. K. Venkataraman , "Numerical methods", NPC 1991
3. Balagurusamy, " Programing in C", 3<sup>rd</sup> edition, Tata Mc Graw Hill.

	L	T	P	Cr
<b>PH 0812 - Condensed Matter Physics</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Unit - I : Crystal Bonding** **12hrs**

Force between atoms- cohesive energy - calculation of cohesive energy - bonding in solids - ionic, covalent, metallic, molecular - hydrogen bonded crystals - binding energy of ionic crystals - Madelung constant - Born Haber cycle.

**Unit - II : Lattice Dynamics** **12hrs**

Reciprocal space: Brillouin zones - vibration modes of mono and diatomic lattices - quantization of lattice vibration - phonon momentum - scattering of neutrons by phonons - neutron diffraction .

**Unit - III : Dielectrics** **12hrs**

Different types of polarization - internal field and its calculation - Clausius -Mossotti equation - dielectric in an a.c. field - dielectric loss - ferroelectric materials and their behaviour.

**Unit - IV : Optical Properties** **12hrs**

Index of refraction - damping constant - characteristic penetration depth - absorbance - reflectivity and transmissivity - point defect - color centres - luminescence - exciton - polaron - interband - intraband transitions - dispersion relation.

**Unit - V : Atomic molecular structure** **12hrs**

Central field approximation - Thomas Fermi model and its application - Hartree and Hartree Fock equations - hydrogen molecule - Heiter London model - LCAO - hybridization.

**References:**

1. C. Kittel Introduction to Solid State Physics 7<sup>th</sup> Edition, Wiley Eastern 1996
2. A. K. Chandra Quantum Chemistry Prentice Hall 1990
3. R.E. Hummel Electronic properties of materials Narosa 1993
4. S. Raimes The wave mechanics of electrons in metals North Holland 1967

	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
<b>PH 0813 - Vibrational Spectroscopy</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Unit - I: Molecular vibrations and infrared spectroscopy** **12hrs**

Vibration of diatomic and polyatomic molecules - origin of infrared spectra - Selection rule - Spectral transitions - Internal vibrations - Spectra of simple molecules - Vibrational assignments - Infrared instrumentation- Sources - monochromator - Detectors - Single beam and Double Spectrophotometers - Sampling Techniques - F. T. I.R spectroscopy.

**Unit - II : Raman Spectroscopy** **12hrs**

Nature of Raman effect - Quantum mechanical description - Selection rules - Depolarization ratio - Rotation - vibration spectra - Resonance Raman Effect - Instrumentation - Sample handling techniques- Non linear Raman effects- F.T. Raman Spectroscopy.

**Unit - III: Group theoretical applications** **12hrs**

Groups and their properties - Molecular symmetry - Symmetry elements- Molecular point group- Reducible and Irreducible representations - Great Orthogonality Theorem - Character tables - Normal vibrations - Classification - Selection rules for vibrational transitions - Infrared and Raman Spectral activity

**Unit - IV: Normal Coordinate analysis** **12hrs**

Internal and symmetry coordinates - Kinetic and potential energy matrices - Force constants - Wilson's Secular equation - Factorization and solution - Spectra of isotopic molecules - Approximation methods- Force fields - Normal coordinate analysis of some simple symmetric molecules.

**Unit - V: Lattice dynamics and crystal spectra** **12hrs**

Monoatomic chain - Diatomic chain - Vibrations of three dimensional lattice - Brillouin zones - Dynamical matrix - Crystal spectra - Factor group analysis - Inter atomic forces in solids - Force constants of perovskite fluorides - separation of internal and external vibrations.

**References:**

1. Banwell C. N., and McCash E. M. Fundamentals of Molecular Spectroscopy, 4<sup>th</sup> Edition, Tata Mc Graw Hill Co., New Delhi, (Latest Edition).

2. Sathyanarayana. D. N. , Vibrational Spectroscopy – Theory and Applications, New Age International , New Delhi, 1996.
3. Turrell G., “Infrared and Raman Spectra of crystals”; Academic Press, New York 1972
4. Barrow G. M., “Introduction to Molecular Spectroscopy”. Tata Mc. Graw Hill Co., New Delhi 1982
5. Wilson E.B.’ Decius J.C., and Cross D. C., Molecular Vibrations, Mc Graw Hill, New York 1980.

	L	T	P	Cr
<b>PH 0814: MEDICAL APPLICATIONS OF LASER</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Unit – I: Laser Theory and Medical Lasers** **12**

Fundamentals of Laser action – Relation between spontaneous and stimulated emission probabilities – Three level and Four level laser system –Laser systems in medicine: Ruby, Nd-YAG, Argon, CO<sub>2</sub>, Eximer Laser, N<sub>2</sub> Laser – Diode Laser - Beam delivery systems – Principles of laser power – energy meters.

**Unit – II : Fundamentals of Laser-Tissue Interaction:** **12**

Laser characteristics as applied to medicine and Biology - Different types of Laser tissue interaction: Photochemical – Photothermal – Photoablative and Electromechanical effects – Tissue optics – Experimental methods and determining the optical properties of tissue – Theory of Integrating sphere.

**Unit – III: Thermal Applications** **12**

Surgical applications of Lasers – Evaporation and excision techniques – sterilization – homeostasis – clinical applications based on thermal effect : oncology – Gynecology – Dermatology – Ophthalmology – Dentistry.

**Unit – IV: Non Thermal Applications** **12**

Principles of Photoradiation therapy – applications – Laser Spectroscopy techniques in medical diagnosis: Reflectance, Fluorescence, Raman Spectroscopy – Principles of optical mammography – FLIM techniques.

**Unit – V: Safety Regulations** **12**

Protection standards for lasers – Safety regulations – specific precautions – medical surveillance.

**References:**

1. Markolf H. Niemz “Laser – Tissue Interactions” Fundamentals and applications Springer Verlag, Berlin – 1996.

2. Martellucci. S.S., and Chester. A. N.. "Laser Photobiology and Photomedicine", Plenum Press, New York, 1985
3. Pratesi. R, and Sacchi C. A., "Lasers in Photomedicine and Photobiology"" Springer Verlag, West Germany, 1980
4. William T. Silfvast "Laser - Tissue Interactions"" Fundamentals and applications Springer Verlag, Berlin - 1996.
5. William T. Silfvast " Laser Fundamentals" - Cambridge University Press - New Delhi - 1998.

	<b>L</b>	<b>T</b>	<b>P</b>	<b>Cr</b>
<b>PH 0815 - ULTRASONICS</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Unit - I: Ultrasonic Propagation in Solids and Liquids** **12**

Propagation of Ultrasonics waves in Solids - Plane wave propagation - Relation of the velocity of sound to the elastic properties - Adiabatic and Isothermal elastic constants - Ultrasonic propagation in liquids - Internal pressure and free volume calculations.

**Unit - II: Determination of Velocity of Propagation of Ultrasonics** **12**

Pulse Echo methods - Phase comparison methods - Pulse superposition - Measurements at high pressure and high temperature - Transducer coupling materials.

**Unit - III: Ultrasonic Transducers** **12**

Piezoelectric and magnetostrictive transducers - Equivalent circuits - Efficiency - Transducer mounting - Linear and sector transducers - Variable frequency systems.

**Unit - IV: Absorption of Ultrasonic Radiation** **12**

Classical absorption due to viscosity - Absorption due to thermal conductivity - Relaxation processes - Evaluation of dispersion and absorption curves - Structural relaxation - Relation between collision frequency and relaxation time - Ultrasonic attenuation in solids.

**Unit - V: Applications of Ultrasonics** **12**

Applications of ultrasonics in NDT - Medical Applications - Biological effects of Ultrasound - Different modes of scanning - Doppler Ultrasound techniques - Ultrasonic transaxial tomogram (U.T.T) - Acoustic microscope - Acoustic hologram.

**References:**

1. Woodcock J.P., Ultrasonics, Adam Hilger Ltd., U.K., 1992.
2. Gooberman G. L. Ultrasonics - Theory and Applications, The English Universities Press Ltd., London, 1968

3. Schreiber Edward, Elastic Constants and their measurement, Anderson and Soga, McGraw Hill Book Co., New Delhi, 1973.
4. Lerski R. A. (Ed), Practical Ultrasound, IRL Press, Oxford, 1988.
5. Robert T Beyer and Stephen V. Letcher, Physical Ultrasonics, Academic Press, London, 1969.

	L	T	P	Cr
<b>PH 0816 - ADVANCED MATERIALS SCIENCE</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>
<b>Unit - I: Semi conducting Materials</b>				<b>12</b>

Semiconductor - Direct and indirect bonding characteristics - Importance of quantum Confinement - Quantum wires and dots - Fabrication process of integrated circuits - Dilute magnetic semiconductors - Characteristics and applications - Ferroelectric semiconductors - Applications.

**Unit - II: Ceramic materials** **12**

Ceramic superconductors - Preparation - Sol gel techniques - nanoparticles - Applications - High temperature superconductors - Superconducting magnets - High  $T_c$  Tapes - Applications of composite materials - Fibre reinforced composites - Composite structure and manufacturing methods.

**Unit - III: Polymeric Materials** **12**

Polymer semiconductors - Photoconductive polymers - Composition and Structure of polymers - Electrical conductivity - LEP's design and fabrication - Applications - Mechanical properties - Nanoindentation techniques.

**Unit - IV: Optical Materials** **12**

Modern imaging materials, Principle of imaging - Superconducting, piezoelectric, acousto - optic and electro - optic materials - Optical storage materials - Photochromic, thermoplastic and Photoresist materials - materials suitable for detecting toxic gases.

**Unit - V: New Materials** **12**

Smart materials - Shape memory alloys - Shape memory effect - Martensitic transformation - Shape memory alloys - functional properties - processing - texture and its nature - applications.

Nanomaterials - Synthesis of different shapes of nanomaterials - Physico - Chemical properties - Applications.

**References:**

1. Verdeyen. J, Laser Electronics, II Edition, Prentice hall 1990.
2. Tumer C. W and Van Duzer. T, Principles of Superconductive Devices and Circuits, 1981.

3. Reynolds and M. Pomerantsev in Electroresponsive molecules and polymeric systems Ed. by Skotheim T. Marcel Dekker New York 1991.
4. Yariv A., Principles of Optical Electronics, John Wiley, New York, 1984.
5. Hull. B, and John V, Non- Destructive Testing, McMillan Education Ltd., London, 1988.
6. Funakubo H Shape memory alloys Gordon & Breach, New York 1984.

**M.Phil.( Chemistry)**  
**EDUCATIONAL OBJECTIVES**

To offer

- Advanced aspects of physical / organic / inorganic chemistry
  
- Training in chronological survey of research activities in the related field
  
- Project training extending to advanced research

## CURRICULUM FOR M.PHIL (CHEMISTRY)

### SEMESTER 1

S.No	Code No	Course Title	L	T	P	Cr
1	CH 0811	Research Methodology	3	1	-	4
2	CH 0812	Advanced Topics in Chemistry	3	1	-	4
3	CH 0813	Elective	3	1	-	4
4	CH 0814	Seminar	-	-	6	3

### SEMESTER 2

S.No	Code No	Course Title	L	T	P	Cr
1	CH 0821	Project	-	-	30	15

### ELECTIVE TOPICS

S.No	Code No	Name of the Elective
1	CH 0813 A	Special topics in Chemistry
2	CH 0813 B	Special topics in Chemistry

**CH 0811 RESEARCH METHODOLOGY**

**L T P C**  
**3 1 - 4**

**1. SYSTEMATIC RESEARCH METHOD**

**12 hrs**

Survey of literature – primary and secondary sources – reviews – treatises – monographs- patents- reviews -abstraction of research papers - current literature methods – search through e media – data search by - science direct and science finder – writing scientific articles, communications, papers – identification and selection of research problem – experimental techniques – analysis and interpretation of data – writing thesis.

**2. ERROR ANALYSIS**

**12 hrs**

Limiting errors – types of errors – Gross, systematic and Random – central value – statistical treatment of data – rejection of data – method of least squares – variance and standard deviations of combination of components – uncertainty analysis and treatment of single sample data – linear regression – polynomial regression.

**3. APPLICATION OF PHYSICAL METHODS IN CHEMISTRY**

**12 hrs**

Principles, Instrumentation and Applications of Infrared Spectroscopy – Ultraviolet and Visible Spectroscopy – Colorimetry – Flame Photometry – Atomic Absorption Spectrometry – XRD and SEM / TEM

**4. APPLICATION OF PHYSICAL METHODS IN CHEMISTRY II**

**12 hrs**

Principles, instrumentation and applications –  $^1\text{H}$  NMR and  $^{13}\text{C}$  NMR spectroscopy – Mass spectrometry – GCMS-elemental analysis – TGA and DTA

**5. CHROMATOGRAPHY**

**12 hrs**

Principles of chromatography- different types of chromatography methods – TLC – Paper chromatography – Column chromatography – Ion exchange chromatography – Gas Chromatography – High performance liquid chromatography- illustrative applications.

## REFERENCES

1. J.Anderson, B.H. Dursten and M.Poole, "Thesis and Assignment writing" Wiley Eastern, 1977.
2. P.Rajammal and P.Devadoss, " A Handbook of Methodology of Research", R.M.M.Vidya Press, 1976.
3. Robert A Day, "How to write and publish a scientific Paper", 4<sup>th</sup> ed. Cambridge Low price Edn. 2004.
4. John A Dean, "Chemical Separation Methods", 1969.
5. D.J.Pasto, C.R. Johnson and M.J.Miller, "Experiments and Techniques in Organic Chemistry", Prentice Hall, Inc, 1992.
6. Dudley H Willams and Ian Fleming, "Spectroscopic Methods in Organic Chemistry", 4<sup>th</sup> ed. T M H Publishing Co. New Delhi, 1990.
7. R.M.Silverstein, G. Clayton Bassler and Terence C. Morrill, "Spectrometric identification of Organic Compounds", 5<sup>th</sup> ed. John Wiley & Sons, INC. 1991.
8. D.A.Skoog, D.M.West and F.J.Holler and S.R.Crouch, "Analytical Chemistry-An Introduction", Sanunders Colledge of Publishing, 7<sup>th</sup> ed. 1999
9. D.A.Skoog, D.M.West and F.J.Holler, "Fundamentals of Analytical Chemistry", Sanunders Colledge of Publishing, 7<sup>th</sup> ed. 1997
10. H.H.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, "Instrumental Methods of Chemical Analysis", CBS Publishers & Distributors, 1986.
11. Gurdeep R. Chatwal, K.Anand, "Instrumental Methods of Chemical Analysis", 5<sup>th</sup> ed. 2003.

## CH 0812 ADVANCED TOPICS IN CHEMISTRY

	L	T	P	C
	3	1	-	4
<b>1. BIO-INORGANIC CHEMISTRY</b>				<b>12</b>
Bio inorganic chemistry of toxic metals - Detoxification of metal chelation - Drugs that add by binding at the Metal sites of metalloenzymes - Radiation risks and medical benefits - Bio inorganic chemistry of radio isotopes-Platinum Complexes in Cancer Therapy-Cisplatin and its mode of action-Gold and Antirheumatic drugs- mode of action - Lithium in Pschycopharmacological drugs.				
<b>2. REACTIVE INTERMEDIATES</b>				<b>14</b>
Structure, stability and generation of carbocations, carbanions, carbenes, nitrenes and free radicals - reactions of carbocations, carbanions, carbenes, nitrenes and free radicals - enolates-generation, reaction selectivity-stereochemistry of enolate alkylations - asymmetric alkylations - Evans, Enders ad Meyers method -				

Enamines - preparation and applications in synthesis - Finkelstein reaction and Wurtz coupling - Ester Hydrolysis - mechanism.

### 3. REAGENTS AND ORGANIC SYNTHESIS

12

Lithium diisopropylamide N-Bromosuccinimide -- aluminium isopropoxide - lithium aluminium hydride - potassium tert.butoxide - trimethylsilyl iodide - protecting groups - hydroxyl, amino, carbonyl and carboxylic acid - Synthetic analysis - control of stereochemistry - illustrative example - longifolene.

### 4. CATALYSIS

12

Phase transfer catalysis - concepts - classification - mechanism - applications in polymer and organic synthesis - catalysis by ion exchange resins - super acid catalysis - sulphate, metal oxides - applications- Intermolecular catalysis - enzyme like catalysis by synthetic linear polymers.

### 5. BIOPHYSICAL CHEMISTRY

10

Thermodynamics of biochemical reactions - binding of oxygen by hemoglobin - Electrophoresis - types - paper electrophoresis - cellulose acetate - electrophoresis - gel electrophoresis - applications-analytical use - uses in molecular biology.

**Total 60**

### REFERENCES

1. J.D.Lee, " A New Concise Inorganic chemistry, ELBS, 1987.
2. Kettle, S.F.A., "Coordination Compounds", Nelson, 1969.
3. M.N.Huges, "Inorganic chemistry of biological processes" 2<sup>nd</sup> ed. John Wiley and Sons, 1985.
4. D.E.Fenton, "Biocoordination chemistry" Oxford Sci. Pub. 1995.
5. J.J.R.Frausto das Silva and R.J.P.Williams, "The Biological chemistry of the elements-The Inorganic chemistry of life", Oxford univ. Press, 1993.
6. H.Sigel,(Ed) "Metal ions in biological systems" Vol. 1-30, Marcel Dekker.
7. C.Wentrup, "Reactive molecules", John Wiley and Sons, New York, 1984.
8. T.L.Gilchrist and C.W.Rees, "Carbenes, Nitrenes and Arynes", Thomas Nelson and Sons Ltd, London, 1969.
9. Jerry March, "Advanced Organic Chemistry, Reaction mechanisms and structure", 4th ed. Wiley Eastern, 1999.
10. Francis A Carey and Richard J Sundberg, "Advanced Organic Chemistry", (Part A and Part B), Plenum press, 1993.

11. S.G.Davies, "Organotransition Metal Chemistry", Applications to Organic Synthesis, Pergamon Press, 1982.
12. Robert E Ireland, "Organic Synthesis", Prentice Hall of India Pvt. Ltd., New Delhi, 1975.
13. R.O.C.Norman, "Principles of Organic Synthesis", Chapman and Hall, New York, 1980.
14. Raymond K Mackie and David M Smith, "Guide book to Organic Synthesis", ELBS
15. W.Carruthers, "Some Modern Methods of Organic Synthesis" 3<sup>rd</sup> Edn., Cambridge University Press, 1986.
16. P.Atkins and J.D.Paula, "Physical Chemistry", 7<sup>th</sup> ed. Oxford University Press, London, 2002.
17. G.W.Castellan, "Physical Chemistry", 3<sup>rd</sup> Edn., Narosa Pub. House, New Delhi, 2004.
18. K.J.Laidler, "Physical Chemistry with Biological Applications", Pergamon Press, Oxford, 1977.
19. A.Singh and R.Singh, "Biophysical Chemistry", 1<sup>st</sup> ed. Campus Books International, New Delhi, 2004.
20. C.M.Starks, "Phase Transfer Catalysis-Principles and Techniques", Academic Press, New York, 1978.
21. Charles M. Starks and Charles Liotta, "Phase Transfer Catalysis", Academic Press, New York, 1978.

## ELECTIVE-1

CH 0813A SPECIAL TOPICS IN CHEMISTRY      L T P C  
3 1 - 4

### 1. MATERIALS CHEMISTRY

12 hrs

Preparation and properties of nano particles - Materials -Metals, semiconductors-ceramics (oxides, carbides, sulphides, nitrides) - Physical methods - Physical vapour deposition (evaporation and sputtering) - Chemical methods - Reduction methods - Sol-gel methods - Optical properties, electrical properties and magnetic properties.

### 2. PHOTOCHEMISTRY

12 hrs

Electromagnetic radiations -molecular transitions - different type of bonds - energy requirements - thermal reactions vs photochemical reactions - various photo physical processes - radiative and Non-radiative transitions- fluorescence, phosphorescence - examples - eximers and exciplexes - delayed fluorescence - internal conversion, intersystem crossing, energy transfer and quenching - Stern-Volmer analysis - photosensitization.

### 3. MACROMOLECULAR DYNAMICS

12 hrs

Molar masses - determination - viscometer - osmometry - Donnan membrane equilibrium - ultracentrifugation - light scattering - diffusion - Stokes -Einstein equation - Einstein- Smoluchowski equation - thermodynamics of polymers solution - Flory-Huggin theory.

### 4. ELECTROCHEMISTRY AND ELECTROCHEMICAL TECHNIQUES 12 hrs

Thermodynamic properties of ion in solution - enthalpy - Gibbs energy - entropies of ion in solution -Electrode kinetics - process at electrodes - ButlerVolmer equation - Electroanalytical techniques - Polarography - Amperometry - Cyclic Voltammetry - Coulometry

### 4. GREEN CHEMISTRY

12 hrs

Significance - Solvent free reactions- Microwave assisted synthesis - Role of ionic liquids in green chemistry - Supercritical fluids - Catalysis and green chemistry - zeolites, clays - mesoporons - waste water treatment by oxidation techniques at ambient conditions - Textile effluents - effects and remedial measures - bio catalysis.

60 hrs

### REFERENCES

1. Kenneth, J Klabunde, "Nanoscale Materials in Chemistry", Wiley Interscience, 2001.
2. H.S.Nalwa, "Nanostructured materials and nanotechnology", Academic Press, Sandiego, 2000.
3. H.Weller, "Colloidal semiconductor Q-particles-Chemistry in the transition between solid state and molecules", Angew. Chem. Int. ed. 32, 41, 1993.
4. Rohatgi Mukherjee, "Fundamentals of Photochemistry", 2<sup>nd</sup> Edn., New Age International, 2004.
5. William Horspool, "Synthetic Organic Photochemistry", Plenum Press, New York, 1984.
6. D.A.Skoog, D.M.West and F.J.Holler and S.R.Crouch, "Analytical Chemistry-An Introduction", Sanunders Colledge of Publishing, 7<sup>th</sup> ed. 1999
7. D.A.Skoog, D.M.West and F.J.Holler, "Fundamentals of Analytical Chemistry", Sanunders Colledge of Publishing, 7<sup>th</sup> ed. 1997
8. H.H.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, "Instrumental Methods of Chemical Analysis", CBS Publishers & Distributors, 1986.
9. Gurdeep R. Chatwal, K.Anand, "Instrumental Methods of Chemical Analysis", 5<sup>th</sup> ed. 2003.
10. Anil Kumar De, "Environmental Chemistry", 3<sup>rd</sup> ed. Wiley Eastern Ltd., 1994.
11. R.Sanghi and M.M.Srivastva, "Green Chemistry", Narosa, 2003.
12. S.Delvin, "Green Chemistry" IVY Publishing House, 2006.
13. M.M.Srivastva and R.Sanghi, "Chemistry for Green Environment", Narosa, 2005.

## ELECTIVE-2

### CH 0813B SPECIAL TOPICS IN CHEMISTRY

L	T	P	C
3	1	-	4

#### 1. COORDINATION CHEMISTRY

Crystal field spectra of coordination compounds – 3d<sup>1</sup> to 3d<sup>9</sup> system. Metal – ligand equilibria – Formation of binary and ternary complexes of amino acids and peptides – Formation constants – Experimental methods of determination-Structural correlation and thermodynamic aspects – Charge transfer spectra – Halide complexes, Cyanide complexes Co Ni (II) and Co (II) systems.

#### 2. CHEMICAL TOXICOLOGY

Toxic chemicals in the environment–Toxic effects–Biochemical effects of Arsenic, Cadmium, Lead, Mercury, Copper, Chromium – Biochemical effects of some pollutants, Cyanide, Pesticides, Asbestos – Air pollutants – Air quality standards – Sampling and analysis –Air pollution control.

#### 3. STEREOCHEMISTRY

Optical isomerism – molecular dissymmetry – optical isomerism in compounds that contain asymmetric carbon – racemic modifications – criteria of optical purity – configuration – absolute and relative configuration conformation and reactivity in cyclic systems, cyclohexane and decalins- stereoselectivity , principles– diastereoselectivity and enantioselectivity – few examples from pericyclic reactions.

#### 4. OXIDATION AND REDUCTION REACTIONS

Conventional oxidation reactions – various oxidising agents – LTA, DDQ and SeO<sub>2</sub> – DMSO – oxalyl chloride – DMSO/DCC – DMSO/Ac<sub>2</sub>O – Hydroxylation of double bonds – Woodward and Prevost methods – epoxidations – Peracids and Sharpless epoxidation – ozonolysis- Reduction hydrogen/metal catalysts – hydrogenation, hydration of double and triple bonds – asymmetric reduction of carbonyl group.

#### 5. ORGANOMETALLICS IN ORGANIC SYNTHESIS

Synthesis of organolithium, tin and silicon compounds – application in carbon-carbon bond formations – transition metal organometallics – homogeneous catalytic reaction-hydrogenation, hydroformylation, isomerisation and polymerization – pi-metal complexes – activation of small molecules by coordination.

#### REFERENCES

1. J.D.Lee, " A New Concise Inorganic chemistry, ELBS, 1987.
2. Kettle, S.F.A., "Coordination Compounds", Nelson, 1969.
3. M.N.Huges, "Inorganic chemistry of biological processes" 2<sup>nd</sup> ed. John Wiley and Sons, 1985.
4. D.E.Fenton, "Biocoordination chemistry" Oxford Sci. Pub. 1995.
5. J.J.R.Frausto das Silva and R.J.P.Williams, "The Biological chemistry of the elements-The Inorganic chemistry of life", Oxford univ. Press, 1993.
6. H.Sigel,(Ed) "Metal ions in biological systems" Vol. 1-30, Marcel Dekker.
7. Ernest L. Eliel and S.H.Wilen, "Stereochemistry of Organic compounds", John Wiley and Sons, New York, 1994.
8. P.S.Kalsi, "Stereochemistry, Conformation and Mechanism", Wiley Eastern Limited, 1993.
9. P.S.Kalsi, "Stereochemistry and Mechanism through solved problems" Wiley Eastern Limited, 1994.
10. C.Wentrup, "Reactive molecules", John Wiley and Sons, New York, 1984.
11. T.L.Gilchrist and C.W.Rees, "Carbenes, Nitrenes and Arynes", Thomas Nelson and Sons Ltd, London, 1969.

12. Jerry March, "Advanced Organic Chemistry, Reaction mechanisms and structure", 4th ed. Wiley Eastern, 1999.
13. Francis A Carey and Richard J Sundberg, "Advanced Organic Chemistry", (Part A and Part B), Plenum press, 1993
14. S.G.Davies, "Organotransition Metal Chemistry", Applications to Organic Synthesis, Pergamon Press, 1982.
15. Robert E Ireland, "Organic Synthesis", Prentice Hall of India Pvt. Ltd., New Delhi, 1975.
16. R.O.C.Norman, "Principles of Organic Synthesis", Chapman and Hall, New York, 1980.
17. Raymond K Mackie and David M Smith, "Guide book to Organic Synthesis", ELBS
18. W.Carruthers, "Some Modern Methods of Organic Synthesis" 3<sup>rd</sup> Edn., Cambridge University Press, 1986.