Curriculum and Course Contents

for the
M.Sc. (5 Year Integrated and 2 Year post B.Sc.)

and the

Ph.D. Programmes

in

Chemistry
(Date: 2008)

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- **THE DEPARTMENT**

The Department of Chemistry is committed to dual goal of excellence in teaching and it offers programmes of course work and research leading to M.Sc. and Ph.D. degrees. There are two streams in M.Sc. programmes : (1) a five-year integrated M.Sc., admission to which is given to those who qualify the J.E.E. This programme is open to the students who have completed 10 + 2 level of studies in science subjects (PCM) and (ii) a two year M.Sc. programme, admission to which is given to those students who qualify JAM (with Chemistry as one of the subjects in the final year of B. Sc.and Mathematics at 10 + 2 level). Admission to Ph.D. programme is open to those who have Ist class M.Sc. degree (Chemistry/Physics/Biochemistry/Biotechnology/LifeSciences/Pharmacy/Material Science) and have valid GATE/CSIR/UGC fellowship. The admission is offered to those who successfully qualify the departmental interview.

The goal of our academic programme is to prepare students for a career in science by expanding their knowledge of chemistry while developing their ability for critical analysis and creativity. The department strives for excellence in both classroom and teaching and research and faculty members are recognized leaders in their field.

The department consists of 29 full-time faculty members. Their academic background provides a varied and well-balanced spectrum of research interests covering all major areas of Chemistry including analytical, inorganic, organic, physical and biochemical. Since the traditional boundaries between the sub-divisions of Chemistry are rapidly disappearing, the academic programmes of the Department stress breadth in understanding all aspects of chemistry and related disciplines and cooperation between research groups within the department/institute is encouraged. In the five year integrated M.Sc. programme the students are given courses in chemistry, physics, mathematics and engineering subjects in the first two years of their studies. In subsequent years they are given courses mainly in chemistry. The courses cover inorganic, organic and physical chemistry as well as important areas of chemical bonding, molecular spectroscopy and biomolecules. Besides the basic analytical and synthetic methods the laboratory laboratory courses include instrumental spectroscopic and chromatographic techniques. The courses in the final year provide electives in various sub-areas of chemistry such as inorganic, organic, physical chemistry and are designed to take the students gradually to the frontiers of knowledge in the chosen discipline. A vital component of the M.Sc. curriculum, is a "two-semesters project" through which the students are exposed to current literature, sophisticated instrumental techniques and research methodologies. Visits to industrial and scientific establishments also form a part of credit requirements.

In the Ph.D. programme, the students focus on course work and research during their first year and concentrate primarily on research in the subsequent stages of their studies. The programmes are designed to be both comprehensive and flexible. On an average the department has about 110 research scholars on roll. Faculty research programmes are well supported by competitive external fundings from agencies like Department of Science and Technology, Council of Scientific and Industrial Research, Department of Biotechnology, Department of Atomic Energy, AICTE and various industries and many others.

- **Infrastructure**

The department is well equipped with instruments crucial to the pursuit of modern chemical research. The departmental facilities include NMR, FTIR, UV-vis., Mass, GC, Elemental C.H.N. analyser, Atomic Absorption, well developed computer laboratory, lasers, fluorescence spectroscopy, peptide sequencing, ultracentrifuges, HPLC, etc.

Graduate students are strongly encouraged to learn to operate the equipments which they need in their research. State-of-the-art equipments available at Sophisticated Analytical Instrumentation Facility and in other departments of the institute are also used by our students.

The department also has a number of general facilities. An excellent glass-blowing shop, store-room and machine shop efficiently take care of most items required in chemical research. The Institute's main-frame computer alongwith the excellent computing facilities of the department are also available. The department has several terminals for general use.

The institute library contains major journals in chemistry and related areas. Library facilities of Tata Institute of Fundamental Research and Bhabha Atomic Research Centre are also available to our students.

The department supports many programmes which provide a broad focus for the dissemination of scientific knowledge. Seminars by students, faculty and renowned speakers from outside form an integral part of such activity.

The combined creative and energetic efforts of outstanding faculty, staff, students and postdoctoral fellows provide an extremely dynamic environment that fosters high productivity and encourages the establishment of valuable collaborative interactions. The department has always strived to provide high quality teaching/research leading to the M.Sc. and Ph.D. degree in Chemistry.

FACULTY

PROFESSORS

K. D. Deodhar, Ph.D. (IIT Bombay)
A. K. Singh, Ph.D. (IIT Kanpur)
Susheel Durani, Ph.D. (Jammu)
M. K. Mishra, Ph.D. (Florida)
Pradeep Mathur, Ph.D., (Keele Univ.)
H. B. Singh, Ph.D., (Aston Univ.)
S. N. Datta, Ph.D. , (Virginia)
A. Q. Contractor, Ph.D. (IIT Bombay)
B.L.Tembe, Ph.D. (SUNY- Stony Brook)
C. P.Rao, Ph.D. (IISc. Bangalore)
Vishwakarma Singh, Ph.D. (Gorakhpur)
Sambasivarao Kotha, Ph.D. (Hyderabad)
G. K. Lahiri, Ph.D. (Jadavpur)
Y. Uma Sasidhar, Ph.D. (IIT Madras)
Nand Kishore, Ph.D. (IIT Delhi)
M. S. Balakrishna, Ph.D. (IISc. Bangalore)
R. Murugavel, Ph.D. (IISc. Bangalore)

ASSOCIATE PROFESSORS

Anil Kumar, Ph.D. (IISc. Bangalore)
M. Ravikanth, Ph.D. (IIT Kanpur)
Irishi Namboothiri , Ph.D. (IISc. Bangalore)
Krishna P.Kaliappan, Ph.D.(IISc. Bangalore)
Anindya Datta, Ph.D. (Jadavpur)
Prasenjit Ghosh, Ph.D.(Columbia)
G. Naresh Patwari, Ph.D. (Bombay)
Raghavan B. Sunoj, Ph.D. (IISc Bangalore)

ASSISTANT PROFESSORS

ArindamChowdhury, Ph.D. (Carnegie Mellon Univ.)
Rodney A. Fernandes (Pune Univ.)
Pradeepkumar, P.I. (Uppsala Univ.)
Ruchi Anand (Cornell Univ.)

EMERITUS PROFESSORS

S.C. Bhattacharyya, Ph.D. (Cantab)
S.M. Khopkar, Ph.D. (Jadavpur)
D.K.Chakrabarty, Ph.D. (Moscow)
G. K. Trivedi (Pune Univ.)

M.Sc. (Integrated) Curriculum

CURRICULUM FOR 5 YEAR INTEGRATED M.Sc. PROGRAMME IN CHEMISTRY

First Year : I Semester (Semester-I (4T+2L))

MA-105	Calculus	3,1,0	8
CH-103	Chemistry-I	2,1,0	6
CS-101	Computer programming and utilization	2,1,0	6
HS-101	Economics	2,1,0	6
CH-117	Chemistry Lab	0,0,3	3
ME-113	Workshop practice	0.5,0,3	4
			33

Contact hours :
Credits   : 33.00

First Year : II Semester (Semester-II (4T+2L))

MA-106 +MA-108	Linear algebra +Ordinary differential equations (Half semester course)	3,1,0	8
PH-105	Physics-II (Modern Physics)	2,1,0	6
CH-104 (DIC)	Departmental Introductory Course	2,1,0	6
IC-102	Data analysis and interpretation	2,1,0	6
PH-117	Physics Lab	0,0,3	3
ME119	Engineering graphics and drawing	1,0,3	5
			34

Contact hours :
Credits   : 34.00

Second Year : Semester I (Semester-III (4T+2L))

EE-101	Introduction to electrical and electronic circuits	3,1,0	8
BT-251 (DO1)	Molecular Cell Biology	2,1,0	6
CH-211	Physical Chemistry - I	2,1,0	6
CH-221	Organic Chemistry - I	2,1,0	6
CH-206	Inorganic Chemistry Lab –I	1,0,3	4
IC-211	Experimentation and measurements lab	0,0.5,3	4
			34

Contact hours :
Credits   : 34.00

Second Year : Semester II (Semester-IV (5T+1L))

ES-200/HS-200	Environmental studies / Humanies (H.S.C.)	3,0,0	6
PH-103 (DO2)	Electricity and magnetism	2,1,0	6
CL-152	Elements of Chemical Engineering (CE-DIC)	2,1,0	6
CH-222	Organic Chemistry - II	2,1,0	6
CH-210	Inorganic Chemistry – I	2,1,0	6
CH-215	Physical Chemistry Lab – I	1,0,3	4
Minor	Institute Course		6
			40

Contact hours : 28.00

Credits   : 40.00

Third Year : Semester I (Semester-V (4T+2L))

IE-1	Institute Elective-1 (HSS-XYZ)	3,0,0	6
CH-427	Chemical and Statistical Thermodynamics	2,1,0	6
CH-423	Organic Chemistry –III	2,1,0	6
PH-201	Optics	2,1,0	6
CH-317	Organic Chemistry Lab – I	1,0,3	4
EP-215	Electronic Lab – I	0,0,3	3
			31

Contact hours : 25.00
Credits   : 43.00

Third Year : Semester II (Semester-VI (4L+2L))

IE-2	Institute Elective-2 (HSS-XYZ)	3,0,0	6
CH-426	Rate Processes	2,1,0	6
CH-424	Organic Chemistry – IV	2,1,0	6
CH-4XY	Modern Methods of Analysis	2,1,0	6
CH-316	Inorganic Chemistry Lab – II	1,0,3	4
CH-318	Organic Chemistry Lab – II	1,0,3	4
			32

Contact hours : 28.00
Credits   : 44.00

Fourth Year :Semester I (Semester-VII (4T+2L))

IE-3	Institute Elective-3 (HSS/Or any other IE)	2,1,0	6
CH-425	Chemical Bond and Molecular Geometry	2,1,0	6
CH-509	Physical Organic Chemistry and Photochemistry	2,1,0	6
CH-4XW	Chemistry of Main Group Elements	2,1,0	6
CH-4XX	Physical Chemistry Lab – II	1,0,3	4
CH-419	Separation Techniques Lab	1,0,3	4
			32
CH-4XY	Mini Project*	0,0,3	3

*Option only for Honors Program
Contact hours : 27
Credits   : 42

Fourth Year : Semester II (Semester-VIII (3T+3L))

IE-4	Institute Elective-4 (HSS/ Or any other IE)	2,1,0	6
CH-440	Introduction to Biomolecules	2,0,0	4
CH-4XZ	Chemistry of Transition Elements	2,1,0	6
CH-432	Inorganic Chemistry Lab – III	1,0,3	4
CH-4XV	Physical Chemistry Lab – III	1,0,3	4
CH-418	Organic Chemistry Lab – III	1,0,3	4
			28
CH-4XY	Mini Project*	0,0,3	3

	Elective-xI*	2,1,0	6

*Option only for Honors Program   Contact hours : 23.00
Credits   : 38

Summer between VIII and IX semesters

CH-499	Summer Project*		12

*Option only for Honors Program

Semester-IX (4T+2P)

CH-5XX	Topics in Chemistry	3,0,0	6
CH-547	Organometallic Chemistry	2,1,0	6
CH-5XY	Molecular Spectroscopy	2,1,0	6
CH-521	Interpretative Molecular Spectroscopy	2,0,0	4
CH-595	Project		12
			34

Semester-X (3T+3P)

	Elective-I	2,1,0	6
	Elective-II	2,1,0	6
	Elective-III	2,1,0	6
CH-596	Project		18
			36
	Elective-xII*	2,1,0	6

*Option only for Honors Program

Electives :

CH-502 Synthesis and Characterisation of Inorganic Compounds.
CH 504 Computational Chemistry
CH-522 Chemistry of Coordination Compounds
CH-524 Bioinorganic Chemistry
CH 528 Natural Products
CH 540 Drugs and Biologically Active Compounds
CH 550   Electrochemistry
CH 552 Interfacial Phenomena
CH 556 Polymer Science
CH-559 Solid State Chemistry and its application
CH 560 Quantum Chemistry
CH 574 Topics in Inorganic Chemistry-I
CH 576 Statistical Mechanics
CH 578 Topics in Inorganic Chemistry-II
CH-582 Inorganic Photochemistry
CH 584 Biophysical Chemistry
CH 586 Structure and Properties of   Materials
CH 588 Organic Synthesis
CH-599 Organic Synthesis and reagents

HS AND INSTITUTE ELECTIVES

The student is allowed to take any course as an Institute Elective provided that it is not offered by his/her own Department as a compulsory course or as a Departmental Elective. This is in addition to the courses explicitly listed below under the Institute Elective heading. However the consent of the Instructor and his/her faculty adviser will be necessary. The information about other courses is available on the Institute's home/web page.

HS Electives - Autumn Semester

HS 423   Trends in Twentieth Century Drama
HS 425   Stress and Coping
HS 427   Essentials of Gandhian Political Economy
HS 429   Sociology of Science
HS 433   Man, Environment and Society
HS 443   Philosophy and History of Science
HS 463   Introduction to Art and Aesthetics
HS 467   Indian Philosophy
HS 475   Perspectives on Economic Development
HS 477   Principles of Management
HS 481   Psychology in Executive's Self Management
HS 483   Introduction to Logics and their Automation
HS 485   Management of Human Resources in Organizations
HS 487   Planning and Economic Policies in India
HS 489   State, Polity and Society
HS 491   Contemporary Urban India: Sociological Perspective

Institute Electives - Autumn Semester

CE 466   Computational Mechanics : An Introduction
EE 663   Thin Film Components and Circuits
EN 402   Introduction to Energy Engineering
ES 400   Environmental Science and Engineering
HS 422   Introduction to Classic English Literature
HS 424   Understanding Sciencd and Technology through Literature
HS 426   Theory and Policy of Managerial Finance
HS 428   Futures Studies
HS 432   An Introduction to the Sociology of Rural Development
HS 440   Industrial Economics
HS 442   Logic and Foundations of Mathematics
HS 457   Managerial Economics
HS 462   Applied Social Psychology
HS 464   Science, technology and Society
HS 466   Introduction to Linguistics
HS 468   Philosophy of Religion
HS 478   Industrial Sociology
HS 480   An Organizational Psychology Approach to Engg. Management

HS 484	International Finance and Monetary System
HS 486	Theory of Sets and Multisets
HS 490	Organizational Behaviour and Implications for Management
HS 492	Management by Values
IM 610	Managerial Economics
IM 622	Manufacturing Strategies
ME 474	Investment Analysis and Securities Markets
MS 400	Modern Concepts in Materials Science
MT 604	Corrosion Process and Control
PH 400	Lasers
PH 426	Astro Physics
SC 400	Introduction to Systems
SC 404	Methods for Systems Analysis II

HS Electives/Institute Electives - Spring Semester

BM 402	Neurophysiology and Motor Control
CE 466	Computational Mechanics : An Introduction
EN 402	Introduction to Energy Engineering
ES 400	Environmental Science and Engineering
ES 402	Terrestrial Biosphere : Physical and Sosietal Issues
HS 424	Understanding Science and Technology through Literature
HS 426	Theory and Policy of Managerial Finance
HS 432	An Introduction to the Sociology of Rural Development
HS 440	Industrial Economics
HS 442	Logic and Foundations of Mathematics
HS 457	Managerial Economics
HS 464	Science, Technology and Society
HS 466	Introduction to Linguistics
HS 468	Philosophy of Religion
HS 474	Investment Analysis and Securities Markets
HS 478	Industrial Sociology
HS 480	An Organizational Psychology Approach to Engg. Management
HS 482	Communication Skills
HS 484	International Finance and Monetary System
HS 486	Theory of Sets and Multisets
HS 490	Organizational Behaviour and Implications for Management
HS 492	Management by Values
HS 494	Women in Third World Development
MA 406	General Topology
ME 462	Appropriate Technology
ME 474	Investment Analysis and Securities Markets
ME 478	Management Principles and Practice
MS 400	Modern Concepts in Materials Science
MT 604	Corrosion Process and Control
PH 400	Lasers
PH 426	Astro Physics
SC 400	Introduction to Systems

M.Sc. (2 Year) Curriculum

CURRICULUM FOR 2 YEAR M.Sc. PROGRAMME

First Year First Semester
Semester-I (4T+2L)

CH-427	Chemical and Statistical Thermodynamics	2,1,0	6
CH-425	Chemical Bond and Molecular Geometry	2,1,0	6
CH-423	Organic Chemistry -III	2,1,0	6
CH-4XW	Chemistry of Main Group Elements	2,1,0	6
CH-4XX	Physical Chemistry Lab - II	1,0,3	4
CH-419	Separation Techniques Lab	1,0,3	4
			32

Contact hours   : 23.00
Credits   : 40

First Year Second Semester
Semester-II (5T+2L)

CH-426	Rate Processes	2,1,0	6
CH-424	Organic Chemistry - IV	2,1,0	6
CH-4XY	Chemistry of Transition Elements	2,1,0	6
CH-4XZ	Modern Methods of Analysis	2,1,0	6
CH-440	Introduction to Biomolecules	2,0,0	4
CH-432	Inorganic Chemistry Lab - III	1,0,3	4
CH-418	Organic Chemistry Lab - III	1,0,3	4
			36

Contact hours : 28.00
Credits   : 44

Summer between II and III semesters

CH-499	Summer Project*		12

Second Year First Semester
Semester-III (4T+1L+2P)

CH-5XY	Molecular Spectroscopy	2,1,0	6
CH-521	Interpretative Molecular Spectroscopy	2,0,0	4
CH-547	Organometallic Chemistry	2,1,0	6
CH-509	Physical Organic Chemistry and Photochemistry	2,1,0	6
CH-5XZ	Physical Chemistry Lab - III	1,0,3	4
CH-597	Project		12
			38
CH-5XX	Topics in Chemistry*	3,0,0	6

Contact hours : 25
Credits   : 37

Second Year Second Semester
Semester-IV (3T+3P)

	Elective-I	2,1,0	6
	Elective-II	2,1,0	6
	Elective-III	2,1,0	6
CH-598	Project		18
			36
	Elective-IV*	2,1,0	6

*Option only for Honors Program

Contact hours : 27
Credits   : 39

Honors in Chemistry (For the Five year Program, Total 30 Extra Credits)

1. UG research credits (Mini projects) for semesters VII and VIII (6 Credits)
2. A summer project at the end of 4th year (12 credits)
3. Two extra electives one each during VIII and X semesters (12 credits)

Mini project is a semester long project carried out under the supervision of any faculty member by mutual consent.
Student should spend two semesters (VII and VIII) in two different labs.
No faculty member can advise more than one student in a year (Exceptions should be approved by DUGC).
A separate log book should be maintained which should be regularly checked by the advisor by putting his initials.
A brief report (up to 5 pages) along with the log book should be submitted for evaluation.
The evaluation pattern of the summer projects will be similar to the MSc Projects.
Mini projects and summer projects carried out under supervisor/supervisors does not guarantee that the student gets the same advisor for his MSc. Project.
The allotment of MSc project advisor will be solely determined by the CPI and according to DUGC recommendations.

Minor in Chemistry (For the B.Tech and DD, Total 30 Extra Credits)

1. CH-104 (DIC)
2. Physical-I (Recommended prerequisites CH-104)
3. Organic-I (Recommended prerequisites CH-104)
4. Inorganic-I (Recommended prerequisites CH-104)
5. a) One other course in physical chemistry
   b) Organic-II (Recommended prerequisites Organic-I)
   c) Inorganic-II (Recommended prerequisites Inorganic-I)
   d) Any 400 level course Recommended prerequisites Level I and II courses of same discipline)
   e) Introduction to Biomolecules (Recommended prerequisites CH-104)
   f) The course CH 5XX also qualifies: Recommended prerequisites Physical-I.

Total of 30 credits from the above courses are required for obtaining minor in chemistry.

Honors in Chemistry (For the Two year Program) Total 24 Credits

1. A summer project either after end of first year (12 credits)
2. Extra course in Semester-III (Topics in Chemistry 5XX) (6 Credits)
3. Extra elective in semester IV (6 credits)

The evaluation pattern of the summer projects will be similar to the MSc Projects.
The UG research and summer projects carried out under supervisor/supervisors does not guarantee that the student gets the same advisor for his MSc. Project.
The allotment of MSc project advisor will be solely determined by the CPI and according to DUGC recommendations.

Elective Courses

Electives :

CH-502 Synthesis and Characterisation of Inorganic Compounds.
CH 504 Computational Chemistry
CH-522 Chemistry of Coordination Compounds
CH-524 Bioinorganic Chemistry
CH 528 Natural Products
CH 540 Drugs and Biologically Active Compounds
CH 550   Electrochemistry
CH 552 Interfacial Phenomena
CH 556 Polymer Science
CH-559 Solid State Chemistry and its application
CH 560 Quantum Chemistry
CH 574 Topics in Inorganic Chemistry-I
CH 576 Statistical Mechanics
CH 578 Topics in Inorganic Chemistry-II
CH-582 Inorganic Photochemistry
CH 584 Biophysical Chemistry
CH 586 Structure and Properties of   Materials
CH 588 Organic Synthesis
CH-599 Organic Synthesis and reagents

Ph.D. Courses

Ph.D. Courses

First Semester

Code	Name	L	T	P	C
CH 801	Symmetry in Chemistry	03.00	00.00	00.00	06.00
CHS 801	Seminar I	03.00	00.00	00.00	04.00
CH 805	Stereochemistry and Reactivity of Organic Compounds	03.00	00.00	00.00	06.00
CH 807	Organic Synthesis	03.00	00.00	00.00	06.00
CH 821	Topics in Chemistry I	03.00	00.00	00.00	06.00
CH 825	New Interfaces of Inorganic Chemistry with Biology	03.00	00.00	00.00	06.00
CH 827	Inorganic Complexes	03.00	00.00	00.00	06.00
CH 829	Magnetochemistry	03.00	00.00	00.00	06.00
CH 831	Advanced Laboratory Techniques	02.00	00.00	04.00	08.00
CH 841	Biogenesis and Biosynthesis of Natural Products	03.00	00.00	00.00	06.00

Second Semester

Code	Name	L	T	P	C
CH 602	Characterization of Polymers	03.00	00.00	00.00	06.00
CH 802	Thermodynamics and Extra Thermodynamics Relations	03.00	00.00	00.00	06.00
CHS 802	Seminar II	00.00	00.00	00.00	04.00
CH 804	Pulse and FTNMR Theory and Techniques	03.00	00.00	00.00	06.00
CH 806	Molecular Photochemistry	03.00	00.00	00.00	06.00
CH 820	Structure Analysis by Diffraction Methods	03.00	00.00	00.00	06.00
CH 824	Organotransition Metal and n-accetor Ligand Complexes	03.00	00.00	00.00	06.00
CH 826	Topics in Chemistry II	03.00	00.00	00.00	06.00
CH 828	Spectra of Organic Compounds	03.00	00.00	00.00	06.00
CH 840	Enzymes and Co-enzymes	03.00	00.00	00.00	06.00
CH 842	Elements of Advanced Molecular Quantum Mechanics	03.00	00.00	00.00	06.00
CH 846	Atomic and Molecular Relativistic Quantum Mechanics	03.00	00.00	00.00	06.00
CH 864	Biopolymers	03.00	00.00	00.00	06.00

Course Contents

INSTITUTE CORE COURSES

CH 101 Chemistry - I   2 1 0 6

Failure of classical mechanics; uncertainty principle; wave nature of particle; Postulates of quantum mechanics and Schrodinger equation; interpretation of wave function, particle in a box; hydrogen atom; atomic and molecular orbitals. Structure, bonding and energy levels in molecules and solids. Intermolecular forces. State functions; entropy (S) and free energy (G); Relation between G and emf; calculation of S and G; fugacities activities and equilibrium constants. Rate laws and orders; steady state approximation; chain reactions (polymerisation and explosion); photochemical reactions; molecular reaction dynamics (activated complexes and potential energy surfaces and trajectories) Catalysis.

Texts/References

P.W.Atkins, Physical Chemistry, ELBS/Oxford, 7th Edition, 1995.
G.M.Barrow, Physical Chemistry, 5th Edition, Tata McGraw-Hill, New Delhi, 1992.
D.K.Chakrabarty, Physical Chemistry, Narosa, New Delhi, 1997.
B.H. Mahan and R.J.Myers, University Chemistry, 4th edition, Benjamin, California, 1987.
S.H.Maron and C.F.Prutton, Principles of Physical Chemistry, 4th Edition, Oxford & IBH, New Delhi, 1972.
H.V. Keer, A.Q. Contractor, B.L.Tembe (Editor), R. S. Singh, P. Mathur, G. K. Trivedi, M. Sharan, N. S. Punekar, et al ET-105 Part B, Chemistry (5 Blocks/booklets): Atoms and Molecules, Energetics and Kinetics, Equilibria and Electrochemistry, Inorganic Chemistry and Organic Chemistry. Written for the First Year B. Tech. Course of the Indira Gandhi National Open University, 1995
D.A.McQuarrie and J.D. Simon, Physical Chemistry - a molecular approach, Viva Books Pvt. Ltd. (1998)

CH - 102 Chemistry-II   2 1 0 6

Trends in the periodic table; metallurgy; basic principles and applications;purification of elements and metals; transition metal ions and complexes;coordination chemistry, redox chemistry, magnetochemistry,photochromisim,role of metal ions in biological processes; some relevant uses of transition elements; lanthanides,property trends in s- and p- block elements; liquid ammonia solutions; Grignard reagent; semiconducting and super conducting materials; silicones; silicates; zeolites; VSEPR; alkoxides; oxygen activation; nitrogen fixation; CFC's Teflon, spinel.

Structure and properties of organic molecules; relationship between shapes and properties of organic molecules a perspective. Physical properties intra and inter-class variations. Conformations of alkanes and cycloalkanes; configurations, molecular chirality, geometrical isomerism. Linear and cyclic conjugation, benzene,

aromaticity, properties of conjugated systems. Reactivity, reaction types, reaction mechanisms, reaction energetics and kinetics. Study of selected reactions and their mechanisms; nucleophilic substitution reaction, electrophilic and free radical addition reactions, electrophilic aromatic substitutions, nucleophilic addition; principles of nucleophilic addition to carbonyl groups; hydrolysis of ester and amides, their catalysis and significance; electronically excited states and photochemical reactions.Molecular systems of technological and biological importance. Fats and oils, amphiphilic molecules and their organization. Soaps and detergents.Amphiphilic in action and mechanism of detergent action. Synthetic and natural polymers, polymer properties, Biopolymers - polypeptides, cellulose and starch. Self Study: Sources of organic compounds, products from coal and petroleum. Nomenclature of organic compounds.

Texts/References

R.T. Morrison and R.N. Boyd, Organic Chemistry, Prentice Hall of India Pvt. Ltd., 5th edition,1990.
M.J.Sienko and R.A.Plane, Chemical Principles and Applications, McGraw Hill, 1980.
J.D.Lee, Concise Inorganic Chemistry, 4th Edition, ELBS, 1991.
D.D.Ebbing, General Chemistry, Houghton Miffin Co., 1984.

CH 115 Chemistry Lab.-I   0 0 1.5 1.5

Experiments illustrating the concepts of 1) galvanic cells,(2) thermochemistry, (3) Chemical kinetics, (4) equilibrium constant, (5) analysis by oxidation reduction titration.

CH 116 Chemistry Lab - II   0 0 1.5 1.5

Experiments pertaining to (1) volumetric analysis by complexometry, (2) analysis by ion exchange resins, (3) analysis of a drug, (4) organic/inorganic synthesis, (5) instrumental methods of analysis.

CS 101 Computer Programming and Utilization   2 0 2 6

Basic organization of computer and its functional units. Problem solving skills and algorithm design. Fortran programming language; control structures like selection,looping; modular design using functions & subroutines; basic data structuring concepts - arrays,strings; input output methods. Laboratory exercises will include assignments such as sorting, searching, matrix manipulation and problems from engineering domain.Time permitting, C or C++ may be introduced.

Texts/References:

Mayo,W.E. & Cwiakala,M."Programming with Fortran 77"Schaum's Outline Series,McGraw Hill, 1995.
Metcalf,M & Reid,J. "Fortran 90 explained" Oxford University Press, 1990.
Brainerd, W.S.; Goldberg,C.H.; Adams,J.C." Programmer's guide to Fortran 90". Intertex Pub.; New York, 1990.

HS-101 Economics   3 0 0 6

Basic economic problems. Resource Constraints and Welfare maximization. Nature of Economics: Positive and normative economics: Micro and macroeconomics, Basic concepts in economics. The role of the State in economic activity; market and government failures; New Economic Policy in India. Theory of utility and consumer's choice. Theories of demand, supply and market equilibrium. Theories of firm, production and costs. Market structures. Perfect and imperfect competition, oligopoly,monopoly. An overview of macroeconomics, measurement and determination of national income. Consumption, saving, and investment. Commercial and central banking. Relationship between money, output and prices. Inflation - causes, consequences and remedies. International trade, foreign exchange and balance payments, stabilization policies : Monetary, Fiscal and Exchange rate policies.

Texts/References:

P.A.Samuelson & W.D.Nordhaus, Economics, McGraw Hill, New York, 1995.
A.Koutsoyiannis,Modern Microeconomics,Macmillan, 1975.
R.Pindyck and D.L.Rubinfeld,Microeconomics,Macmillan Publishing Company,New York, 1989.
R.J.Gordon, Microeconomics 4th Edition, Little Brown & Co., Boston, 1987.
William F.Shughart II, The Organization of Industry, Richard D.Irwin,Illinois,1990.

HS 202 Introduction to Philosophy/Eng. Literature   2 1 0 6

The course will acquaint the students of science and engineering with some issues on the nature and methods of science and mathematics, and the ethical issues arising out of the application of science and technology. The objective is to develop a critical, reflective and historical awareness on the issues relating to the following topics:

Philosophy and History of Science: Growth of scientific knowledge: factors leading to the emergence of modern science. Conceptual evolution: internal and external history. Methodology of science: induction, falsificationism, confirmation and probability. Nature of scientific laws and theories: realism, instrumentalism and underdetermination. Relationship between scientific observation, experiment and scientific theory. Nature of scientific explanation: teleological explanations and the covering law model. Selected case studies on scientific theories.

Logic and the nature of mathematical reasoning: Inductive and deductive forms of reasoning. Nature of axioms: formal axiomaticsystems. Concept of consistency, independence and completeness. nature of rules of inference and proof. Selected examples of axiomatic systems and proof procedures.

Cognition: Current approaches to the understanding of mind and mental processes: empiricist, rationalist, behaviourist and cognitivist. Ethics: Impact of science and technology on man and society: elements of environmental and professional ethics.

Texts/References

A.C. Grayling (Ed.) Philosophy; A Guide through the subject, Oxford University Press, Londown, 1995.
Marx W. Wartofsky, Conceptual Foundations of Scientific Thought: An Introduction to the Philosophy of Science, Macmillan, London 1968.
I.B. Cohen, The Birth of a New Physics, Penguin Books, 1985.
H. Eves and C.V. Newsom, Foundations and Fundamental Concepts of Mathematics, Boston, PWS-Kart Pub. Co., 1990.
K.E. Goodpaster and K.M. Sayre (Eds.) Ethics and Problems of 21st Century, Univ. of Notre Dame Press, London, 1979.
S.D. Agashe, A. Gupta and K. Valicha (Eds.) Scientific Method, Science, Technology and Society: A Book of Readings, Univ. of Bombay Press 1980.

HS 203   Introduction to Sociology/Psychology   3 0 0 6

Understanding human experience and behaviour: Definition, schools, methods, branches and application of psychology for engineers; Measuring human abilities; Intelligence, Personnel testing; The individual working life: Personality - definition, approaches and theories; Psychological problems of everyday life: Stress and coping; Psychological disorders, work and mental health; Human learning; Motivation: the concept and theoretical framework, motivating people at work; Attitude and work behaviour, Group dynamism. Intergroup relations, conflict resolutions; Leadership and management.

Texts/References

MConnel, J.V. (1986) Psychology, New York: Holdt, Rinehart & Winston.
Morgan, C.T., King, R.A., Weiss, J.R., & Schopler, J. (1986). Introduction to Psychology (VIIth Ed.), New York: McGraw-Hill.
Myers, D.G. (1995). Psychology (IVth Ed.), New York: Worth.
Asch, S.E. (1987), Social Psychology, OUP Oxford.

HS 204 Introduction to Philosophy/Eng. Literature   3 0 0 6

Nature of Literature: Literature as a Humanistic Experience.

Definitions: (i) Humanities: Concern with culture, values, ideologies; (ii) Literature: Concepts of imitation, expression, intuition and imagination.

Major Themes of Literature: Nature, Science, Selfhood, Love, Rebellion. The concepts of Figurative language, Imagery, Symbolism, Style.

The Forms of Literature: Prose Narratives (short stories and novels), Poetry, Drama and Essays.

Note: (i) Suitable texts are to be chosen by the instructor from the Texts and References listed below as well as from other sources. (ii) Use of a Learner Dictionary (e.g. Oxford Advanced Learner's Dictionary is prescribed for language work).

Texts/References

David Murdoch (Ed.). The Siren's Song: An Anthology of British and American Verse, orient Longman, 1988.
S. Alter and W. Dissanayake (Eds.) The Penguin Book of Modern Indian Short Stories. Penguin Books (India), 1989.
Bertrand Russell, Impact of Science on Society. Allten and Unwin, 1952.
George Orwell, Animal Farm, Penguin, 1951.
J. Bronowski. The Ascent of Man, BBC, 1973.

HS 205 Introduction to Sociology/Psychology 3 0 0 6

What is sociology, some sociological concepts: Social structure, status, role, norms, values etc. Socialization, and culture and change. (6 lectures).

Social stratification - various approaches and concept of social mobility. (4 lectures).

Population and society - Trends of demographic change in India and the world; Human Ecology; Trends of Urbanization in the developing countries and the world.

Major social institutions - Family and marriage, caste and tribe; Organizations: (i) formal organization (bureaucracy) (ii) informal organization. (8 lectures).

Processes of social change - Modernization (including Sanskritization), industrialization, environmental/ecological changes and Development.

Social movements - protest movements, reformist movement and radical movements in India. (8 lectures).

Texts/References

L. Broom, P. Selznick and D. Dorrock, Sociology, 11th Edn. 190 (Harper International).
M. Haralambos Sociology: Themes and Perspectives, Oxford University Press, 1980.
M.S.A. Rao (Ed.) Social movements in India, Vols. 1-2, 1984, Manohar.
David Mandelbaum, Society in India, 1990, Popular.
M.N. Srinivas, Social change in modern India, 1991, Orient Longman.
Guy Rocher, A. General Introduction to Sociology, MacMillan, 1982.

MA 103 Mathematics I 2 0 2 6

Review of the prerequisities such as limits of sequences and functions,continuity, uniform continuity and differentiability. Rolle's theorem, mean value theorems and Taylor's theorem. Newton's method for approximate solution. Riemann integral and the fundamental theorem of integral and the fundamental theorem of integral calculus. Approximate integration. Applications to length, area, volume, surface area of revolution. Moments, centres of mass and gravity.

Review of vectors. Cylinders and quadric surfaces. Vector functions of one variable and their derivatives.

Partial derivatives. Chain rule. Gradient, directional derivative. Tangent planes and normals. Maxima,minima, saddle points. Lagrange multipliers. Exact differentials.

Repeated and multiple integrals with applications to volume, surface area, moments of inertia etc.

Texts/References

G.B.Thomas, and R.L. Finney, Calculus and Analytic Geometry, 6th ed., Addison-Wesley/Narosa, 1985.
T.M.Apostol, Calculus, Vol.1, 2nd ed., Wiley Eastern,1980.

MA 104 Mathematics II 3 0 2 8

Vector fields, surface integrals, line integrals, independence of path, conservative fields, divergence, curl. Green's theorem. Divergence theorem of Gauss, Stokes' theorem and applications of these theorems.

Transformations of coordinate systems and vector components. Invariance of divergence and curl. Curvilinear coordinates.

Vector spaces. Inner products. Matrices and determinants,linear transformations. Systems of linear equations. Gauss elimination,rank of a matrix. Inverse of a matrix. Bilinear and quadratic forms. Eigenvalues and eigenvectors. Similarity transformations. Diagonalization of Hermitian matrices.

Numerical methods for solving systems of linear equations. III-conditioning. Methods of Gauss and least squares. Inclusion of matrix eigenvalues. Finding eigenvalues by iteration.

Texts/References

E.Kreyszig, Advanced Engineering Mathematics, 5th ed., Wiley Eastern,1985.
V.Krishnamurthy, V.P.Mainra and J.L.Arora, An Introduction to Linear Algebra,Affiliated East-West,1976.
T.M.Apostol,Calculus,Vol.II,2nd ed., Wiley Eastern, 1980.

MA 203 : Mathematics III   3 0 2 8

Ordinary differential equations of the 1st order, exactness and integrating factors, variation of parameters, Picard's iteration method.

Ordinary linear differential equations of nth order, solution of homogeneous and nonhomogeneous equations. Operator method. Methods of undetermined coefficients and variation of parameters.

Systems of differential equations. Phase plane, Critical points. Stability.

Infinite sequences and series of real and complex numbers. Improper integrals. Cauchy criterion, tests of convergence, absolute and conditional convergence. Series of functions. Improper integrals depending on a parameter. Uniform convergence. Power series, radius of convergence.
Power series methods for solutions of ordinary differential equations. Legendre equation and Legendre polynomials, Bessel equations and Bessel functions of first and second kind. Orthogonal sets of functions. Sturm-Liouville problems. Orthogonality of Bessel functions and Legendre polynomials.

Laplace transform. Inverse transform. Shifting on the s and t axes, convolutions, partial fractions.

Fourier series, half-range expansions. Approximation by trigonometric polynomials. Fourier integrals.

Transform techniques in differential equations.

Texts/References

E. Kreyszig, Advanced Engineering Mathematics, 5th Ed., Wiley Eastern, 1985.
W.E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 3rd Ed., Wiley, 1977.
G.F. Simmons, Differential Equations with Applications and Historical Notes, Tata McGraw-Hill, 1972.

ME 111 Workshop Practice I   0.5 0 3 4

Introduction to wood working, kinds of woods, hand tools and machines,pattern making, types of patterns, contraction allowance, draft and machining allowances. Principles of moulding methods, cores and core boxes. Introduction to fitting shop tools, equipment and operations. Sheet metal practice. Exercises: Simple exercises in patternmaking, moulding, fitting and sheet metal work.

Text/Reference

S.K.Hajrachoudhury, Elements of Workshop Technology,Vol.I Asia Publishing House, 1986.

ME 112 Workshop Practice II   0.5 0 3 4

Introduction to safety measures, introduction to the principles of working, construction, operation, types of cutting tools, selection of cutting speeds and feeds etc. regarding basic machine tools e.g. lathe, shaping,slotting, milling and grinding machines, etc. Introduction to gas and arc welding processes, soldering and brazing.Exercise; Simple jobs on centre lathe and shaping machines and welding.

Demonstrations; Slotting,milling and grinding machines.

Text/Reference

S.K.Hajrachoudhury, Elements of Workshop Technology,Vol.II Asia Publishing House,1986.

ME-118 Engineering Graphics and Drawing   0 1 3 5

Introduction of drawing instruments, lettering, lines and dimensioning. Construction of simple geometrical figures. Simple orthographic projections, first and third angle. Missing views and lines. Isometric views. Free hand sketching. Projection of points and lines.Projection of planes and solids. Section of solids. Orthographic projections of simple machine elements like couplings, tool post, I.C. engine components etc. using half,full sections. Simple assembly and part drawings. Introduction to AutoCAD.

Reference/Books:

Engineering Drawing and Graphics,K.Venugopal,New Age International(P) Ltd., 1995.
Engineering Drawing,N.D.Bhatt and V.M.Panchal, Charotar Publishing House, Anand, 1996.

PH-101 Physics I   2 1 0 6

Physical quantities, dimensional analysis,velocity and acceleration in plane polar coordinates. Dynamics in non-inertial frame: linearly accelerating frames, rotating frame, centrifugal and Coriolis forces. Conservation of momentum : many particle system,collision in two dimensions, system with variable mass, principle of rocket motion. Motion of rigid bodies: kinematics of rigid body motion, Euler angles, fixed axis rotation, inertia tensor, motion of a symmetrical top. Special theory of relativity: Galilean relativity, Michelson Morley experiment, Fitzgerald contraction and time dilation,Lorentz transformation,Einstein's formulation of special relativity,space timeviewpoints,fourvectors.

Texts/References :

G. Basavaraju and Dipan Ghosh, Mechanics and Thermodynamics, Tata McGraw Hill, 1989.
D. Kleppner and R.J. Kolenkow, An Introduction to Mechanics, McGraw Hill, 1973.
M. Alonso and E.J. Finn, Fundamental University Physics, Addison-Wesley, 1980.

PH-102 Physics II   2 1 0 6

Electrostatics: Coulomb's law, Gauss's theorem, electric potential, Laplace's equation, Poisson's equation, electrostatics with conductors,capacitors dielectrics. Magnetostatics: Biot Savart's law, Ampere's law, Lorentz force. Magnetic Induction: Faraday's law, Lenz's law, self and mutual inductance, energy in a magnetic field, LCR circuit, resonance. Maxwell's equations: Displacement current, electromagnetic waves, Plane wave solutions of Maxwell's equation, Poynting vector, wave propagation through a boundary, reflection, refraction, absorption and skin depth.

Texts/References :

A.S. Mahajan and A. Rangawala, Electricity and Magnetism, Tata McGraw Hill, 1989.
D. Griffiths, Introduction to Electrodynamics, 2nd ed., Prentice Hall, 1989.

PH 115 Physics Lab.I 0 0 1.5 1.5

Error analysis and accuracy of measurement, linear regression. Selected experiments from the following : current and voltage sensitivities of a moving coil galvanometer, measurement of self inductance using Anderson's bridge, resistivity of a thermistor, Helmholtz coil. Fresnel biprism, dispersive power of a prism, Newton's rings. Young's modulus using Koenig's method, moment of inertia of a fly wheel, physical pendulum.

Text/Reference :

B.L. Worsnop and H.T. Flint, Advanced Practical Physics for students, Asia Publishing House, 1971.

DEPARTMENTAL OPTIONS

CE-102 Engineering Mechanics 2 1 0 6

Equivalent Force Systems: Basic concepts of force-couple systems,planar force systems; parallel force systems; simplest equivalent for general force system - "wrench", distributed force systems.

Equations of Statics and its Applications :   Simple frictionless rigid body assemblies; two-force members; machines; trusses; cables; rigid body assemblies including friction.

Virtual Work and Potential Energy Principles : Application of these principles as replacement of equations of statics for real life problems.

Vibrations : Equations of motion for single degree-of-freedom systems and rigid body assemblies; free vibration (simple harmonic oscillator); concepts of damping and critical damping; damped free vibration; equations of motion for harmonic excitation; transient and steady-state vibrations; illustration of MDOF systems concepts with two degree-of-freedom systems.

Texts/References :

I.H. Shames, Engineering Mechanics,Third Edition, Prentice Hall, India, New Delhi, 1990.
F.P. Beer and E.R. Johnston, Mechanics for Engineers, McGraw-Hill Book Co., New Delhi 1987.

MM 152 Materials and Technology   **2 1 0 6**

Materials Cycle and Materials Selection. Nature and Family of Materials. Processing and Structure of Solid Materials. Metallic Materials, Polymeric Materials, Ceramic Materials, Composite Materials, Electronic-related Materials, Corrosion and Degradation of Materials. Case studies in Materials Selection.

Texts/References

J.A. Jacobs and T.F. Kilduff, Engineering Materials Technology Structure, Processing, properties & Selection, Prentice-Hall Career and Technology, New Jersey, 2nd Edition, 1994.
C.Newey and G.Weaver,Eds.,Materials Principles and Practice,Butterworths,London, 1990.

PH 201   Physics IV (Introduction to Optics)   2 1 0 6

Wave nature of light, Fresnel's equations and their consequences. Spatial and temporal coherence, spectral resolution of a finite wave train, Fourier transform spectroscopy. Interference, Fraunhofer and Fresnel diffraction, interferometers, Polarization.

Propagation of light through matter, dispersion and absorption. Introduction to lasers.

Texts/References :

G.B.Fowles, Introduction to Modern Optics, Holt Rein hart and Winston, 1975.
M.Born and E.Wolf, Principles of Optics, McMillan, 1974.
S.C. Lipson and H. Lipson, Optical Physics, Cambridge Unversity Press, 1969

PH 205   Physics III (Quantum Physics and Applications)   2 1 0 6

Review of quantum concepts: particle nature of light, photoelectric effect, Compton effect, matter waves, wave packets, phase and group velocity, Davisson Germer experiment, Heisenberg uncertainty principle.

Schrodinger equation: probabilistic interpretation of wave function, one dimensional problems - particle in a box, harmonic oscillator, potential barrier and tunneling. Hydrogen atom, electrons in a magnetic field, Landau levels.

Elements of statistical physics : density of states, Fermienergy, Bose condensation.

Solid state physics : Free electron model of metals, classical and quantum Hall effect, superconductivity, London equation, coherence and penetration depth, flux quantization, applications of supervonductivity, SQUIDS.

Nuclear physics : binding energy, nuclear reactions, elements of nuclear reactor, fission and fusion, fundamental forces, elementary particles, quarks and leptons.

Texts/References

S.H. Patil, Elements of Modern Physics, Tata McGraw Hill, 1989.
H.S. Mani and G.K. Mehta, Introduction to Modern Physics, Affiliated East West, 1988.
A. Beiser, Perspectives in Modern Physics, McGraw Hill, 1969.
K. Krane, Modern Physics, 2nd ed., John Wiley, 1998.

BT 251 Introduction to Molecular Cell Biology   2 1 0 6

Biology and Bioprocess, Relevance to Society. Procaryotes and eucaryotes. Classification of microorganisms and important cell types. Structure of the bacterial cell. Organization of plant and animal cells, organelles; structure, chemical composition, function. Biomolecules: properties of water amino acids, proteins, carbohydrates, lipids and nucleic acids. Cellular processes: carbon and nitrogen cycle in nature, metabolic grid, clycolysis. TCA cycle and forms of energy in biology, Signal transduction; receptor concept, nature of ligand-receptor interactions. Information transfer in cells: Central dogma, DNA replication, RNA transcription genetic code and translation. Genetics and inheritance: chromosomes, Mendel's laws, phenotype and genotype, genetic diseases in humans. Special topics: Genetic engineering, Cell culture and the immune system.

Texts/References

B. Alberts, D.Bray. J.Lewis, M.Raff, K.Roberts and J.D. Watson (1989). Molecular Biology of the Cell. Garland Publishing, Inc. 2nd Edition.
E.J. Gardner, M.J. Simons and D.P.Snustad (1991). Principles of Genetics, Jonh Wiley & Sons, 8th edition.
D.Voet and J.G. Voet (1990). Biochemistry John Wiley & Sons.
L.Struer (1965). Biochemistry. W.H. Freeman and Company.

CH-351 Chemistry III   2 1 0 6

(Offered by Chemistry Dept. for 3rd year B.Tech.-Chemical Engg. Students)

Gas Chromatography, High Performance Liquid Chromatogrtaphy, Gel Permeation Chromatography, Ion and Affinity Chromatography, UV-Visible Spectroscopy, IR Spectroscopy, Fluorometry, Atomic Absorption and Flame Emission Spectroscopy, NMR and Mass Spectroscopy; Thermogravimetric, Differential Thermal Analysis and Differential Scanning Calorimetry, X-ray Diffraction, Voltametry, Surface Spectroscopy.

Text / References :

G.W.Ewing, "Instrumental Methods in Chemical Analysis", 5th Edition, McGraw-Hill, 1985.

D.A.Skoog and J.J.Leary, "Principles of Instrumental Analysis", 4th Editionl, Saunders College Publishing, 1992.

HS AND INSTITUTE ELECTIVES

HS 423 : Trends in Twentieth Century Drama 3 0 0 6

This course offers a comparative prospective on important trends in modern drama. Through highly participatory pedagogic methods, the students are encouraged to share their special interest in examining specific themes, techniques of theatre representation, acting and writing.

Definitions: The origin and function of drama. The connection between drama, literature, theatre, cinema and performing arts.

Historical over-view of various trends in the West: Naturalism in the plays of Chekhov, Ibsen Strindberg. Antinaturalistic movements such as expressionism of Luigi Pirandello, epic theatre of Bertolt Brecht, surrealism in the plays of Samuel Beckett, Ionesco. The rise of ritualistic, political theatre of Brook, Schechner, Akalitis.

Developments in Post independence Indian drama: Classical ritualistic theatre of Ramlila, Mahabharata etc. Intermediary or Political Folk drama, such as Jatra, Nautanki, Tamasha, Street Plays. Modern naturalistic drama of Badal Sircar, Mohan Rakesh, Vijay Tendulkar.

Texts/References

John Gassner (ed): A Treasury of Theatre: Modern European Drama Form Henrik Ibsen To Jean Paul Sartre Volume Two. Simon And Schuster. New York.
Peter Brook (Tr.): Mahabharata, Harper and Row, 1985.
Richard Schechner: Performative Circumstances from the Avant Garde to Ramlila, Seagull Publications, 1983.
Eric Bentley: The Playwright As Thinker, 1967.
Girish Karnad (Ed.): Contemporary Indian Theatre Interviews with Playwriters and Directors, Sangeet Natak Academi, 1989.

HS 424: Understanding Science and Technology Through Literature 3 0 0 6

This course intends to expose students of science and technology to the reflective views of creative writers. Individual student projects that examine attempts at the popularization of science through various modes of representation such as the printed word, television, cinema, theatre will be encouraged.

Discussion of illustrative literary works to highlight questions of selfhood, self and society, Nature and man/woman relationship that scientific revolution has intensified. Definitions of science, technology. Technology and the media revolution. Nature and natural sciences. Historical changes in the way science and technology are viewed by writers (men and women) in the West and the East. Faustian male archetypes, Feminist Pastoral archetypes.

Texts/References

C.P. Snow: The Two Cultures: And A Second Look. Cambridge University Press, 1964.
Kipphardt Heinar: In the Matter of J. Robert Oppenheimar Methuen. 1967.
Carolyn Merchant: The Death of Nature: Women, Ecology and the Scientific Revolution. Harper and Row, 1980.
Marshall Macluhan: Understanding Media: The Extensions of Man. New American Library 1964.
Walter Gratzer (ed): The Longman Literary Companion to Science, 1989.
Vandana Shiva: Staying Alive: Women, Ecology and Survival in India. Kali for Women, 1988.
Bronowski: The Ascent of Man. Little, Brown and Company, 1973.

HS 425 : Stress and Coping   3 0 0 6

Concept of stress-current and historical status. The nature of the stress response. Common sources of stress - biological. personality and environmental. Coping styles - defensive behaviours and problem-solving. Consequences of stress-medical, psychological and behavioural. The role of social support in mitigating stress. Stress management techniques-relaxation, meditation, cognitive restructuring, self-control, bio-feedback and time management. The students will prepare their stress profile.

Textbooks:

Walt, S. "Stress Management for Wellness". Harcourt Brace & Jovanovich, N.York, 1994.
D. Girdano and G. Everly., "Controlling Stress and Tension", Prentice-Hall, 1986.
A. Monat and R. Lazarus, "Stress and Coping: An Anthology", Columbia Univ. Press, 1985.
A. Weisman, "The Coping Capacity", Human Services Press, 1984.

HS 426 : Theory and Policy of Managerial Finance   3 0 0 6

Introduction to financial statements. Concepts of compounding and discounting, Valuation of securities.

Sources of finance - Trade credit. Bank finance. Term finance. Stock market. Dividend policy. Share valuation. Leverages. Theories of capital structure. Cost of capital.

Capital budgeting. Cash flow analysis. Methods of depreciation. Methods of capital appraisal. Risk and uncertainty in capital budgeting.

Introduction to working capital management. Issues in financial planning. Tax planning. Break-even analysis. International aspects of financial management. Foreign exchange Market. Exchange rates. Currency risks etc.

Texts/References:

R. Brealey and S. Myers, S., Principles of Corporate Finance, McGraw-Hill, 1987.
J.C. Van Horne, Financial Management and Policy, Prentice Hall, 1971.
L.M. Bhole, Financial Markets and Institutions, Second Edition, Tata McGraw-Hill, 1992.
Prasanna Chandra, Financial Management, Third Edition, Tata McGraw-Hill, 1993.

HS 427 : Essentials of Gandhian Political Economy   3 0 0 6

Meaning of Political Economy. Brief critique of mainstream economics. Gandhian approach to objectives of economic activity. Economics and ethics. Theory of consumption. Why and How of village reconstruction. Approach to agricultural and Industrial development. Economics of khadi. Concept of Swadeshi. Views on public finance and foreign trade. Views on Communism, Socialism, Co-operatives, Planning, and Technology. The Role of the State. Theories of trusteeship and decentralization.

Texts/References:

M.K. Gandhi, Industrial and Agrarian Life and Relations, Navajivan Publishing House, 1986.
A.T. Hingorani and G.A. Hingorani, The Encyclopedia of Gandhian Thought, Navajivan Publishing House, 1988.
J.C. Kummarappa, Economy of Permanence, Sarva Seva Sangh Prakashan, 1984.
Pyarelal, Towards New Horizons, Navajivan Publishing House, 1959.
E.F. Schumacher, Small is Beautiful, ABACUS Publications, 1974.
D.F. Ross and M.S. Kanthi, Gandhian Economics, Prasad Publications, 1983.

HS 429 : Sociology of Science   3 0 0 6

Socio-cultural bases of knowledge and science. Conceptions of science: positivistic, realistic, Weberian and forms of conventionalism.

Theory of scientific creativity: Mertonian normative structure of science (and Mitroff's counter norms), notions of creativity of Kuhn, Mulkay, Koestler and Holton.

Discoveries: singleton and multiples. scientism, anti-science movements, - views reflections and institutions, science and religion relations.

Socio-economic and cultural aspects of scientific and technological revolution.Science and technology, conceptual distinction reconsidered, and relations between science and technology.

References:

R.K. Merton, Sociology of Science, Theoretical and Empirical Investigations, University of Chicago Press, 1973.
R. Keat, and J. Urry, Social Theory as Science, Routledge and Egan Paul, 1975.
M.J. Mulkay, Science and Sociology of Knowledge, George Allen and Unwin, 1981.
R. Dahrendorf, et.al. (eds.), Scientific-Technological Revolution: Social Aspects, Sage Studies in International Sociology, 8, ISA, 1982.
W. Krohn, et.al. (eds.), The Dynamics of Science and Technology, D. Reidel Publishing Co., 1978.

HS 432 : An Introduction to the Sociology of Rural Development   3 0 0 6

Sociology of rural development: key sociological issues; modernization theories and theories of underdevelopment.

Rural development in India: A profile of the history of rural development in India; current experiences, programmes and achievements.

Cooperative movement and rural development; leadership and rural development; politics, power and rural development; bureaucracy and rural development, technology for rural development; implications for future.

Texts/References:

A. Webster, Introduction to the sociology of development, Macmillan, 1984.
S.R. Maheshwari, Rural Development in India: A public policy approach, Sage Publications, 1985.
G.R. Madan, T. Madan, Village development in India: A Sociological Approach, Allied Publishers, 1983.
A.R. Desai, Rural Sociology in India, Popular Prakashan, 1969.
T.K. Oommen, Social Transformation in Rural India: Mobilization and State intervention, Vikas Publishing House Pvt. Ltd., 1984.
Vasant Desai, Rural Development, Vols. V & VI Himalaya Publishing House, 1988.
Steve Jones, P.C. Joshi, and Mignd Murmis (ed.),Rural Poverty and Agrarian Reform, Allied Publishers Pvt. Ltd., 1982.

HS 433 : Man, Environment & Society   3 0 0 6

Dynamics of Man-Environmental relationship and societal change; Planning issues and sociological theory: Dialectics of spontaneity and planning in social development; Dialectics of Environmental crisis and crisis perception: Developmental issues in a comparative perspective - Central planning - Postscript to a debate; Free-enterprise strategy and the persistence of underdevelopment - Socialist planning - problems of planning and co-ordination, Modernization, societal transformation and environmental challenges.Environmental issues: rural-urban; crowding and human behaviour; urbanization and slum; poverty, unemployment, land issues; water resources and citizen's role; deforestation and societal impact; politics, power and environment.

Evaluation of environmental programmes, alternatives in development.

Texts/References:

Malcolm, Caldwell, The Wealth of Some Nations, Zed Press Ltd., 1977.
D'souza, Alfred (ed.). The Indian City: Poverty, Ecology and Urban Development, Manohar, 1978.
R.P. Misra, Development Issues of Our Time, Concept Publishing Company, 1985.
Hirsch, Fred, Social Limits to Growth, Routledge and Kegan Paul, 1977.
L.K. Caldwell, Environment, Anchor Books, 1970.
Cyril E. Black (ed.), Comparative Modernization, The Free Press, 1976.
Ulf Himmelstrand (ed.), Spontaneity and Planning in Social Development, Sage publications Ltd., 1981.

HS 440 : Industrial Economics   3 0 0 6

Industrialization: Problems and processes (rationale of industrialization); developing countries - Industrial policy and industrial licensing; Changes in the licensing Policy and procedure - tariffs and protection - capital market : structure, role and incentives- Industrial finance and growth: Banks and industrial finance: Industrial Development and finance corporations: IFCI; ICICI, SFCs, IDBI etc. - place and problems of small industries: definition, types and classification, structure and problems.

References:

S.C. Kuchhal, The Industrial Economy of India, Chaitanya Pub. House, 1990.
M.S. Gupta, and A. Singh, The Industrial Economy of India, Light and Life, 1980.
R. Dutt and K.P.M. Sundaram, Indian Economy, S. Chand and Co., 1988.
D.A. Hay, and D.J. Morris, The Industrial Economics: Theory and Evidence, OUP, 1979.
S.K. Ray, The Industrial Economy of India, Prentice Hall, EE Edition, 1987.

HS 442 : Logic and Foundations of Mathematics   3 0 0 6

History of the relation between logic and mathematics. Geometry and the axiomatic nature of mathematics.   Role of Logic and mathematics in science.

Syntax and semantics: formal systems. Example of first order language. Constructive problems in the notions of truth, model, consistency and completeness. Constructive criticisms of Godel's proof primitive Recursive Functions.

Foundations of Number theory, Axiomatic and constructive approaches, Cantorian set theory and paradoxes. The problem of infinity, Mathematical Induction, Infinite sets.

Brief survey of Platonism, Logicism, Formalism, Intuitionism, Conventionalism. Limitations of the formalist foundations and computability, Turing Machines, Markov Algorithms and Recursion theory.

Meaning and existence in mathematics; views of mathematicians and philosophers. Examples of constructive results.

References:

G.K. Kneebone, Mathematical Logic and the Foundations of Mathematics: An Introductory Survey, Van Nostrand, 1963.
Delong, Howard, A Profile of Mathematical Logic, Addison Wesle Publishing Co., 1971.
R.L. Wilder, Introduction to the Foundations of Mathematics, Second edition, John Wiley, 1965.
S.C. Kleene, Introduction to Meta-Mathematics, Van Nostrand, 1952.

HS 443 : Philosophy and History of Science   3 0 0 6

Development and growth of some of the major concepts, laws and theories from Babylonian astronomy to quantum theory by which physical scientists explain the phenomena of the external world. Use of selected case studies to stress the interconnection of concepts and conceptual schemes to experimentation and observation, the relation between observed data and theoretical concepts, the intellectual procedures of the working scientists, Social and philosophical ideas, growth of knowledge. Analysis of the role of experience, Logical thinking, and free imagination in science. In particular, geometry and mechanics are discussed as examples, with special emphasis on the distinction between empirical facts and the language by which those facts are described. The basic ideas of modern physics are presented with emphasis on the contribution they can make toward the solution of philosophic questions, such as the status of theoretical terms, models, theories, the nature of time, space, causal and statistical law, and the conflict between philosophical creeds like materialism, idealism, pragmatism etc.

The views on science: the Received View, Popper Kuhn, Lukatos, Feyerabend, Toulmin. The growth of scientific knowledge. The nature of social science. The nature of general laws, theories and explanation in social science. The problems in developing a science of human behaviour.

References:

J.B. Conant, Harvard Case Histories in Experimental Science, Harvard University Press, Vol.I and II, 1948.
Suppe, Frederick, The structure of Scientific Theories, Second Edition, of Illinois Press, 1977.
T. Kuhn, The Structure of Scientific Revolution, University of Chicago, 1962.
S.D. Agashe, A. Gupta and K. Valicha, (eds.), Science, Technology and Social Change, Univ. of Bombay, 1980.
G.C. Homans, The Nature of Social Sciences, Harcourt Brace, and World, Inc., 1967.

HS 457 : Managerial Economics   3 0 0 6

Nature and scope of Managerial Decisions. Objectives of firms. Techniques of analyses with special reference to econometric method. Analysis of demand pattern - demand forecasting. Production function and production planning - cost and product relationships cost function. Break-even-point analysis. Pricing and price related policies. Labour productivities and wages. Optimization problems. Introductory aspects of capital budgeting. Selected case studies under Indian conditions.

References:

A.S. Goldberger, Topics in Regression Analysis, Macmillan, 1969.
W.W. Haynes, W.R. Henry, Managerial Economics - Analysis and Cases, Business Publications, Ind., Third Edition, 1974.
V.L. Mote, S. Paul, G.S.Gupta, Managerial Economics - Concepts and Cases, Tata McGraw-Hill Publishing Co. Ltd., 1977.
T.V.S.R. Rao, Econometric Analysis of Managerial Decisions, Oxford and IBH, 1978.
O.P. Chopra, Managerial Economics, Tata McGraw-Hill Publishing Co. Ltd., 1984.

HS 463 : Introduction to Art and Aesthetics   3 0 0 6

The aim of this course is to introduce the students to some of the basic issues pertaining to art through exposure to different art-media and art-works. The emphasis will be on critical analysis of art-works and aesthetic ideas, with special reference to literature and music. The following problems will be treated as central:

What is art? Concepts of Imitation. Symbolization, Expression, Configuration.

What is aesthetics? Theorizing about art and its relevance to creation, appreciation and criticism of art.

Art and life: (a) art and society (Marxist approach); (b) art and psyche (Freudian approach).

Art as an autonomous activity: art and form.

What is aesthetic response? Rasa-theory and emotionality; detached contemplation.

Texts/References:

M. Rader (ed.), A Modern Book of Aesthetics: an anthology, Holt, Rinehart and Winston, 1973.
J. Hospers (ed.), Introductory Readings in Aesthetics, Free Press, 1969.
J.B. Patankar, Aesthetics and Literary Criticism, Nachiketa Publications, 1969.
V. Raghavan, and Nagendra (eds.), An Introduction to Indian Poetics, Macmillan 1970.
H. Osborne, Aesthetics and Art Theory: an historical introduction, Dutton, 1970.

HS 464 : Science, Technology and Society   3 0 0 6

The course focuses on analysing issues relating to the impact of technology on society from perspectives of the disciplines of economics and philosophy.

The economics component discusses technical change at the firm level and the economy level using tools and concepts of economics. Major emphasis is on two areas:

(a) Industrial R & D and innovation and their contribution to growth in productivity and output; (b) Select problems of current interest in India such as modernisation, employment and equity, technological options, Science and technology planning for national development and governmental policies on science and technology.

The philosophy component studies the concepts of science and technology; man and nature; tradition, culture and society; social, cultural and other factors and their bearing on the growth of science and technology; technological change and social institutions, values; technological development and human welfare, choice of technology policy.

Texts/References:

J. Schumpeter, The Theory of Economic Development, Oxford University Press, 1989.
P. Stoneman, The Economic Analysis of Technological Change, Oxford University Press, 1983.
C. Mitcham, and R. Mackey, (Eds.), Philosophy and Technology, Free Press, 1972.
N. Cross, D. Elliot, and R. Roy, (Eds.), Man-Made Futures, Hutchinson Educational and Open University Press, 1974.

HS 466 : Introduction to Linguistics   **3 0 0 6**

The scientific study of language as it has developed in the twentieth century has vital links with many other modern theories and disciplines which include the communication sciences and the systems approach. This course is an introduction to the science of language, called linguistics. It deals with the structure and function of language, with particular attention to Noam Chomsky's 'generative' model. The following topics will be discussed:
Language and communication: animal and human communication; artificial and natural languages; social functions of language.

The 'science' of language: language as a system; levels of linguistic structure; the 'generative' model of Chomsky.

Evolution and variation of language: historical change; geographical variation; social variation.

Language and mind: language and thought; language and the brain; language acquisition and child language.

Texts/References:

N. Chomsky, Reflections on Language, Fontana, 1975.
N. Chomsky, Rules and Representations, Basil Blackwell, 1980.
N. Smith and D. Wilson, Modern Linguistics the results of Chomsky's revolution, Penguin, 1979.
D. Bolinger, Aspects of Language, Harcourt, Brace and World, 1968.
J. Lyons, Introduction to Theoretical Linguistics, Cambridge, 1969.

HS 467 : Indian Philosophy   3 0 0 6

A study and examination of the logical, epistemological and ethical problems in the classical schools of Indian Philosophy, science and metaphysics in ancient India. The course will emphasize the insights of ancient Indian thinkers and their perennial preoccupation with issues centering on man and his being in the world in society.

Texts/References:

M. Hiriyanna, The Essentials of Indian Philosophy, Allen and Unwin, 1967.
S. Radhakrishnan, Indian Philosophy, 2 Vols. Allen and Unwin, 1966.
S. Radhakrishnan and C.A. Moore, (Eds.) A Sourcebook in Indian Philosophy, Princeton Univ. Press, 1967.
Pappu S.S. Rama Rao (Ed.), Indian Philosophy Past and Future, Motilal Banarasidas, 1982.

HS 468 : Philosophy of Religion   3 0 0 6

Science and Religion. Analysis and understanding of "religion" from different standpoints. Arguments for and against the existence of God. Historical religions, Mysticism and Occultism. Nature of man's reference to God. Religious experience and religious language. Theistic Existentialism. Hermeneutics and religious frames of reference.

Texts/References:

John Hick (Ed.), Classical and Contemporary Readings in the Philosophy of Religion, Prentice-Hall,Inc., 1969.
Winston, L. King, Introduction to Religion - A Phenomenological Approach, Harper and Row, 1970.
Baruuch Brody (Ed.), Readings in the Philosophy of Religion, Prentice-Hall, Inc., 1974.
Robert Hall (Ed.), Studies in Religious Philosophy, American Book Co., 1969.
Harris R. Raine (Ed.), Neoplatonism and Indian Thought, State University of New York Press, 1982.

HS 475 : Perspectives on Economic Development   3 0 0 6

The classical, extended Keynesian and Schumpeterian theories of economic development and empirical evidence - poverty, inequality, and employment - controversies on policy options: planning versus the price mechanism, sectoral balance versus priorities, foreign trade or import substitution, active or passive monetary and fiscal policies, labour-intensive versus capital-intensive technologies.

The students will be encouraged to do assignments using Indian data.

References:

B. Herrick and C.P. Kindleberger, Economic Development, The McGraw-Hill Book Company, 1983.
D. Lal, The Poverty of Development Economics, Harvard University Press 1985.

HS 477: Principles of Management   3 0 0 6

The growth of management as a science. Contributions of Taylor, Fayol, Gilbreth, Bernard and Drucker. The functions of a manager. Planning - its nature and objectives, types of plans, long range planning, management by objectives (MBO) and   making planning effective. Organising-departmentalisation, decentralisation. Staffing - selection and recruitment, appraisal, management development. Leading and directing - leadership, motivation and communication. Controlling - its nature, techniques, management synthesis.

References:

H.Weihrich & H. Koontz, Management a Globalperspective, McGraw Hill, 1993.
J.L. Massie, Essentials of Management, Prentice-Hall, 1992.

S. Robbins, Management: Concets and Practices, Prentice Hall, 1984,
F.A. Menzes, Cases in Management, Tata McGraw, 1977.

HS 478 : Industrial Sociology   3 0 0 6

Types of productive systems - the rise of factory system. Importance of human Relations
at work and various experiments to bring out human factor at work. The concept of
organization - structure of and principles of organizations both formal and informal.

Industrial bureaucracy - society of inequals.
Executives - roles functions and strains.
Specialists, supervisory levels and white collared workers - roles, strains.
Workers in modern society - roles, alienation, embourgeoisoment.
Trade union as an instrument of power.
Automation and its impact on industry.

Texts/References:

E.V. Schneider, Industrial Sociology, McGraw-Hill, 1982.
D.C. Miller and W.H. Form, Industrial Sociology, Harper and Row, 1980.
S.R. Parker, R.K. Brown and others, The Sociology of Industry, George Allen and
Unwin, 1970.
J.H. Goldthorpe, et.al., The Affluent worker in the class structure, Cambridge University
Press, 1989.

HS 480 : An Organizational Psychology Approach to Engineering   3 0 0 6
         Management

The course is intended to provide specific managerial skills and would also help
engineers to understand the management processes and thus improve their adjustment in
organizations.

Defining engineering and management in industrial organization. Conflict in the role
model of engineers and managers -- resolution, and implications for productivity and
effectiveness. Concepts of product development and technical feasibility vis-a-vis
consumer utility and market feasibility. Interpersonal skills and engineers' job induced
attitudes: its managerial implications.
Overview of organizational psychology in engineers management: Basic concepts of
perception, attitudes, belief and values in organizational behaviour. Personality types and
social stereotypes of engineers. Engineers value and organizational value; dissonance
and congruence; its managerial implications. Interpersonal skills; older engineers;
problem of aging, experience, and technical obsolence -- coping.

Types of organizational structure and communication in functionally differentiated, product oriented and matrix organization. Participative management and its relations to productivity and innovativeness.

Engineers' selection and placement -- techniques and practices; Training -- technical training, on the job training, managerial training. Career path -- in production, R & D, sales and marketing departments. Performance appraisal. Compensation -- financial and non-financial.

Project groups : Venture analysis; budgeting and planning; small group dynamics; bureaucracy versus convergent and divergent thinking.

Management styles: a cross-cultural perspective -- Western thoughts, Japanese management style and evolving Indian -- ethos and management.

Texts/References:

A. Shapero, Managing Professional People: Understanding Creative Performance, Free Press, 1985.
R.E. Shannon, Engineering Management, Wiley, 1980.
E.P. Hawthorne, The Management of Technology, McGraw-Hill, 1978.
W.A. Gee and C. Tyler, Managing Innovation, Wiley, 1976.

HS 481: Psychology in Executive's Self Management   3 0 0 6

The course purports (i) to make participants aware of the effect of individuals' cognitive and emotional processes on personal effectiveness, (ii) to help them learn use of special psychological techniques at personal level in work place.

Basic concepts; Scope of self management; self appreciation and well being. Self concept: Product and procedure of experience; its relation to sense of well being. Self Theory: Karen Horney, Carl Roger and Erich From. Self and attribution process in social learning theories. Exercise: Understanding self profile and personal values.

Management of executives' cognitive process: Usage of memory techniques in -- names, personal information, conversation and meetings. Human intelligence and creativity; concept of convergent thinking and divergent thinking. Left and right brain throries. Usage of rational reductionist mode and insightful intuitive mode in problem solving. Exercise: Rational approach to problems and creative approach to problems.

Management of executives' emotion: Concept of emotion, meaning and appreciation of anxiety, shyness, frustration, loneliness, conflict, aggression-hostility. Exercise: Emotion in Communication.

Person-environment and interpersonal context: Behaviour modification, social and interpersonal skill: Survey of blocks to self management. Exercise: training lab; and self-awareness groups.

References:

G. Egan, Interpersonal Living: A Skill/Contract Approach to Human-Relations Training in Groups. Brooks/Cole Publishing Co., 1976.
D.P. Elkins (Ed.), Self Concept Source Book: Ideas and Activities for Building Self-Esteem, Growth Associates, 1979.
A.S. Brown, Maximizing Memory Power: Using Recall in Business, John Wiley and Sons, Inc., 1987.
B. Goss, and D. O'Hair, Communicating in interpersonal relationships, Macmillan Publishing Co., 1988.

HS 482 : Communication Skills   3 0 0 6

The aim of this course is to equip the students of science/technology with basic Communication Skills.

The process of communication. Barriers to communication. Overcoming the barriers to communication.

Effective verbal communication. Public speaking. Oral presentation. Group discussion. Facing the personal interview. Practice sessions.

Effective written communication. Reports. Business letters. Exercises.

Effective use of the English Language. Elements of Style. Pronunciation - practice in the Language Laboratory.

References :

Bill Scott, Communication for Professional Engineers, Thomas Telford Ltd., 1984.
John M. Lannon, Technical Writing, Little Brown and Co., 1985.
William Strunk Jr., The Elements of Style, 3rd edn., Macmillan Publishing Co., 1979.

HS 483 : Introduction to Logics and their Automation   3 0 0 6

Classical Logic: Truth functions, Propositional arguments, Characteristic matrices, Decision methods, Natural deduction, Sequent calculus, Axiomatic approach, Quantifier calculus.

Modal Logic: As an extention of classical logic, Modal operators and modal systems, Natural deduction in modal logics.

Relevance Logic: Criteria of relevance, axiomatics, and semantics.
Automated theorem proving in these logics.

Texts :

Susan Haack, Philosophy of Logics, Cambridge University Press, 1978.
Handbook of Philosophical Logic; Vols.1, 2 and 3; D. Gabbay and F. Guenthner (eds.), D. Reidel Pub. Co., 1983.
P.B. Thistlewaite et.al., Automated theorem providing in Non-Classical Logics, Pitman, 1988.

HS 484 : International Finance and Monetary System   3 0 0 6

Open economy macroeconomics and balance of payments, components of balance of payments, disequilibrium in balance of payments, and the need for adjustment and/or financing. Approaches to balance of payment adjustment: Monetary, Income.

Elasticities and absorption approaches. Exchange rate as an instrument of adjustment. Basic exchange rate concepts: spot vs. forward; real vs. nominal; fixed vs. flexible. Models of exchange rate determination; current account vs. capital account models.

A historic perspective of International Monetary systems of the post world war era; Bretton Woods system and the Managed Floating regime. Exchange Rate arrangements, supply of reserve assets, adjustment mechanisms in these systems. Relative roles of gold, national and supranational currencies (Special Drawing Rights and European Currency Unit) in the provision of international liquidity.

Provision of short run and long run (development) finance by international agencies. The role of International Monetary Fund (IMF), and World bank and other institutions in providing financial assistance to LDCs. Petrodollars and their recycling. Eurocurrency system. The third world and debt trap.

References:

A. Crockett, International Money: Issues and Analysis, ELBS & Nelson, 1982.
P. Hallwood, and R., MacDonald, International Money: Theory, Evidence and Institutions, Basil Blackwell, 1986.
M.Levi, International Finance, 2nd Edition, Tata McGraw-Hill, 1990.
F.L. Rivera-Batiz and L. Rivera-Batiz, International Finance and Open Economy Macroeconomics, Macmillan Pub.Co., 1985.

HS 485 : Management of Human Resources in Organizations   3 0 0 6

This course is designed to understand the personal and interpersonal behavioural problems people face within the organization. It also intends to highlight the techniques of organizational behaviour through which the human resource potentialities of the personnel can be effectively utilized and developed for their self and organizational development.

An introduction of the personal and interpersonal dynamics of the organization - Managing high performance: A challenge - Work motivation: Theoretical and behavioural framework. Improving work motivation in organizations.

Human Resources Development (HRD); Behaviour scientist's view. Human capacity: Physical and psychological - Building management, decision, interpersonal and goal setting skills - The functions of HRD and Personnel Department.

Organizational change and development - Organizational development (OD): Brief historical presentation. OD techniques: T group and sensitivity training, management by objectives (MBO), transactional analysis (TA), quality circles (QC), performance appraisal (PA), and training programmes. Managing human resources and organizational development: The present status.

Texts/References:

C.R. Anderson, Management: Skills, Functions, and Organizational Performance, Wm. C. Brown, 1984.
W.L. French, C.H. Bell, and R.A. Zawacki, Organizational development: Theory, Practice and Research, Irwin, 1989.
P. Hersey and K.H. Blanchard, Management of Organizational Behaviour: Utilizing Human Resources. Prentice-Hall, 1988.

HS 486 : Theory of Sets and Multisets   3 0 0 6

Philosophical aspects of the concept of Set, Cantorian (Intuitive) set theory, Russell's endeavour and culmination into axiomatics.

Axioms of general set theory: Extensionality (concept of equality and the theorem of equality), Elementary sets (empty set, Singletons, and pair set), Comprehension (Set Construction) and its ramifications, Union (intersection and complementation), Power set (enlarging the universe of sets), Infinity (larger and larger sets), Replacement (functional relativization), and Regularity (foundation).

Finite and Infinite sets, Schroeder-Bernstein theorem, Countability, Cardinals, hierarchy of infinities, and Continuum hypothesis.

Concept of partial and total orderings, maximal and minimal elements, Lattices and Boolean algebra, Zorn's lemma, similarity mappings and order types, well ordering, Ordinals, initial segments, Burali-Forti paradox, Principle of transfinite induction, Axiom of Choice (AC), Construction of choice functions, some applications and equivalence of AC. Multisets and their applications (in computer science).

Texts :

D. Van Dalen, Sets: Naive, Axiomatic, and Applied, Pergamon, 1978.
A. Levy, Basic Set Theory, Springer-Verlag, 1979.

D.E. Knuth, Seminumerical Algorithms: The Art of Computer Programming, Vol.2 (Second edn.), Addison-Wesley, 1981.
A. Fraenkel, et.al., Foundations of Set Theory (New Edition), North-Holland, 1974.

HS 487 : Planning and Economic Policies in India   3 0 0 6

1. Introduction: A chronological survey of Indian Plans.

2. Theoretical underpinnings of India's Planning Models.

3. Objectives of economic planning in India - Growth, Price stability, Employment generation, Poverty alleviation, Sustainable balance of payments, etc.

4. A historical perspective on the economic policies implemented in India (during the post-independence period) to achieve the goals of planned economic development: Monetary and fiscal policies; Industrial policy; Foreign trade and exchange rate policies; Price and wage policies, etc.

5. A critique of Indian planning and policies in the light of the select macroeconomic indicators such as: (i) Growth rate(s); (ii) Inflation rate(s); Unemployment levels; (iii) Incidence of poverty; and, (iv) External payments position.

6. Planning versus privatisation: Lessons from other country experiences.

References

Bagchi, A. and Banerjee, N. (Eds.), Change and Choice in Indian Industry, K.P. Bagchi & Co., Calcutta, 1982.
Brahmananda, P.R. and Panchmukhi, V.R. (Eds.), The Development Process of the Indian Economy, Himalaya Publishing House, Bombay, 1987.
Chakravarty, S., Development Planning: The Indian Experience, Clarendon Press, Oxford, 1987.
Lucas, R.E.B., and Papanek, G.F. (Eds.), The Indian Economy: Recent Developments and Future Prospects, Oxford University Press, Delhi, 1988.
Rudra, A., Indian Plan Models, Allied Publishers, 1975.
Joshi, V., & Little, I.M.D., India: Macroeconomics and Political Economy, 1964-1991, Oxford University Press, Delhi, 1994.

HS 490 : Organizational Behaviour and Implications for Management   3 0 0 6

This course is designed for the final year engineering students. It has four interrelated goals. The first is to make the prospective engineers familiar with the basic concepts of organizational behaviour. Second is to introduce the management and behaviour sciences theories alongwith their application for managing people at work. The third is to introduce major components of American and Japanese management. Finally, an attempt will be made to critically examine all management strategies of organizational behaviour in reference to Indian organizations. The course will be of help in applying engineering

knowledge more effectively in the field of business management and entrepreneurship development.

Course content

An Introduction of Organizational Behaviour. Historical development and basic concepts. Understanding a social system. Mainsprings of motivation. Human needs and motivating employees. Interpreting motivational models of Maslow, Herzberg, Vroom, and McClelland. Job satisfaction and work performance. Appraising and rewarding performance. Leadership and organizational development. Supervision and participation, Interpersonal and communication problems within the organizations. Organizational Development : A brief introduction and theoretical development. Organizational Development Techniques : Their applications in Indian Organizations. Japanese Management : Basic philosophy and features. Comparative analysis of American and Japanese management. Organizational behaviour in perspective.

Books

Davis, K. Human behaviour at work: Organizational behaviour. NY: The Groller Business Library, 1987.
Luthans, F. Organizational behaviour. NY: McGraw, 1995.
Hersey, P. & Blanchard, K.H. Management of organizational behaviour: Utilising human resources. New Jersey: Prentice-Hall, 1988.

HS 492 : Management by Values   3 0 0 6

Objectives

The course is based on the premise that values are germane for effectiveness of managers in industrial organisations, and these are unique to every society. Currently there is a legitimate and growing interest in discovering the 'Indianness' of Indian management. These efforts are based primarily on empirical studies of various categories of successful Indian enterprises. This course attempts to analyze the Indian organization today. It also studies how the values of the Indian manager affects his performance. Emphasis on individual values would be given, as organisational values stem from individual values. The course attempts to teach Indian students that it is from the depth of inner-silence that they could derive their power to 'vision, lead and build.'

Course outline

Values for Indian Managers. Anatomy of Ethico-Moral Management, from self to SELF: The Ascent from Pettiness to Dignity. Appraisal of Management by Values Programmes. Socio-cultural Change and the Managers' Travails. Social Values and Individual Attitudes. Work-Ethic. India's Vision of Humanism. Hierarchism as an Organisational Value. Rediscovering Indian Psychology for Managers. Leadership Modelling. Mental Health of a Manager.

References

Chakraborty, S.K., Management by Values: Towards Cultural Congruence, Oxford University Press, 1991.
Chakraborty, S.K., Managerial Effectiveness and Quality of Work Life - Indian Insights, Tata McGraw Hill, 1987.
Monappa, A., Ethical Attitudes of Indian Managers, All India Management Association, 1972.

HS 601 : Development, Planning And Policies: Issues and Alternatives   3 0 0 6

History of Idea of development - Issues and alternative strategies in development- Man in capitalist society other than capitalist diagnoses and answers - Beyond the State and Market- Man's needs - Roads to sanity, survival and sustainable development. Perceptions of Indian thinkers on developemt and planning such as Dadabhai Naoroji, B.G. Tilak, M.G. Ranade, R.C.Dutta, M.N. Roy, P.C. Ray, D.D. Kosambi, M. Bhabha, V. Sarabhai, P.C. Mahalnobis, M.K. Gandhi, Jawaharlal Nehru, J.R.D. Tata etc.

Meaning, nature and the scope of planning-concepts and techniques and strategies of planning- Input-Output Models and Linear Programming Technique- Planning in India-Evaluatation of Indian Plan models and performance of planning in India. Planning versus privatisation- Experiences of the erstwhile Centrally Planned Economies. Perspectives on Socio-economic policies in India-Population policies - mobilisation of resources- Monetary and fiscal policies-Rural development and Agricultural policies-policies for the upliftment of weaker sections-industrial policies-foreign trade and exchange rate policies, etc.

Text/References

Eric Fromm, The Sane Society, Fawcet, Premier, New York, 1955.
Bhabhatosh Datta, Indian Economic Thought, 1900-1950, Tata McGraw Hill, New Delhi, 1978.
J.P. Sharma (ed. Individuals and Ideas in Modern India, FIRMA,KLM, Calcutta, 1982.
Bhiku Parekh, Colonialism, Tradition and Reform, Sage, New Delhi, 1989.
R.E.B. Lucas and G.F. Papanek (eds.), The Indian Economy :Recent Developments and Future Prospects, Oxford Univesity Press, New Delhi, 1988.
Ashok Rudra, Indian Plan Models, Allied Publishers, 1975.
S. Chakravarty: Development Planning: The Indian Experience, Clarendon Press, Oxford, 1987.
R.M. Sundarum, Growth and Income Distribution in India: Policy and Performance since Independence, Sage, New Delhi, 1987.
C.T. Kurien, Growth and Justice, Oxford University Press, Madras, 1992.

BM 402 Neurophysiology and Motor Control   3 0 0 6

Functional organization of the nervous and muscular system. Methods of investigation of

nerve an muscle function. Electrical and mechanical signal acquisition and analysis: principles and techniques.

Cellular aspects of neuronal activity. Models of neuronal excitability and activity. Transmission of signals within nerve cells and across junctions. Neuroeffector transmission.

The Sensory systems. Overall organization. Transduction properties of the sensory pathways. Sight, audition, somatic sensation, taste, smell, signalling in the sensory afferent nerves. Central sensory areas: decoding of afferent signals, information processing, neural networking.

The motor systems. Motor nerves and pathways Skeletal muscle. Somatic motor function: the reflex arc, muscle spindle organs, negaice, feedback and servo control of muscle. Motor units: the eletromyogram. Central nervous control of somatic motor function. Neuromuscular disease.

Neuroendocrine controls. Regulation of endocrine organs by nerves; neurohumoral secretions. Clinical aspects.

Texts/References:

Kuffler S Martin AR & Nicholas J From Neuron to Brain, 2nd Edition, Sinauer, 1984.
Kandel Er & Schwartz L Principles of Neural Science. 2nd Edition, Elsevier, 1989.
Brown A G Nerve Cells and Nervous Systems. Narosa Publishers, 1991.
McGregor RJ & Lewis ER Neural Midekkubg. Plenum, NY, 1977. Stein JF Neurophysiology. Oxford University Press, 1982
Ruch R & Patton D Physiology and Biophysics. Academic Press, 1965

CE 466 Computatiional Mechanics :An Introduction   2 0 2 6

Physical problems and their classification. Boundary, initial and eigen value problems. Examples of continuum mathematical model-unsteady and steady quasiharmonic, wave and diffusion equations.

Finite element discretization procedure-basic concepts, methods of weighted residuals, development to finite element programs and computer implementation. Some discussion on finite element versus other discredization procedures.

Texts/References

E. Becker, G.F. Carey and J.T. Oden, Finite Elements - An Introduction, Prentice Hall, N.J. 1918.
O. Fried, Numerical Solution of Differential Equations, Academic Press, N.Y., 1979.

EE 663 Thin Film Components and Circuits   3 0 0 6

Impact of microelectronics. Theoretical foundations of vaccum techniques. Production and measurement of high vaccum. Preparation and characterization of thin films. Design of lumped and distributed thin film circuit components. Thin film transistors and superconducting devices.

Texts/References :

R.W. Berry, P.M. Hall and M.T. Herris, Thin Film Technology, Van Nostrand, 1970.
L.I. Maisell and R. Glang, Handbook of Thin Film Technology, McGraw Hill, 1973

EN 402 Introduction to Energy Engineering   2 1 0 6

Prerequisite : Nil

Energy resources of India, availability and utilisation of modern resources, viz, coal, petroleum, gaseous fuels, hydel and nuclear fuel, traditional resources, viz. firewood, cattledung, animal power and solar sources.

Principles of energy conversion, heat engines, thermal power plants using coal, petroleum nuclear power plants using coal, petroleum nuclear fuels and hydel energy, fundamentals of energy conversion using solar thermal, photovolatic, fuel cell, biogas, firewood, wind mini-hydel and tidal resources.

Investments for resource development cost and effeciences of motive and thermal power generation and consumpotion, etc., environmental effects of energy use.

Strategy for energy development in India, problems and prospects of centralised and decentralised patterns, potential for blomass and biogas system.

Texts/References

M. Khovakh Ed., Motor Vehicle Engines Mir Publishers, Moscow, 1979
D.M. Simmons, Wind Power Noyes Data Corporation, New Jersey, 1975.
S.P. Sukhatme, Solar Energy, Principles of Thermal Collection and Storage, Tata Mcgraw-Hill, New Delhi, 1984
J.J. Duderstadt, Nuclear Power, Marcel Dekker, New Jersey, 1979.
P.J. Meynel, Methane Planning a Digester Prism Press, United Kingdom, 1976
E.Mosinye, Water Power Plants, Akademiai Kiado, Budapest, 1963.

ES 400 Environmental Science and Engineering   2 1 0 6

Prerequisite : Nil

Environment, Environmental quality and degradation, description of environment setting, principles and procedures for environment impact assessment policies and acts, prediction and assesment of impacts on specific environments e.g.

Biological: Basics of Ecology, Biological setting, Critical impacts.

Water: Identification of water pollutants, water quality and management criteria, wastewater characteristics, treatment and removal.

Air: Identification of air pollutants, air quality, air pollution dispersion potential, mesoscale and mocroscale impacts, abatement strategies, analysis and treatment of gaseous and particulate pollutants, recovery and recycling of effluents.

Noise: Noise standards and criteria, effects and control.

Cultural : Basic Information on culturak resources, mitigation measures, case studies.

Socio-Economic : Identification of critical socio-economic factors, prediction and significance of inpacts.

Text/References

L.Canter, Environmental Impact Assessment, McGraw-Hill, 1977.
E.P. Odum, Fundamentals of Ecology, V.B.Saunders and Co. 1974
W.J. Weber, Physics-Chemical Processes for Water Quality Control, Wiley-Inter Sc. 1969.
L.L.Ciaccio Water and Water Pollution handbook Marcel Dekker, New York, 1972.

ES 402 The Terresterial Biosphere: Physical and Societal issues.   3 0 0 6

Humans and Nature: Population, Resources, Environmental Degradation Basic Concepts Matter Energy Resources, Soil Water, Food, Land Resources etc., Impacts on Local and Global Climate.

Renewable and Nonrenewable Energy Sources.

Pollution, Environment, Health and Risk: Air Pollution, Water Pollution, Pesticides and Pest Control.

Environmental and Society: Economics and Environment, Politis and Environment, World Views, Ethics and Environment.

References

Living in the Environment by G. Tyler Millr, J.R. Wordsworth Publishing Co.
Race to Save the planet-study Guide by Edward C. Wolf Wordsworth Publishing Co., 1990
Race to Save the Planet-Viewers Guide by Donald B. Conroy, Wordsworth Publishing Co. 1990
The Global Ecology Handbook by Water H. Corson, Beacon Press, 1990.

MA 406 : Abstract Algebra I   3 1 0 8

Prerequisite : MA 401 (Exposure)

Review of groups, subgroups, homomorphisms. Solvable groups, Sylow subgroups.

Rings, ideals, quotient rings. Euclidean, principal ideal domains, unique factorisation domains.

Extension fields, splitting fields, fundamental theorem of Galois theory. Constructibility by ruler and compass. Solvability by radicals. Structure of finite fields.

Lattices, Boolean algebras, structure of finite Boolean algebras. Stone representation theorem.

Texts/References :

I.N. Herstein, Topics in Algebra, Wiley-Eastern, 1987.
K.D. Joshi, Foundations of Discrete Mathematics, Wiley Eastern, 1989.
N. Jacobson, Basic Algebra, Vol. I, Hindustan Publishing Corpn., 1984.

ME 462 : Appropriate Technology   2 1 0 6

Introduction to appropriate technology, concepts, criteria and methodology, choice of technology, case studies.   Technological alternative for energy and other specific applications. Technological need assessment. Scanning spectrum of technology-case studies.

Text/Reference :

Nicolas Jequier, Appropriate Technology- Problems and Promises, 1976.

ME 474: Investment Analysis and Securities Markets   2 1 0 6

Preliminary considerations in portfolio management, financial statements and their utility, debt structure, ploughback and accounting practices, mechanics of trading in a stock exchange, long buying, short selling and effect on price movements, technical factors and charts.

Trade cycles, market indicators, climate for particular industries,comparison of salient features of prospects of the company, management quality, information system analysis, liquidity in individual markets and scrips.

Psychological factors in securities markets, strategies adopted by the operators. Timing investment and disinvestment, bargain hunting. The broker and his role, procedural considerations, irregularities in the markets. Taxation and legal considerations.   Formula plans, alternative approaches, formulation of individual strategy. Other avenues for investments parallel with the economy.

Texts/References :

N.J. Yasaswy, Equity Investment Startegy. Hyderabad Investment and Financial Consultancy Services P. Ltd.
S.L.N. Simha and others, Investment Management, Institute for Financial and Management Research, Madras ,1979.
M. Mendelson and S.Robbins, Investment Analaysis and Securities Markets, Basic Books NY 1976.
R.K. Piparaiya, The Money Game, by IBH,1982.
U.L. Gupta, Working of Stock exchange in India Thomson Press (I) New Delhi - 72.
K. Doodha, Working of Stock Exchanges in India, Bombay University, 1962.

MT 604 Corrosion: Process and Control   3 0 0 6

Dry corrosion-dxidation characteristics of metals, alloys and composite materials at elevated temperatures. Review of the remedial measures for the control of corrosion at high temperatures. Wet corrosion. Pourbaix and Evans diagrams. Corrosion couples. Stress corrosion.
Corrosion fatigue, Intergranular corrosion. Pitting corrosion and its induction time.

Cathodic inhibitors. Analysis of anodic polarization curves and their use in corrosion control. Corrosion protection and control methods. Instrumentation and experimental techniques.

Text/References:

N.D. Tomashov, Theory of Corrosion and Protection of Metals, Macmillan, 1967.
M.G. Fontana and N.D. Greene, Corrosion Engineering, McGrawHill, 1967.

PH 400 Lasers   2 1 0 6

Electric and magnetic dipole transtions. Einsteein's transition probabilities. Lifetime and collision broadening of atomic transitions. Doppler broadening. Master amplification. Rate equation for atomic transtitions. Microwave solid state measers. Optical resonators and lens waveguides. Lasers and their general characteristics. Resonant cavities and laser modes. Different types to lasers. Sample applications (scientific and technological).

Texts/References:

B.A.Lengyel, Introduction to Laser Physics, Wiley Interscience 1971.
A.E. Siegman, An Introduction to Laser and Masers, McGraw Hill 1971.
W.V. Smith and P P Sorokin, The Laser McGraw Hill.

PH-426 : Astrophysics   2 1 0 6

Spectral Classification of stars, electro-magnetic spectrum, Doppler shift, flux and intensity, Planck's radiation formula, thermal equilibrium and Boltzman factor, Saha - Boltzman ionization equation.

Astronomical scale, units of steller brightness, radius of star, effective temperature.

Equation of state for stellar atmosphere, sources of continuous spectrum, opacity, equation of radiative transfer, abundance of elements, variation of abundances and isotope ratios.

Structure equations, mode of eneryg transport, nuclear reactions, Structure equations, mode of energy transport, nuclear reactions, forma-tion and evolution of stars, white dwarves, neutrons stars and Black holes.

Interstellar matter, 21 cm and molecular lines.

Galaxies and Quasers.

Cosmology : The origin of the universe - steady state vrs. big bang theory.

Text/Reference

E.V.P. Smith and K.C. Jacobs, Introductory Astronomy and Astrophysics, W.B. Saunder, 1973.
T.L. Swihart, Astrophysics and Stellar Astronomy, John Wiley, 1968.
J.V. Narlikar, Structure of the Universe, Oxford University Press, 1977.

SC 404 Methods for Systems Analysis II   2 1 0 6

Prerequisite: Nil

Stochastic Processes, Spectral Analysis, Random differential equations. Statistical Synamics of System. Optional Stochastic Systems, Markov and Semi Markov decision processes.

Courses offered

by

the Department of Chemistry

DEPARTMENTAL COURSES

PREPARATORY COURSES

CH 001 : Preparatory Chemistry I   **3   2   0**

General introduction: Formula, stoichiometry, molarity, molality, normality, applicationns of these concepts.

Gases: Boyle's law, Charles' law, PV=nRT and applications : Dalton's law of partial pressure, Graham's law of diffusion, kinetic theory of gases (physical concept) and applications in problems solving.

Chemical Equilibrium - Ionic Equilibrium: Law of mass action, reversible reaction, equilibrium constant for homogeneous annd heterogeneous reactions, effect of pressure, volume and concentration of reactants and products on equilibrium,effect of temperature on equilibrium constant. Dissociation constants of acids and bases, common ion effect, ionisation constant of water, pH, buffer solutions and hydrolysis of salts. Solubility product and its application to chemical analysis. Determination of K_a, K_b, K_w and K_{sp} by conductance measurements. Colligative properties, Fractional distillation, phase diagrams.

Thermodynamics: First law of thermodynamics, reversible work, irreversible work, isothermal and adiabatic, thermochemistry, Hess's law, bond energy. The entropy concept.

Chemical Kinetics: Rate expression, order and molecularity, first order reaction, half life period, radioactive carbondating, Arrhenius equation activation energy and catalysis.

Electrochemistry: Faraday's laws of electrolysis, galvanic cells, electrode potential and electrode reactions of simple electrode processes.

Atomic Structure and Periodic classifications: Spectra of H-atom, Bohr's model of H-atom, wave nature of electron, atomic orbitals, shapes of s,p, and d orbitals, quantum numbers, Pauli Principle, Hund's Rule, electronic configuration of elements upto Krypton, periodic classification of elements. Solids.

Texts/References

G.M. Barrow, Physical Chemistry, 5th Edition, Tata McGraw-Hill, New Delhi, 1992
S.H. Maron and C.F.Prutton, Principles of Physical Chemistry, 4th Edition, Oxford & IBH, New Delhi, 1972.

CH 002 : Preparatory Chemistry II   **3 2 0**

Inorganic Chemistry

Periodicity in Properties: Ionization potential, electron affinity, ionic radii and electronegativity. Chemical Bonding: Ionic solids, Born-Haber cycle, covalent bonds, dipole moment, resonance, hybridization, geometry and shape of simple molecules. Coordinate Bond hydrogen bond.

Chemistry of p-block and d-block elements:

Halogens; Periodicity of properties, preparation and uses of halogens and hydrogen halides. Oxides and oxyacids of chlorine.

Introduction to transition elements; oxides and oxyacids of sulphur, nitrogen and phosphorus.

Isolation of Metals; Extraction of Mg, Al, Zn, Cu and Fe.

Preparation and Properties of chemical compounds of industrial importance : Caustic soda, sodium carbonate, bleaching powder, superphosphate, gypsum alum, aluminium, chloride. Copper sulphate,silver nitrate, ammonia and ammonium sulphate.

Organic Chemistry

Classification and nomeclature of compounds. Empirical and molecular formula determination, isomerism. Electronic effects, resonance and inductive effects. Acidity of carboxylic acids and phenols, basicity of amines.
Covalent bond, types of hybridization in carbon compounds. Heterolysis and homolysis of covalent bonds - nucleophiles and electrophiles. Reactions of alkanes, alkenes and alkynes.
Characteristic reactions of common functional groups like alcohols, aldehydes, ketones, acids, esters and amines.
Difference between aliphatic annd aromatic compouds. Benzene and electrophilic substitution.

Texts/References

R.T.Morrison abd R.N. Boyd, Organic Chemistry, Prentice Hall of India Pvt. Ltd., 5th edition, 1990.
J.D.Lee, Concise Inorganic Chemistry, 4th Edition, ELBS, 1991.
Basic Inorganic Chemistry, Second edition, F.Albert Cotton, Geoffray Wilkinson, Paus G.Gans, John Wiley & Sons, 1987.

CH-011 : Preparatory Chemistry Laboratory I   0 0 3

Practical exercises :

Experiments related to -
1. Acid-base titration.
2. Redox titration
3. Chemical Equilibrium
4. Ionic Equilibrium
5. Solubility Product
6. Chemical kinetics
7. Electrochemistry.

CH-012 : Preparatory Chemistry Laboratory II   0 0 3
1. Qualitative analysis of anions and cations.
2. Detection of elements- N, S, halogens
3. Separation and purification methods.
4. Melting point and boiling point determination.

CH 101 Chemistry - I   2 1 0 6

Failure of classical mechanics; uncertainty principle; wave nature of particle; Postulates of quantum mechanics and Schrodinger equation; interpretation of wave function, particle in a box; hydrogen atom; atomic and molecular orbitals. Structure, bonding and energy levels in molecules and solids. Intermolecular forces. State functions; entropy (S) and free energy (G); Relation between G and emf; calculation of S and G; fugacities activities and equilibrium constants. Rate laws and orders; steady state approximation; chain reactions (polymerisation and explosion); photochemical reactions; molecular reaction dynamics (activated complexes and potential energy surfaces and trajectories) Catalysis.

Texts/References

P.W.Atkins, Physical Chemistry, ELBS/Oxford, 5th Edition, 1995.
G.M.Barrow, Physical Chemistry, 5th Edition, Tata McGraw-Hill, New Delhi, 1992.
D.K.Chakrabarty, Physical Chemistry, Narosa, New Delhi, 1997.
B.H. Mahan and R.J.Myers, University Chemistry, 4th edition, Benjamin, California, 1987.
S.H.Maron and C.F.Prutton, Principles of Physical Chemistry, 4th Edition, Oxford & IBH, New Delhi, 1972.
H.V. Keer, A.Q. Contractor, B.L.Tembe (Editor), R. S. Singh, P. Mathur, G. K. Trivedi, M. Sharan, N. S. Punekar, et al ET-105 Part B, Chemistry (5 Blocks/booklets): Atoms and Molecules, Energetics and Kinetics, Equilibria and Electrochemistry, Inorganic Chemistry and Organic Chemistry. Written for the First Year B. Tech. Course of the Indira Gandhi National Open University, 1995

D.A.McQuarrie and J.D. Simon, Physical Chemistry - a molecular approach, Viva Books Pvt. Ltd. (1998)

CH 102   Chemistry-II   2 1 0 6

Trends in the periodic table; metallurgy : basic principles and applications;(Ellingham diagram); purification of elements and metals; transition metal ions and complexes: Valence bond theory, Crystal field theory and their applications (stability, stereochemistry, spectroscopy, magnetic and redox properties and spinel structures); Introduction to general role of metal ions in biological processes; General properties of s- and p- block elements and their compounds ; shapes of molecules; some relevant uses of inorganic materials including superconductors, sheet silicates, zeolites, silicones, carboranes,CFC's Wilkinson's and Zeigler-Natta catalysts; Metal induced activation of small molecules (H_2, N_2, O_2).

Structure and properties of organic molecules : a perspective. Conformations of alkanes and cycloalkanes, configuration, molecular chirality, geometrical isomerism. Linear and cyclic conjugation, aromaticity; properties of conjugated systems. Reactivity, reaction types, reaction mechanisms, reaction energetics and kinetics. Study of selected reactions with mechanisms, nucleophilic substitution reaction, electrophilic and free radical addition reactions, electrophilic aromatic substitutions, nucleophilic addition to carbonyl groups, electronically excited states and photo_ chemical reactions. Molecular systems of technological and biological importance. Fats and oils, soaps, amphiphilic molecules and their organization, mechanism of detergent action; Synthetic and natural polymers, polymer properties; Biopolymers-polypeptides, cellulose and starch.

Texts/References

R.T. Morrison and R.N. Boyd, Organic Chemistry, Prentice Hall of India Pvt. Ltd., 5th edition,1990.
M.J.Sienko and R.A.Plane, Chemical Principles and Applications, McGraw Hill, 1980.
J.D.Lee, Concise Inorganic Chemistry, 4th Edition, ELBS, 1991.
D.D.Ebbing, General Chemistry, Houghton Miffin Co., 1984.

CH 115 : Chemistry Lab -I   0 0 1.5 1.5

Experiments illustrating the concepts of 1) galvanic cells, (2) thermochemistry, (3) chemical kinetics, (4) equilibrium constant, (5) analysis by oxidation reduction titration.

CH 116   Chemistry Lab -II   0 0 1.5 1.5

Experiments pertaining to (1) volumetric analysis by complexometry, (2) analysis by ion exchange resins, (3) analysis of a drug, (4) organic/inorganic synthesis, (5) instrumental methods of analysis.

CH 206 Principles of Chemical Analysis,Inorganic Chemistry Lab-I   1 0 4 6

Basic concepts of quantitative analysis, methods of sampling, errors in chemical analysis of data, general theory of neutralisation, redox, precipitation and complexometric titrations. Solubility product and precipitation, organic precipitants and extractants. A brief survey of separation methods: solvent extraction and chromatography.

Inorganic Semi-micro qualitative analysis involving 4 radicals. Volumetric analysis involving redox, precipitation and complexometric titrations. Gravimetric estimation of metals. Analysis of alloys and minerals.

Texts :

D.A. Skoog, D.M. West and F.J. Holler, Analytical Chemistry: An introduction, sixth edition, Saunders College Publisher, 1994.
G.H. Jeffery, J.Bassett, J.Mendham and R.C. Denny; Vogel's Text book of Quantitative Chemical Analysis, fifth edition, ELBS, 1991.

CH 210   Inorganic Chemistry I   2 1 0 6

Introductory survey of transition elements with reference to electronic configuration, oxidation states, complex compounds. Introductory concepts of molecular symmetry. Spectral and magnetic properties. Introduction to theories of metal-ligand bonding and stereochemistry. Chemistry of titanium, vanadium, chromium, manganese sub-group elements, iron, cobalt, nickel, platinum metals, copper and zinc sub-group elements, group III, IV, V, VI, VII and rare gases with reference to isolation, properties, uses and important compounds.

Texts/References

F.A.Cotton and G. Wilkinson, Basic Inorganic Chemistry, Wiley Easter, 1978.
M.J.Sienko and R.A. Plane, Chemical Principles and Properties, McGraw Hill, 1975.
J.D. Lee, Concise Inorganic Chemistry, Van Nostrand Reinhold, 1977.

CH 214 Physical Chemistry-II   2 0 0 4

Electrochemistry of solutions : Ion-solvent interactions, ion-ion interactions, macro molecule-ion interactions, ionic migration and diffusion. Thermodynamics of galvanic cells : Equilibrium electrode potentials, IUPAC convention for electrode potentials, classification of electrodes. Origin of emf and classification of electrochemical cells. Redox equilibria in bioenergetics and metabolism. Pourbaix diagrams and their application in corrosion.

Texts/References :

L.I. Antrapov, Theoretical Electrochemistry, Mir Publishers, 1972.
J.O'M. Bockris and A.K.N. Reddy, Modern Electrochemistry, Vo. 1, Plenum Press,1970.
P.W. Atkins, Physical Chemistry, 6th Ed., Oxford University Press, 1998.

CH 215   Physical Chemistry Lab -I   0 0 4 4

Potentiometry, Electrode potentials, activity coefficient, titration/s, solubility product.Condutometry, titration/s, dissociation of weak acid as a function of concentration.Ionization constant by spectrophotometry, enzyme kinetics, use of immobilized enzyme electrode, adsorption isothem, M.O. methods in chemistry .

CH 217   Physical Chemistry I   **2 0 0 4**

Contents:

Real gases, critical phenomena, intermolecular forces, potential energy functions, liquid state, thermodynamics of solutions, non-ideal solutions, solutions of macromolecules, colloidal solutions, phase rule and phase equilibria.

Texts/References :

G.W. Castellan, Physical Chemistry, 3rd Ed. Addison - Wesley/Narosa Publishing House, 1993.
P.W. Atkins, Physical Chemistry, ELBS / OUP 4th Edition, 1991.
G.N.Lewis and Randall Thermodynamics, (Revised by K.S.Pitzer
and L.Brewer), International Students Edition, McGraw Hill, 1961.

CH 221   Organic Chemistry-I   2 1 0 6

Systematic study of structure, properties and chemistry of hydrocarbons with emphasis on theoretical, stereochemical and mechanistic concepts.

Texts/References

R.T. Morrison and R.N. Boyd, Organic Chemistry, 6th Ed., Prentice Hall, 1992.
T.W.G. Solomons, Fundamentals of Organic Chemistry, 5th Ed., John Wiley, 1992.

CH 222 Organic Chemistry -II   2 1 0 6
Prerequisite : CH 221

Chemistry of heterofunctional organic compounds. Systematic Study of structure, properties and chemistry of heterofunctional organic compounds with emphasis on theoretical, stereochemical and mechanistic concepts.

Text/Reference

R. T. Morrison and R.N. Boyd, Organic Chemistry, 6th Ed.,Prentice Hall, 1992.

T.W.G. Solomons, Fundamentals of Organic Chemistry, 5th Ed., John Wiley, 1992.

CH 316   Inorganic Chemistry Lab -II   0 0 4 4

Complex material analyses: minerals/ alloys. Quantitative estimations using conductometry and spectrophotometry.   Estimation of iron in iron ore. Estimation of mixture of metal ions by EDTA titrations. Karl-Fischer Titration.

CH 317   Organic Chemistry Lab -I   0 0 4 4

Determination of physical constants, purifi-cation of solids and liquids and methods of checking their purity. Separation of enantiomers and measurements of optical rotation. Studies of electrophilic/nucleophilic substitution reactions, redox reactions.

Texts/References

R.M. Roberts, J.C. Gilbert, L.B. Rodeward and A.S. Wingrove, Modern Experimental Organic Chemistry, Holf-Saunders Intnl.Edn., 4th Edn., 1985.

CH 318 Organic Chemistry Lab -II   0 0 4 4

Qualitative analysis of organic compounds. Chemical separation of binary mixtures and their qualitative analysis.

Texts/References
R.L. Shriner, R.C. Fuson and D.Y. Curtin,
Systematic Identification of Organic Compounds, a lab. manual, 6th ed. Wiley, New York.

CH 338 Physical Chemistry Lab. - II   0 0 4
Phase equilibria, viscosity and molecular weight of polymers, surface tension, reaction kinetics (rates, order of reaction, influence of ionic strength), use of thermocouples, transition temperature determinations, self generated experiment.

CH-351 Chemistry III   2 1 0 6

Gas Chromatography, High Performance Liquid Chromatogrtaphy, Gel Permeation Chromatography, Ion and Affinity Chromatography, UV-Visible Spectroscopy, IR Spectroscopy, Fluorometry, Atomic Absorption and Flame Emission Spectroscopy, NMR and Mass Spectroscopy; Thermogravimetric, Differential Thermal Analysis and Differential Scanning Calorimetry, X-ray Diffraction, Voltametry, Surface Spectroscopy.

Text / References :

G.W.Ewing, "Instrumental Methods in Chemical Analysis", 5th Edition, McGraw-Hill, 1985.

D.A.Skoog and J.J.Leary, "Principles of Instrumental Analysis", 4th Editionl, Saunders College Publishing, 1992.

CH 418   Organic Chemistry Lab.III   0 0 4 4

Chemical separation of ternary organic mixtures and characterization of the components. Simple one or two step prepara- tions involving different techniques. Isolation of natural products.

CH 419   Separation Techniques Lab.   0 0 4 4

Separation by Soxhlet and liquid-liquid extraction. Cation and anion exchange chromatography, column, thin layer and paper chromatography, gas-liquid and gel permeation chromatography. Fractional distillation.

Texts/References

B.L. Karger, L.R. Snyder and C. Horvath, An Introduction to Separation Science, John Wiley and Sons, Inc., 1973.
J.A. Dean, Chemical Separation Methods, Van Nostrand Reinhold, 1970.
D.J. Pasto and C.R. Johnson, Organic Structure Determination, Prentice Hall, 1969.

CH 423   Organic Chemistry-III   2 1 0 6

A reappraisal of structure, stereochemical principles, properties and reactivity in organic compounds. Study of the following classes of reactions, nucleophilic substitutions, eliminations, electrophilic additions, electrophilic and nucleophilic substitution in aromatic compounds, nucleophilic addition, halogenation, and alkylation of carbonyl compounds. Reactions involving enamines, ester enolates and active methylenes.

Chemistry of conjugated dienes, enones. Pericyclic reactions, FMO theory. Photochemical reactions. Aliphatic and aromatic nitro and amino compounds. Oxidation and reduction reactions.

Texts/References

R.T. Morrison and R.W. Boyd, Organic Chemistry, 5th Ed., Wiley Eastern, 1992.
J. March, Advanced Organic Chemistry, 3rd Edn. McGraw Hill,1991.
S.H.Pine, Organic Chemistry, 5th Edn., McGraw Hill, 1987.
F.J. Carey and R.J. Sundburg, Advanced Organic Chemistry, Part A and Part B, 2nd Edn. Plenum Press, 1983.

CH 424   Organic Chemistry-IV   2 1 0 6

Introduction to heterocyclics and their importance. Nomenclature of ring systems, structure, reactivity and synthesis of reduced three, four, five and six membered oxygen, nitrogen and sulphur heterocyclics; aromatic heterocyclics, 5-membered, 6-membered and polyhetero ring systems - indole, azoles and diazines. Constitution and configuration of simple sugars, chemical reactions of monosaccharides and their cyclic anomers.

Texts/References

R. K. Bansal, Heterocyclic Chemistry, Synthesis, Reactions and Mechanisms, Wiley Eastern Ltd., 1990.
J.A.J. Joule and G.F. Smith, Heterocyclic Chemistry, ELBS, 2nd Ed., 1982.
F.G. Riddell, The Conformational Analyis of Heterocyclic Compounds, Academic Press, 1980.
L.A. Paquette, Principles of Modern Heterocyclic Chemistry, W.B. Benjamin, Inc., 1978.
B.M. Acheson, An Introduction to the Chemistry of Heterocyclic Compounds, Interscience, 2nd Ed., 1975.

CH 425   Chemical Bond and Molecular Geometry   2 1 0 6

Postulates of quantum mechanics; hermitian operators; complete set. Derivation of the uncertainty relations. Exactly solvable problems, orbital angular momentum, and the hydrogen atom. Spin, spin orbitals, and characteristics of a many-electron wave function.

Variation theorem, variation method, the linear variation method, and the non-crossing rule. Applications: Many-electron atoms, self-consistent field, atomic orbitals, Slater Type Orbitals, Slater exponents and the periodic properties of elements; LCAO-MO, Hückel orbitals; Born-Oppenheimer approximation, Potential energy surface, Hellman-Feynman theorem; Hydrogen molecule ion, Hydrogen molecule; Qualitative molecular orbitals for homo- and hetero-nuclear diatomics, isoelectronic principle, hybrid orbitals, and Walsh molecular orbital diagram.

Time-independent perturbation theory - Rayleigh-Schrödinger formulation. Applications: Zeeman effect, Stark effect, crystal field splitting, and simple ligand field treatments.

The valence bond treatment of hydrogen molecule; Resonance; Polarity and dipole moment; Electronegativity; Valence-bond wave functions for polyatomic molecules.

Texts/References

R. McWeeny, Coulson's Valence, Oxford University Press, 1979.
D. A. McQuarrie, Quantum Chemistry, Oxford University Press, 1983.
I. R. Levine. Quantum Chemistry, Prentice Hall India (Ltd), 1995.
S. N. Datta, Lectures on Chemical Bonding and Quantum Chemistry, Prism Books, 1998.

CH 426   Rate Processes   2 1 0 6

Rates of chemical reactions, rate expressions. Methods of determining rates and orders of reactions. Complex reactions. Collison and transition state theories of chemical reaction rates. Potential energy surfaces and reaction dynamics. Application to unimolecular and bimolecular reactions. Homogeneous catalysis, chain reactions. Photochemical reactions. Fast reactions. Diffusion in solids, liquids and solutions. Chemical oscillations and nonlinear dynamics.

Texts/References

K.A. Connors, Chemical Kinetics : A Study of Reaction Rates in Solution, V.C.H. Publications 1990.
J.I. Steinfeld, J.S. Francisco and W.L. Hase, Chemical Kinetics and Dynamics, Prentice Hall 1989.
K.J.Laidler, Chemical Kinetics, 3rd ed. Harper and Row, 1987.
R.D.Levine and R.B.Bernstein, Molecular Reaction Dynamics and Chemical Reactivity, Oxford University Press, 1987.
J.W. Moore and R.G. Pearson, Kinetics and Mechanisms, John Wiley and Sons, 1981.

CH-427 Chemical and Statistical Thermodynamics   2 1 0 6

Thermodynamic functions.   Partial molal quantities. Phase equilibria. Non-ideal solutions. Mixing and excess functions. Chemical equilibria. Ensembles, MB, BE and FD distributions. Partition functions and their relationships to thermodynamic functions and equilibrium constants. Virial   coefficients.   Introduction to non-equilibrium thermodynamics. Onsager's reciprocity relations.

Texts/References

P.W. Atkins, Physical Chemistry, 4th & 5th Eds.,1993.
K.S. Forland, T. Forland annd S.K. Ratkje, Irreversible Thermodynamics, Theory and Applications, John Wiley,1988.
G.W. Castellan, Physical Chemistry, 3rd Ed.,Narosa Pub- lishing House, 1985
R.S. Berry, S.A. Rice and J. Ross, Physical Chemistry, John Wiley, 1980.
F.T. Wall, Chemical Thermodynamics, W.H.Freeman and Co., 1965.
G.N.Lewis, M. Randall, K.S. Pitzer and L. Brewer, Thermodynamics, McGraw Hill,1961.
T.L. Hill, Statistical Thermodynamics, Addison Wesley,1960.

D.A. McQuarrie and J.D. Simon, Physical Chemistry - a molecular approach, Viva Books Pvt. Ltd. (1998)

CH 429   Modern Methods of Analysis   **2 1 0 6**

Evaluation of reliability of analytical data and statistics in chemical analysis. Expression of results to significant   figures. Sampling and preparation of sample for analysis.Introduction to optical methods, ultraviolet, visible, infrared spectrophotometry and fluorimetry. Atomic absorption and flame emission spectroscopy. Scattering of radiation, nephelometry, turbidimetry and Raman Spectroscopy. Electroanalytical methods such as voltammetry, polarography, amperometry, conductometry and high frequency titrations. Thermogravimetry and differential thermal analysis. Introduction to interphase separations with special reference to chromatography. Gas chromatography and HPLC.

Text References

G.W.Ewing, Instrumental methods of chemical analysis, 5th Edn., McGraw-Hill, 1985.
H.H.Willard, L.L.Merrit, J.A. Dean and F.A. Settle, Instrumental Methods of Analysis, 6th Edn., Van Nostrand Reinhold, 1980.
H.A. Laitinen and W.A. Harris, Chemical Analysis, 2nd Edn. McGraw-Hill, 1975.

CH 432   Inorganic Chemistry Lab.III   0 0 4 4

Complexometric titrations by masking and demasking reactions. Estimations by nephelometry,fluorimetry,simultaneous   spectrophotometry,   atomic   absorption sepectroscopy. Determination of composition of complexes in solution. Synthesis and characterization of transition metal complexes (including organometallic compounds) and their study by spectral, magnetic and thermal methods.

CH 434   Physical Chemistry Lab.III   0 0 4 4

Determination of the following physical quantities : partial molal volumes, dipole moments, activities by freezing point, quantum yields, heats of vaporisation and depressions of freezing points of solutions, velocity constant and activation energy. Electrodes with different substrates for H_2 evolution, photoelectrochemical solar cells. Vacuum measurement. IR spectrum of HCl, Use of M.O. theory, solution of Schrodinger equation for polyatomics.

CH 437 Chemistry of Transition Elements   2 1 0 6

General chemistry of the transition elements, lanthanides and actinides including atomic nuclei and nuclear reactions, coordination chemistry including theories of metal-ligand bonding, spectral and magnetic properties, organometallic compounds of transition elements, role of transition metal ions in biological processes.

Texts/References

F.A. Cotton, G. Wilkinson, C.A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, Wiley Eastern, John Wiley, 6th Ed., 1999.
J.E. Huheey, E. Keiter and R. Keiter, Inorganic Chemistry, 4th Ed., Harper Collins College Publisher, 1993.
D.Banerjea, Inorganic Chemistry Principles, Books Syndicate Pvt. Ltd., 2000
N.N. Greenwood and E.A. Earnshaw, Chemistry of Elements, Pergamon Press, 1989

CH 438   Chemistry of Main Group Elements   2 1 0 6

Chemistry of non-transition elements, stereochemistry and bonding in non-transition elements and compounds. Solvents, solutions, acids and bases, brief review of inorganic chains, rings and cages, organometallic compounds of non-transition elements, role of non-transition elements in biological processes.

Texts/References

F.A. Cotton,G. Wilkinson, C.A.Murillo and M.Bochmann, Advanced Inorganic Chemistry, John Wiley, 6th Ed.,John Wiley,1999.
C.Elschenbroich and A. Salzer, Organometallics, 2nd Ed., Wiley VCH, 1992.
D.F.Shriver, P.W.Atkins and C.H.Langford, Inorganic Chemistry, Oxford University Press, 3rd Ed., 1999.

CH 440   Introduction to Biomolecules   2 1 0 6

Molecular logic of living matter. Origin of biomolecules. Cell structure. Amino acids structure, functional group properties and reactions. Protein structure, conformation and biomolecular interactions. Sugar-polysaccharides, structure and functions. Nucleotides, nucleic acids structure and function, DNA organisation, replication, transcription, ribosomes, gentic code and protein synthesis. Enzymes-categorization, catalysis, kinetics-single substrate enzyme catalyzed reactions, inhibition. Lipids-structure and prop- erties of different classes of lipids. Biomembrane organisation-membrane lipids. Membrane bound proteins-structure, properties and transport phenomena. Bioenergetics-basic principles, glycolytic pathways, Kreb's cycle, oxidative phosphorylation, coupled processes. Photosynthesis.

Texts/References

R.J.Simond, Chemistry of Biomolecules, Royal Society of Chemistry, U.K. London, 1992.
A.L.Lehninger, Biochemistry : The Molecular Basis of Cell Structure and Function, Worth Publishers, 1982.
L. Stryer, Biochemistry, W.H. Freeman and Company, 1975.
V.Voet and J.G.Voet, Biochemisktry, John wiley, New York, 1990.

CH-442   Molecular Spectroscopy   3 1 0 8

Interaction of radiation with matter, principles of spectroscopy, lasers.Rotational spectra, molecular geometries, Zeeman and Stark effects, Molecular symmetry-point groups, representations, character tables. Molecular vibrations, normal mode analysis, infrared lasers. Raman Scattering, Resonance Raman Spectroscopy. Time resolved spectroscopy.

Molecular electronic spectra, photophysical processes, dye lasers. Magnetic resonance, relaxation times- FT-NMR, spin- spin coupling, ESR, NQR, hyperfine interactions. Mossbauer spectroscopy.

Text/References

R.S.Drago, Physical Methods in Chemistry, Saunders, 1992.
C.N.Banwell, Fundamentals of Molecular Spectroscopy, Tata McGraw Hill, 1983.
W.A. Gullory, Introduction to Molecular Structure and Spectroscopy, Allyn and Bacon, 1977.
R. Chang, Basic Principles of spectroscopy, McGraw Hill, 1971
G.M.Barrow, Molecular Spectroscopy, McGraw Hill, 1962.

CH 443   Seminar   0 0 4 4

CH 481: Chemistry and Computers   **2 0 2 6**

Numerical computing using a high level language like FORTRAN/C: Programming principles using loops, arrays and functions; use of libraries; Numerical methods: truncation and round off errors; roots; interpolation; differentiation and integration; linear equations, matrix operations; curve fitting; ODEs; optimization; Application of numerical methods to chemical problems.

Text/References

S. J. Chapman, Fortran 90/95 for Scientists and Engineers (2nd edition), McGraw-Hill, 2003.
W. E. Mayo and M. Cwiakala, Programming with FORTRAN 77, Schaum's Outline Series, McGraw Hill, 1995.
A. Kelly and I. Pohl, A book on C (4 th edition), Addison-Wesley, 1999.
S. C. Chapra and P. Canale, Numerical Methods for Engineers (4th edition), Tata McGraw-Hill , 2002.
R. J. Schilling and S. L. Harris, Applied Numerical Methods for Engineers: Using MATLAB and C, Brooks/Cole Publishing Company <http://www.brookscole.com>, 2000.
J. H. Mathews, Numerical Methods for Mathematics, Science, and Engineering (2nd edition), Prentice Hall of India, 2001.

CH 502 Synthesis and characterisation of Inorganic Compounds.   2 1 0 6

Preparative chemistry of compounds of main group and transition elements including inorganic chains, rings, cages, clusters, halogen and rare gas compounds. Experimental problems encountered in the synthesis, isolation, purification, characteization and identification of inorganic compounds. Physical methods for characterization, PES, EXAFS, Mossbauer spectroscopy, magnetic susceptibility and cyclic voltammetry.

Text/References

R.S.Drago, Physical Methods for Chemists, Saunders, 1992.
R.J.Angelias, Synthesis and Techniques in Inorganic Chemis- try, 2nd Edn., Saunders, 1977.
G.Pass and H. Sutchliffe, Practical Inorganic Chemistry: Preparation, Reactions and Instrumental Methods, 2nd Edn., Chapman and Hall, 1974.
W.L.Jolly, The Synthesis and Characterisation of Inorganic Compounds, Prentice Hall, 1970.

CH 504 Computational Chemistry   1 0 4 6

A brief outline of molecular mechanics, semi-empirical approximations, ab initio methods, basis sets and Z-matrix; Application of these computational methods for prediction of structural and electronic properties of molecules by using standard programs; FMOs in organic chemistry, crystal and ligand field calculations, computation of potential energy surfaces. Conformational analysis by molecular mechanics; Dynamical and structural studies of molecules using molecular dynamics simulations; Monte Carlo simulations of molecules.

References:

C. J. Cramer, Essentials of Computational Chemistry: Theories and Models, John Wiley & Sons, 2002.

David Young, Computational Chemistry: A practical Guide for applying Techniques to Real World Problems, Wiley Interscience, 2001.

A.R. Leach, Molecular Modelling: Principles and Applications, Pearson Education, 2001.

J. B. Foresman, A. Frisch, Exploring Chemistry with Electronic Structure Methods. Gaussian Inc., 1996.

M.P. Allen and D.J. Tildesley, Computer Simulations of Liquids, Oxford, 1987

CH-508   Bioorganic chemistry   **2 1 0 6**

General comparision of organic reactions carried out in laboratory and organic reactions observed in biological systems. Nature of biomolecular interactions, physical concepts. Stereospecificity and rate enhancement in enzyme catalysed reactions. Discussion on non-availability of electrophilic sites in enzymes and their presence in co-enzymes. Following reactions will be discussed (comparing the usual mechanism to enzyme catalysed mechanism) : hydrolysis of esters, amides, phosphoesters, etc. C-C and C=C bond formation, oxidation, reduction and decarboxylation. Remote functionalisation cyclisation reactions. Biomimetic reactions. Hydrophobicity, organized assemblies. Supramolecular structure, drug design.

Text/References

Gordon and Breach & Harwood, Enantioselective synthesis using biological systems, Academic publishers, 1991.
Bioorganic Chemistry Frontiers Vol.2, Ed. H. Dugas, Springer-Verlag, pp.1-252, 1990.
H.Dugas, Bioorganic Chemistry. A Chemical approach to enzyme action, 2nd Edn., Springer-Verlag, 1989.
D.E.Metzler, Biochemistry-The Chemical Reactions of a Living Cell, Academic Press, 1977.
E.E. Tamlen, Bioorganic Chemistry, Academic Press, 1977.

CH-509   Physical Organic Chemistry   **2 1 0 6**

Theoretical principles of chemical reactivity. Perturbation theory. Frontier orbitals and rules governing their interactions. HSAB principle. Qualitative valence bond theory. Reaction profiles. Factors controlling barrier heights. Potential Energy Surfaces. Hammond postulate. Marcus theory. Isotope effects. Conformational analysis. Structural effects on chemical reactivity. Linear free energy relationships. Polar and steric effects in aliphatic systems. Solvents and solvation effects. Empirical solvent polarity scales. Solvent acidity. Extened pK_a scale, dependence on molecular structure and solvation effects. Acid and base catalysis. Transition state stabilization and enzyme catalytic principles. Nucleophilic reactivity. Electrophilic reactivity and mechanisms. Molecular rearrangements. Reactions of carbonyl compounds. Reactive intermediates, Radicals, Carbenes, Nitrenes, Benzynes.

Text/References

A. Pross, Theory and Physical Principles of Organic Reactivity, John Wiley, 1995.
A Rauk, Orbital Interaction Theory of Organic Chemistry, John Wiley, 1994.
T.H.Lowry and K.H.Richardson, Mechanisms and Theory in Organic Chemistry, Harper and Row, 1976.

CH 511 : Integrated Lab   0 0 12 12

Experiments involving synthesis, characterisation and quantitative measurements.

CH 513 : Inorganic Chemistry Lab   0 0 8 8

CH 515 : Organic Chemistry Lab   0 0 8 8

CH 517 : Physical Chemistry Lab   0 0 8 8

CH 521 Interpretative Molecular Spectroscopy   2 1 0 6

Mass spectrometry, the production and analysis of positive ions, molecular ions, application of isotopic abundance measurements, fragmentation modes and rearrangement of ions. Mass spectra of certain chemical classes. Electronic spectroscopy (UV-visible,fluorescence and phosphorescence):Simple chromophoric groups, conjugated and aromatic systems. Characteristic absorption of organic and inorganic compounds. Infrared spectroscopy:Characteristic group frequencies of organic and inorganic molecules. Nuclear magnetic resonance spectroscopy of compounds containing ^{1}H,^{13}C,^{19}F and ^{31}P nuclei. Identification of organic and inorganic compounds using combination of spectral data.

Text/References

R.S.Drago, Physical Methods for Chemists, W.B.Saunders,1992.
R.M.Silverstein, C.G.Bassler and T.C. Morril, Spectrophotometric Identification of Organic Compounds, 5th Edn.,Wiley, 1991.
D.H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 3rd Edn., McGraw Hill, 1980.
W. Kemp, Organic Spectroscopy, ELBS, 1979.
W.L.Jolly, The synthesis and characterization of Inorganic Compounds, Prentice-Hall, 1970.

CH 522   Chemistry of Coordination compounds   2 1 0 6

Classification of ligands by donor atoms, stability, reactivity, bond types, geometry and coordination compounds. Kinetics and mechanism of reactions of transition metal complexes : substitution reactions, electron transfer redox processes, acid base and related processes. Inorganic photochemistry of coordination compounds.

Text/References

F.A.Cotton ,G. Wilkinson, C.A.Murillo and M.Bochmann, Advanced Inorganic Chemistry, 6th Edition, Wiley, 1999

J.E. Huheey, E. Keiter and R. Keiter, Inorganic Chemistry, 4th Ed., Harper Collins College Publisher, 1993.

D.Banearjea, Coordination Chemistry, Tata McGraw Hill, 1993.

R.G.Wilkins, Kinetics and Reaction Mechanism of Transition Metal complexes, 2nd Revised Ed., VCH, New York, 1991.

F. Basolo and R.G. Pearson, Mechanism of Inorganic Reactions, 2nd Edition, Wiley, 1967.

CH-524   Bioinorganic Chemistry   2 1 0 6

Chemical make up and essential inorganic elements of organisms. Chemistry aspects of metal complexes. Spectral, biochemical and biological methods used in bioinorganic chemistry. Bioinorganic chemistry of Na^+, K^+, Mg^{2+} and Ca^{2+}. Role of metal ions in biology : Proteins and enzymes of V, Mn, Fe, Co, Ni, Cu, Zn and Mo. Structural and functional models. Transport and storage of metal ions. Carcinogenicity of chromium. Selenium in biology.

Text/References

S.J.Lippard & J.M.Berg, Principles of bioinorganic chemistry, University Science Books, Mill Valley, 1994.

I. Bertini, H.B.Gray, S.J.Lippard and J.S.Valentime, Bioinorganic Chemistry, Univ. Sci. Books, Mill Valley, 1994.

James A.Cowan, Inorganic Biochemistry, VCH Publishers, 1993.

Jan. Reedijk, Marcel Dekker,Inc.(Ed.), Bioorganic Catlysis, 1993.

R.W.Hay, Bioinorganic Chemistry, Ellis Hollwood,Ltd.1984.

CH 528   Natural Products   2 1 0 6

 Terpenoids : Classification, structure, chemistry and biogenesis of some important mono; sesqui,di, and triter penes.

Steroids : Sterols and bile acids, estrogens, androgens, gestogens and adrenocortical hormones. Hormone production. Cardiac glycosides. Steroidal triterpenes; biogenesis of steroids and correlation with terpenoids.

Alkaloids : Characteristic reactions, general methods of degradation, structure and chemistry of some well-known alkaloids.

Natural Pigments: Flavones, flavanones, isoflavones, xanthones, quinones, pterins, chlorophyll and haemin.

Carbohydrates: Stereochemistry, reaction and conformation of monosaccharides, deoxy and aminosugars, hexonic acid and vitamin C, disaccharides, polysaccharides, inositol; gan- gliosides and other glycosides. Chemistry of vitamins A,B,C and E.

Text/References

I.L.Finar, Organic Chemistry, Vol.2, 5th Edn., ELBS, 1975.
K. Nakanishi, T. Goto, S.Ito, S. Najori and S. Nozoe,Natural products Chemistry, Vol. 1 and 2, Academic Press, 1974.
A.A.,Newman, Chemistry of Terpenes and Terpenoids, Academic Press, 1972.
S.W. Pelletier, Chemistry of the Alkaloids, Van Nostrand Reinhold, 1970.
C.W.Shoppee, Chemistry of the Steroids, 2nd Edn., Butter
worths, 1964.
R.D.Guthrie and J. Honeyman, An Introduction to the Chemistry of Carbohydratres, 3rd Edn., Clarendon Press, 1968.
T.A.Geissman,Chemistry of Flavonoid Compounds, Pergamomn Press, 1962.

CH 540 Drugs and Biologically Active Compounds   2 1 0 6

Pre-requisite : A brief history of medicinal chemistry.   Drug receptor interactions. Approaches to drug design. Drug metabolism. A few drugs from each of the following groups will be discussed.

Analgesics, antidepressants, antipsdychotics, antiinflammatory agents, cardiovascular agents, diuretics, antibacterials, antibiotics, antivirals, antimalarials, antiamoebics, drugs for neoplastic diseases.

Vitamins : A, B1, B2, B6 niacin, folic acid, dantothenic acid, biotin, B12,C,D,E and K. Hormones : Thyroid hormones and antithyroid drugs. Steroid hormones and some important steroidal drugs.

Texts/References

A.Burger, Medicinal Chemistry, 4th Ed., Wiley Interscience, 1981.
R.F. Doerge, Ed., Wilson and Gisveld's Text Book of Organic Medicinal and Pharmaceutical chemistry, 8th Ed., J.B. Lippincott Co., 1982.
D. Lednicer and L.A. Mitscher, The Organic Chemistry of Drug Synthesis, Wiley Interscience, 1977.
O.L.Salerini, Natural and Synthetic Organic Medicinal Compounds, C.V. Mosby Co., 1976.

CH 544   Organic Reagents and Reactions   2 1 0 6

Chemical oxidizing agents : Oxidation at a single carbon and vicinal carbons, oxidation using transition metal oxidents, oxidation at sulphur, nitrogen, phosphorus and at unfunctionalized carbons. Chemical reducing agents : Homogenous and heterogenous catalytic reductions, metal hydride reducions, dissolving metal reductions, bimolecular reductions - Clemensen, Wolf-Kishner reduction. Applications of reagents derived from compounds of silicon, boron, phosphorus, sulphur, nickel and palladium in functional group interconversion.

Text/References

R.L.Augustin and D.J. Trecker (Ed), Oxidations, Vol. II, Marcel-Dekker, 1991.
R.K. Mackie and D.M.Smith, Guidebook to Organic Synthesis, ELBS, 1985.
F.A. Carey and R. J. Sundburg, Advanced Organic Chemistry, Part B, 2nd Edn., Plenum Press, 1983.
R.L.Augustin (Ed), Odixations, Vol. I, Marcel-Dekker, 1969.
R.L.Augustin (Ed), Reduction Techniques and Applications in Organic Synthesis, Marcel-Dkker, 1968.

CH-547   Organometallic Chemistry   2 1 0 6

Historical background, factors controlling metal-carbon bond formation, methods of M-C bond formation, comparative survey of structure and bonding of metal alkyls and aryls,complexes with p acids, CO and related ligands, complexes with olefins, acetylenes and related unsaturated molecules, catalytic properties of mononuclear compounds, stereochemical non-rigidity in organometallic compounds, boranes, carboranes and metallocarboranes, bimetallic and cluster complexes, structure and applications in catalysis, applications of organometallic compounds in organic synthesis, enantioselective synthesis via organometallic compounds, importance of organometallic compounds in certain biological systems.

Text/references

G.O.Spessard, G.L.Miessler, Organometallic Chemistry, Prentice Hall, 1997.
C.Elsehenbroich and A. Salzer, Organometallic Chemistry, 2nd Ed., Wiley VCH, 1992.
F.A.Cotton, G. Wilkinson, C.A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, 6th Edn., Wiley, 1999.
N.N.Greenwood and A. Earnshaw, Chemistry of the Elements, lst Edn., Pergamon, 1985.
B.F.G. Johnson, Transition Metal Clusters, Wiley, 1980.
G. Wilkinson, F.G.A. Stone and E. Abel, Comprehensive Organometallic chemistry, Pergamon, 1980.

CH 550   Electrochemistry   **2 1 0 6**

Nernst equation. Origin of EMF of a galvanic cell. Polarizable and non-polarizable electrodes, the electrocapillary curve, null point of metals and its determination. Thermodynamics of electrical double layer, Lipmann equation, measurement of surface excess. Models for the electrical double layer. Electrode kinetics. The concept of over potential. Electrochemical reactions under mass transfer control, chronopotentiometry,

voltammetry and polarography. Electrochemical reactions under charge transfer control, general ized Butler Volmer equation, determination of kinetic parameters. Mechanism and electrocatalysis of hydrogen and oxygen evolution reactions.

Text/References

D.I. Antropov, Theoretical Electrochemistry, Mir Publishers, 1972.
J. Koryta, J. Dvorak, V. Bohackova, Electrochemistry,Methuen & Co. Ltd., 1970.
J.O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry, Vol.1 and 2, Plenum Press, 1970.

CH 552   Interfacial Phenomena   2 1 0 6

Adsorption isotherms: Langmuir, BET, Frumkin, Temkin and Freundlich. Adsorption on porous solids. Chemisorption of gases on metals and semiconductors. Kinetics of adsorption processes, heterogeneous catalysis. Catalysis by metals, semiconductors and solid acids. Characterization of solid surface structure and composition using electron microscopy, FEM, XPS, Auger, Mossbauer, SIMS, ISS and LEED.

Text/References

D.K.Chakrabarty, Adsorption and catalysis by solids, Wiley Eastern, 1990.
F.P.Kane and G.B.Larrabee (Eds.),Characterisation of solid surfaces, Plenum, 1978.
A.W.Adamson, Physical Chemistry of Surfaces, 3rd Edn.,Wiley Interscience, 1976.
A. Clark, The Theory of Adsorption and Catalysis, Academic Press, 1970.

CH 556: Polymer Science   2 1 0 6

Introduction and applications of polymers, molecular weight distributions, various experimental methods (GPC/SEC, solution viscosity, VPO, light scattering) to determine relative and absolute molecular weight distributions, chain growth and step growth mechanisms and kinetics, ionic polymerization, living polymerization, stereochemistry of polymers, free radical copolymerization (random, block, alternate and graft copolymers), kinetics and mechanisms of free radical copolymerization, polymerization conditions and polymer reactions, thermal, mechanical and solution properties of polymers, thermoplastics, thermosets and elastomers, conducting polymers, branched polymers (star, dendritic and hyperbranched polymers).

Text/References

George Odian, Principle of Polymerization (3rd Edition), New York, John Wiley, 1991
P. J. Flory, Principles of Polymer Chemisty, Cornell University Press, 1953
Manas Chanda, Advanced polymer chemistry:a problem solving guide, New York: Marcel Dekker, 2000
Fred W. Billmeyer Jr., Textbook of Polymer Science (3rd Edition), John Wiley, 1991

CH 559   Solid State Chemistry and Its Applications   2 1 0 6

Diffraction techniques and the structure of solids; analysis of diffraction data. Crystal defects, nonstoichimetry and solid solutions. Structure of solid electrolytes, zeolites, conducting polymers and surfaces. Solid state transformations and reactions.

Electronic structure of solids: Fermi level, Bloch orbitals, energy bands, Brillouin zone. Electric and magnetic properties of solids: insulators, semiconductors, conductors and Fermi surfaces; superconductivity; polarization, refractive index, dielectrics and ferroelectrics; diamagnetism and paramagnetism; ferromagnetism, ferrimagnetism and antiferromagnetism. Molecular metals, phosphors and solid state lasers.

Texts/References

C. Kittel, Introduction to Solid State Physics, (6th edition), Wiley, 1991.
A. R. West, Solid State Chemistry and Its Applications, Wiley, 1989.
P. A. Cox, Electronic Structure and Chemistry of Solids, Oxford University Press, 1991.
A.W. Adamson, Physical Chemistry of Surfaces, Wiley, 1990.
H. V. Keer, Principles of the Solid State, Wiley Eastern, 1993.
D. K. Chakrabarty, Solid State Chemistry, New Age International, 1996.
A. Zangwill, Physics at Surfaces, Oxford University Press, 1988.

CH 560 Quantum Chemistry   2 1 0 6

Matrix formulation of quantum mechanics: transformation, representations, projection operators, equations of motion. Operator formalism: Virial theorem, normal operators, Dirac's method of solution of harmonic oscillator problem. Angular momentum: ladder operator technique, solutions, differential equation methods, spin, addition of angular momenta. Explicit derivation of Hartree and Hartree-Fock equations, Roothaan equations, basis sets - STO and GTO, calculation of integrals, semiempirical methods. Configuration interaction. Tunnel effect: square barrier, WKB approximation, electron and proton transfer. Many-body treatments: correlation energy, N-dependence, diagrammatic representations and linked cluster theorem.

Texts/References

I. R. Levine, Quantum Chemistry, Prentice Hall India (Ltd.), 1995.
A. Szabo and N. S. Ostlund, Modern Quantum Chemistry, McGraw-Hill, 1989.
J. Goodisman, Contemporary Quantum Chemistry, Plenum, 1977.
F. L. Pilar, Elementary Quantum Chemistry, McGraw-Hill, 1968.
S. N. Datta, Lectures on Chemical Bonding and Quantum Chemistry, Prism Books, 1998.

CH-568   Advanced Coordination Chemistry   2 1 0 6

Chemistry of Sigma donor and pi-acceptor complexes. Ligand field and molecular orbital theories. Term diagrams in octahedral, tetrahedral and lower symmetries.

Electronic dipole selection rules, band intensities, factors influencing band widths. Dichroism studies. Charge transfer spectra. Calculation of ligand field parameters. Magnetic properties of coordination compounds, basic equations of magnetic ^ susceptibility, diamagnetism, paramagnetism, ferromagnetism and antiferromagnetism, temperature independent. paramagnetism and electron delocalisation, effect of zero field splitting. ESR and NMR studies of paramagnetic complexes.

Text/References

R.S.Drago, Physical Methods for Chemists, W.B. Saunders Co., 1992.
B.N.Figgis, Introduction to Ligand Fields, Wiley Eastern, 1976.
A.B.P. Lever, Inorganic Electronic Spectroscopy, Elesevier, 1968.

CH-574   Topics in Inorganic Chemistry-I   2 1 0 6

Electron transfer properties of metal complexes. Molecular recognition. Asymmetric catalysis. Phosphorus compounds as ligands. Cluster chemistry. Bio-inorganic reaction mechanisms.

Text/References

W.L.Jolly, Modern Inorganic Chemistry, McGraw, Hill Co., 1984.
R.W. Hay, Bioinorganic Chemistry, Wiley, 1984.
M.Day and J.Selbin, Theoretical Inorganic Chemistry, Von. Nostrand, 2nd Ed. 1980.
H.J.Emeleus and J.J. Anderson, Modern Aspects of Inorganic Chemistry, Von. Nostrand, 1962.

CH-576   Statistical Mechanics   2 1 0 6

Ensembles and Averages, equivalence of Ensembles, classical Limit. Monte Carlo and Molecular Dyamics simulations. Distribution functions at equilibrium. Integral equation methods. Perturbation theory. Density functional methods. Molecular fluids. Estimation of thermodynamic functions. Non-equilibrium methods. Linear response theory. Projection operator method. Stochastic processes and Brownian motion. Selected applications to problems in chemical dynamics, relaxation processes and neutron diffraction.

Texts/References

M.P.Allen and D.J.Tildesley, Computer Simulation in Liquids, Oxford University Press, 1987.
J.P.Hansen and I.R.McDonald, Second Ed., Theory of Liquids, Academic Press,1986.

D.Chandler, Statistical Mechanics, Oxford University Press,1985.
H.L.Friedman, A Course in Statistical Mechanics, Prentice Hall,1983.
L. D. Landau, E. M. Lifshitz and L.P. Pitaevskii, Statistical Physics Parts I and II, Pergamon Press, 1980
D.A.McQuarrie, Statistical Mechanics, Harper and Row,1974.

CH-578   Topics in Inorganic Chemistry - III   2 1 0 6

Basic aspects of single crystal diffraction. Molecular metals. Inorganic rings. Transition metal chemistry of macrocycles. Metal ions in medicine. Fluxional molecules.

Text/References

J.E.Huheey, Inorganic Chemistry, 4th Ed., Harper Collins College Publisher, 1993.
G.H.Stout and L.H.Jensen, X-ray Structure Determination : A Practical guide, 2nd Ed., John Wiley, 1989.
J.P.Ferraro and J.M.Williams : Introduction to synthetic electrical conductors, Academic Press, 1987.
B.Sarkar (Ed.), Biological Aspects of Metals related Diseases, Raven Press, 1983.
G.A.Melson (Ed.), Coordination Chemistry of Macrocyclic Compounds, Plenum Press, 1979.
D.E.C. Corbridge, The Structural Chemistry of Phosphorus, Elsevier, 1974.

CH 582 Inorganic Photochemistry   2 1 0 6

Introduction to inorganic photochemistry. Photochemical laws and photochemical kinetics. Photophysical processes. The electronic absorption spectra of inorganic compounds. Characteristics of the electronically excited states of inorganic compounds. Photoelectochemistry of excited state redox reactions. Photosensitization. Photochemical reactions; substitution, decomposition and fragmentation, rearrangement, and redox reactions. Selective inorganic photochemistry using laser beams. Inorganic photochemistry in biological processes and their model studies.

Text/References

G.L.Geoffrey and M.S. Wrighton, Organometallic Photochemistry, Academic Press, 1979.
K.K.Rohatagi-Mukherjee, Fundamentals of Photochemistry, Wiley Eastern, 1978.
M.S.Wrighton, Inorganic and Organometallic photochemistry, ACS Pub.,1978.
V. Balzani and V. Carasiti, Photochemistry of Co-ordination compounds, Academic Press,1970.

CH-584   Biophysical Chemistry   2 1 0 6

Structure of water. Biological relevance of chemical potential. Hydrophobic and hydrophilic interactions in biological systems. Protein-Solvent Interactions - preferential

binding, hydration and exclusion. Protein structure, stability, folding, unfolding and their studies with spectroscopic and calorimetric methods. Protein-Ligand Binding. Structure-Function relationships. Equilibria across membranes.

Text/References

Roger B. Gregory, ed., Protein-Solvent Interactions, Marcel Dekker,Inc., 1995.
Barry T. Nall and Ken A. Dill, ed., Conformations and Forces in Protein Folding, Americal Association for the Advancement of Science, 1991.
Carl Branden and John Tooze, Introduction to Protein Structure, Garland Publishing, Inc., 1991.
Jeffries Wyman and Stanley J.Gill, Binding and Linkage : Functional Chemistry of Biological Macromolecules, University Sciences Books, 1990.
C.R.Cantor and P.R.Schimmel, Biophysical Chemistry, Part III, W.H.Freeman and Co., 1980.

CH 586   Structure and Properties of Materials   2 1 0 6

Common structure of elements and compounds. Bonding in solids. Structure determination by X-ray diffraction methods. Diffusion in solids. Electrical, magnetic, optical, dielectric and thermal properties of solids.

Text/References

H.V.Keer, Principles of the Solid State, Wiley Eastern Ltd., 1993.
C.Kittel, Introduction to Solid State Physics, John Wiley & Sons, 1991.
A.R.West, Solid State Chemistry and Its Applications, John Wiley & Sons, 1989.
A.F.Wells, Structural Inorganic Chemistry, Clarendon Press, 1986.
L.V.Azaroff, Elements of X-ray Crystallography, McGraw-Hill,

CH 588   Organic Synthesis   2 1 0 6

Concepts of symmetrization, umpolung, selectivity and specificity (stereo, regio and chemo). Antithetic and metathetic approaches. Selective introduction and manipulation of functional groups. Selectivity in functional groups reactions, activation, protection and blocking of groups. C-C bond forming reactions-cyanohydrin formation, organometallic additions, Wittig and related reactions, halomethane addition, nucleophilic substitution, Aldol condensation, enolate alkyla- tion, Friedel-Crafts reaction, Michael reaction, Claisen condensation, Cope and Claisen rearrangements, inter- and intra molecular Diel's-Alder reactions, Barbier Weiland degradation, Dieckmann and acyloin condensations, directed aldol condensation, conjugate addition and annulation reactions. Photochemical synthesis. Applications of the above methodologies in the synthesis of key synthones and other molecules.

Text/References

S.Warren, Designing Organic Synthesis, John Wiley and Sons, 1980.
W.Caruthers, Some Methods of Organic Synthesis, Cambridge University Press, 1978.
H.O.House, Modern Synthetic Reactions, 2nd Ed., W.A.Benjamin, 1972.
R.O.C. Norman, Principles of Organic Synthesis, 2nd Edn., Methuen and Co. Ltd., 1972.

CH 590   Thermal and Phtochemical Reactions   2 1 0 6

Prerequisite : Nil

Classification and investigation of reaction mechanisms. Thermal and photochemical activation. Energy and geometry of exicted states. Concerted and stepwsie eactions. FMO and PMO treatments. Electronic orbital symmetries. Conservation of orbital symmetry. Correlation diagrams. Woodward Hoffman's rules for pericyclic eactions - electrocyclic, cycloaddition and related reactions. Sigmatropic rearrangements and other group migration reactions. Photochemical laws, general haracteristics of photochemical reactions. Nature of electronically exicited states. Energy transfer mechanics.Study of photochemical reactions of alkenes, ketones, benzene and related chromophores, nitro and related chromophores, some heterocyclic chromophores, photooxidations.

Text/References

A.Gilbert and J. Baggot, Essentials of Molecular Photochemistry, Blackwell, Scientific Publications, 1992.
T.L.Glichrist and R.C.Storr, Organic Reactions and Orbital symmetry, Cambridge University, 1978.
N.J.Turro, Modern Molecular Photochemistry, Benjamin/ commings, 1978.
I.Fleming, Frontier Orbitals and Organic Chemical Reactions, Wiley, 1977.

CH-595 : Project (M.Sc. Integrated)   0 0 15 15

CH-596 : Project (M.Sc. Integrated)   0 0 25 25

CH-597 : Project (M.Sc. 2 Year)   0 0 05 05

CH-598 : Project (M.Sc. 2 Year)   0 0 15 15

CH 602 Characterisation of Polymers   3 0 0 6

Solubility chart for identification of polymers, specific chemical tests for various polymers, and group analysis.

Molecular weight determination using viscometry, osmometry, light scattering ultracentrifuge and gel permeation chromatography.

Thermal behaviour of polymers - DTA, TGA, DSC and TMA studies, pyrolytic gas chromatography.

Mechanical behavior of polymers, viscoelastic studies internal friction, swelling phenomenon, crosslink density.
Methods to study tacticity, stereo-regularity and crystallinity. Electrical resistivity, dielectric behaviour.

Texts/References

Collins, Experiments in Polymer Science, Interscience, 1970.
(The course will be accompanied by appropriate experimental demonstration).

CH 801 Symmetry in Chemistry   3 0 0 6

Symmetry in nature. Structural regularity in Chemistry, Elements of group theory. Group theory and quantum mechanics. Symmetry principles in structural and bonding theories of molecules. Aromatic and antiaromatic molecules. Molecular geometry; Jahn-Teller and Renner effects; dipole moments. Symmetry group for a non-rigid molecule.

Conservation of orbital symmetry in pericyclic reactions. Symmetry in inorganic reactions. Symmetry rules for transition states. Spin symmetry restrictions in reaction path. Time reversal symmetry.

Symmetry in the interaction of radiation with matter. Transition probability and selection rules; normal modes of vibration; symmetry in electronic, nmr and esr spectra; symmetry rules governing the relation of polarisability, susceptibility, etc. to macro-scopic phenomena like optical and magnetooptical activity, birefringence and piezo-electricity. Symmetry in a wider oerspective. Phase transitions; conservation laws, accidental degeneracy and hidden symmetry; superselection rules.

Texts/References

G. Davidson, Introductory Group Theory, Elsevier, 1971.
J.M.Holias, Symmetry in Molecules, Chapman and Hall, 1972.
F.A.Cotton, Chemical Applications of Group Theory, Interscience, 1971.
D.Bishop, Theory and Chemistry, Oxford University Press, 1974.
G.B.Gill and M.R.Willis, Pericyclic Reactions, Halstead Press, 1974.

CH 802   Thermodynamics and Extra-Thermodynamic Relations   3 0 0 6

Fundamentals of chemical thermodynamics, Statistical mechanical interpretation of the thermodynamic laws, Entropy and probability. Free energy. Partition functions. Partition function and equilibrium constant. Arrhenious and Eyring equations. Elements of absolute rate theory. Free energy and entropy of activation.

Qualitative correlations between reaction rate and equilibria. Linear free energy and other `extra-thermodynamic' relationships. Structural effects on rate and equilibria in organic systems; substituents and solvent effects. The Hammett and Taft equations; conformational equilibria in acyclic compounds. Structural effects on rate and equilibria in inorganic systems: Linear free energy relationship in ligand substitution kinetics; nucleophilicity scales; nucleophilic discrimination factor and intrinsic reactivity of a complex in ligand substitution kinetics.

Mechanochemical phenomena-the mechanism and rate of mechanical polymer degradation in solution; highly ordered fluid structure a reaction medium; mechanochemistry of non-crystalline and partly crystalline fibres.

Texts/References

J.E. Lefler and E.Grunwald, Rates and Equilibria of Organic Reactions, Wiley, 1963.
J. Hine, Structural Effects on Equilibria in Organic Chemistry, 2nd Ed. McGraw-Hill, 1962.
F. Basolo and R.G. Pearson, Mechanism of Inorganic Reactions, Interscience-Wiley, 2nd Edition, Wiley, 1967.

CH 804 Pulse and FTNMR theory and Techniques   3 0 0 6

NMR Parameters; nuclear spin properties of elements; spin-spin coupling; Bloch equation; the rotating frame of reference. Basic high resolution NMR spectrometer; pulsed NMR spectrometer; gating and pulse programming; free induction decay; Fourier analysis and fourier transform; fast fourier transforms; instrumental requirements, computer hardware and software of data aquisition and processing; a typical software; optimisation of parameters. Nuclear spin relaxation; auto-correlation and spectral density functions; NOE; relaxation mechanism, quantitative aspects and dynamic experiments; methods of T1 and T2 measurements.

Spin echo; multiple pulse techniques; rotating frame experiments; chemical rate processes.

Double resonance in proton and carbon-13 NMR; gated decoupling; specific pulse sequences for DEFT, WEFT, INEPT, etc. Assignment techniques in CMR; quantitative aspects in CMR.

NMR of other nuclei such as 2_H, 15_N, 19_F, 29_{Si}, 31_P etc. Two dimension J. Spectroscopy. Demonstration-cum-project.

Texts/References

Edwin D. Becker, High Resolution NMR, Academic Press, 1968.
George C. Levy, Editor, Topics in Carbon-13 Spectroscopy, Vol.I, John Wiley and Sons, 1974 and vol.II, John Wiley and Sons, 1976.
F.W. Wehril and T.Wirth in `Interpretation of carbon-13 NMR Spectra', Hyden, London, 1978.
R.S. Drago, Physical Methods in Chemistry, 2nd ed., W.B. Saunders Co., 1992.

CH 805 Stereochemistry and Reactivity of Organic Compounds   3 0 0 6

Structure and symmetry point group. Stereo-isomerism-optical isomerism, racemic modification, diastereoisomers, torsional isomerism, atropisomers, absolute configuration, conformational analysis, conformational and reactivity. Stereo-chemistry of ring systems. Fused rings, allenes, macromolecules tricovalent carbon. Optical rotatory dispersion, circular dichroism and their application. Stereospecific and stereo-selective synthesis. Stereochemistry and mechanism of reactions.

Texts/References

E.L. Eliel, S.H. Wilen, L.N. Mander, Stereochemistry of Organic Compounds, John Wiley, New York, 1994.

D. Nasipuri, Stereochemistry of Organic Compounds (Principles and Applications), 2nd edition, New Age International, New Delhi, 1994.

K.Mislow, Introduction to Stereochemistry, 2nd edition, Benjamin, 1966.

CH 806 Molecular Photochemistry   3 0 0 6

Photochemical laws, Electronic absorption, Spectra of atoms and molecules. Nature of eletronically excited states. Electronic energy transfer in solution and its applications to photochemistry.

Experimental methods in photochemistry. Study of selected photochemical reactions. Photochemistry of vision. Photosynthesis. Photochromism. Bioluminescent and Photo-luminescent reactions. Excited states in organized media.

Texts/References

N.J. Turro, Modern Molecular Photochemistry, Benzamin/Cummings, 1978.
A.A. Lamola and N.J. Turro, Energy Transfer and Organic Photochemistry, Wiley Interscience, 1969.
Selected Readings from Advances in Photochemistry Eds. W.A. Noyes Jr., J.N. Pitts Jr., G.S. Hammond, K.Gollnick and H. Volman, Interscience, 1953 to-date.
R.L. Drisco and D.W. Cowan, Elements of Photochemistry, Plenum, 1976.
D.B. Smith (Sr. Reporter), Photochemistry, A specialist Periodical Report Royal Society of Chemistry, London, 1968 todate.

CH 807 Organic Synthesis   3 0 0 6

Strategy and design of organic synthesis. Concepts of synthetic equivalent and umpolung. Selective introduction and manipulation of functional groups, protective groups. Applications of following reactions : Formation of carbon-carbon single bond. Enolate anions, Enamines, Directed aldol reactions, thio-carbanions, lithium cuprates, organosilanes, palladium and nickel complexes, carbenoids, photocylisation. Photochemical methods in organic synthesis.

Formation of carbon-carbon double bond. Wittig and related reactions, oxidative decarboxylation, tolune-sulphonyl hydrazone decomposition, reductive additions to triple bond, fragmentation reactions.

Pericyclic reactions. Cycloadditions sigma-tropic rearrangements, electrocyclic and ene reactions. Free radical reactions. Remote functionalisation, biaryl coupling. Oxidation reactions. Selective oxidation of olefins, alcohols, carbonyl compounds.

Reductive reactions: Catalytic hydrogenations, dissolving metal reductions, hydride transfer reactions etc.

Example of stereospecific and enantioselective synthesis of organic compounds.

Texts/References

W.Caruthers, Some Modern Methods of Organic Synthesis, 2nd Edn., Cambridge University Press, 1978.
H.O. House, Modern Synthetic Reactions, 2nd Edn., W.A. Benjamin, 1972.
J.D. Coyle, Ed., Photochemistry in Organic Synthesis, Royal Society of Chemistry, London, 1986.
R.O.C. Norman, Principles of Organic Synthesis, 2nd Edn., Methuen and Co., 1972.
I. Fleming, Selected Organic Syntheses, Wiley, 1973.
F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry, Part B: Reactions and Synthesis, Plenum, 1984.

CH 820 Structure Analysis by Diffraction Methods   3 0 0 6

Review of the principles and applications of the following for structure analysis :

Electron microscopy, electron diffraction, X-ray diffraction and neutron diffraction. Advanced methods of X-ray data collection and solving the phase problem. Patterson function, image seeking functions and their use in structure analysis.

Refinement of crystal structures. Low energy electron diffraction technique of structure analysis. Fluid diffraction patterns and structure dynamics. Methods of neutron diffraction: data collection, structure analysis and refinement. Use of polarised neutron beams in structure analysis.

Texts/References

M.J. Buerger, Contemporary Crystallography, McGraw Hill, 1970.
G.H. Stout and L.H. Jenson, X-ray Structure, Mcmillan, 1968.

CH 824 Organotransition Metal and pi-Acceptor Ligand Complexes   3 0 0 6

Metal carbonyls and other complexes with pi-acceptor ligands. Metal-metal bonds and metal atom clusters. Transition metal complexes with bonds to hydrogen, alkyls, alkenes and other related compounds. The role of insertion, oxidative addition, reductive elimination, associative dissociative reaction in catalysis. The use of organotransition metal complexes for conversion of unsaturated and related compounds.

Texts/References

F.A.Cotton and G.Wilkinson, Advanced Inorganic Chemistry, Wiley, 1988.
R.F. Heck, Organotransition Metal Chemistry, Wiley, 1974.
J.K. Kochi, Organometallic Mechanisms and Catalysis, Academic, 1979.
J.P. Collman and L.S. Hogedul, Principles and Applications of Organotransition Metal Chemistry, Wiley, 1980.

CH 825 New Interfaces of Inorganic Chemistry with Biology   3 0 0 6

Trace elements in biology, metals and metabolism. Interactions of metal ions with biopolymers and their studies by modern spectroscopic techniques. Structures and

functions of metalloproteins and metalloenzymes, synthesis and study of chemical models mimicking their functional properties. Photosynthesis, artificial photosynthesis, biocatalytic hydrogen production. Nitrogen fixation and related systems.

Texts/References

D.A. Phillips, Metal and Metabolism, Clarendion 1976.
B.L. Vallee and W.E.C. Walkar, Metalloproteins, Academic, 1970.
R.K. Clayton, Photosynthesis, Cambridge University, 1980.
T.G. Spiro Ed., Metal ions in Biology, A Wiley, Interscience Series, 1980 onwards.

CH 827 Inorganic Complexes   3 0 0 6

Molecular structure, point groups and character tables. Angular overlap and molecular orbital theories. Infrared, electronic, electron spin resonance and nuclear magnetic resonance spectra of metal complexes. Stability of inorganic complexes of macrocyclic ligands. Kinetics and mechanism of reactions of metal complexes emphasizing electron transfer and photochemical reactions.

Texts/References

F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley, 1988.
R.S. Drago, Physical Methods in Chemistry, Saunders, 1992.
R.G. Wilkins, The Study of the Kinetics and Mechanism of Reaction of Transition Metal Complexes, Allyn and Bacon, 1974.
M.S. Wrighton, Inorganic and Organometallic Photochemistry, ACS Publications, 1978.

CH 828 Spectra of Organic Compounds   3 0 0 6

Magnetic properties of Nuclei, NMR relaxation, chemical shifts and shielding. Bloch's equation. CW and FTNMR. Correlation function and correlation time. Relaxation types and mechanism of relaxation. Double resonance. Chemical exchange. Shielding mechanism, chemical and paramagnetic shifts. Spin-spin splitting analysis of first order and complex NMR spectra. Simulation experimental method. Determination of NMR. CW and FT NMR multiple irradiation. Correlation spectroscopy. Relaxation time measurement. Self diffusion coefficient measurement. Multiple pulse NMR experiment. NOE. WEFT. Chemically induced dynamic nuclear polarization. Biomolecular interactions. Quadrupole nuclei. Determination of order parameter.

Origin of mass spectra, basic principles of chemical ionizations, field desorption and plasma desorption mass spectrometry. GC-MS; Ion-beam electron impact and plasma desorption mass spectrometry. Their applications in determining the structure of organic molecules.

Basic Principles, definitions and units of ORD and CD.

Applications of various empirical and semi-empirical rules in determining the chirality of the organic molecules.

Texts/References

G.C.Levy, Topics in Carbon 13-NMR Spectrometry, Vols. I,II. John Wiley, 1974,1976.
T.L. Jame, Nuclear Magnetic Resonances in Biochemistry, Academic Press, 1975.
Budgikiewic and Williams Holder Ray, Mass Spectrometry by C.Dierassi, 1968.

CH 829 Magnetochemistry   3 0 0 6

Electron spin, Pauli principle, Orbital angular moment and origin of magnetism and susceptibility.   Classification of magnetic groups dia-, ferro-, antiferro- and ferrimagnetism.

Atomic and molecular dia-and para-magnetism and chemical bonding, Pauli paramagnetism in metals. Exchange interaction in the solid state; molecular field theory and ordering of magnetic moments. Magnetochemistry as a method of investigating structure of coordination and organic compounds.

Experimental metods of determining the magnetic susceptibility and magnetization properties. Magnetic materials.

Texts/References

J.B.Goodenough, Magnetism and Chemical Bond, Interscience, 1968.
R.P.Feynman, R.B. Senghton and M.Sands. The Feynman, Lectures of Physics, Vol.II, Addison Wesley, 1964.
A.Earnshaw, Introduction to Magnetiochemistry, Academic Press, 1968.
J.C. Anderson, Magnetism and Magnetic Materials, Chapman and Hall, 1968.

CH 831 Advanced Laboratory Techniques   2 0 4 8

Safety methods in chemistry laboratories, techniques of glass-blowing, high vacuum and temperature control; instrumentation and operation of UV-vis and IR spectrophotometers, fluorescence and AA spectrometer, NMR, GC, HPLC, XRD and other techniques (about 12 assignments).
Applications, data handling and interpretation of selected 6 techniques from above (6 assignments).
Experiments specialized to the area of proposed research field (6 assignments).

Texts/References

Lab.Manuals/Instrument Manuals of Equipments available in the Department.

CH 840 Enzymes and Coenzymes   3 0 0 6

Enzymes-structure and confirmation. Physical and chemical methods as structural probes of active site of enzymes. Affinity mechanism. Enzyme models. Clinical, medical and industrial use of enzymes. Rational drug design via enzyme inhibitors. Bioactivation of prodrugs by enzymes. Coenzyme A. Buotin Thiamine diphosphate. Pyridoxal phosphate, suicide enzyme inhibitor. Hydrogen transfer coenzymes. Flavin coenzymes. Tetrahydro-folic acid. Dihydrofolate reductase. Anti-cancer agents. B12 coenzyme. Poisons as antagonists of PLP enzymes. Analogues of coenzymes.

Texts/References

D.Metzer, Biochemistry, Academic Press, 1977.
E.E. Van Tamlen (Ed.), Bioorganic Chemistry, Vol.I-IV, Academic Press, 1978.
Selected reading from `Science', `Scientific American' and `Accounts of Chemical Research'.

CH 841 Biogenesis and Biosynthesis of Natural Products   3 0 0 6

Introduction : primary and secondary metabolites precursors. Methods used in study of bio-synthesis. Biosynthesis and metabolism. Biosynthesis of photosynthetic apparatuses. Acetogenins, acetate hypothesis, biosynthesis of saturated and unsaturated fatty acids, polyacetylenes and aromatic polyketides. Isoprenoids-biosynthesis of mevolanate, mono, sesqui-, di-, and triterpenes. Modifying reactions. Biosynthesis of triterpenoids, steroids and carotenoies.

Shikimic metabolites (phenyl propanoids) simple cinnamic acid derivates, flavonoids, coumarins, retenoid, tropolones, lignins etc. Alkaloids other amino acid derivates. Alkaloids based on aliphatic amino acids, aromatic amino acids and other amino acids derivatives and peptides. biosynthesis of polyproteins.

Methods-precursor-incorporation experiments in fungi, biosynthesis in cell-free systems and biosynthesis in mutant organism.

Texts/References

R.B. Herbert, Biosynthesis of Secondary Metabolites, Chapman and Hall, 1981.
P.Mannitto, Biosynthesis of Natural Products, Halstad Press, 1981.
S. Natori, N.Ikekawa and M.Susuki, Eds. Advances in Natural Products Chemistry, Kodansha/Wiley, 1981.

CH 842 Elements of Advanced Molecular Quantum Mechanics   3 0 0 6

Second quantisation; many-particle systems; field: degenerate eletron gas; Bogoliubov transformation. Variational principles applied to many-body systems; time-independent and time-dependent.
Schrodinger interaction and Heisenberg pictures; adiabatic `switching on'. Gellmann Low theorem; Green functions; Lehmann representation; physical interpretation of Green

functions; one and two-particle propagators; Hartee-Fock approximation. Reduced density matrices. Diagrammatic perturbation theory. Dyson equation. Goldstone theorem, theory of linear response. Collective modes. Randon phase approximation, Molecular collision theory.

Texts/References

G.Baym, Lectures on Quantum Mechanics, W.A. Benjamin, 1969.
A.L.Fetter and J.D.Walecka, Quantum Theory of Many-Particle Systems. McGraw Hill, 1971.
J. Linderberg and Y.Ohrn, Propagators in Quantum Chemistry, Academic Press, 1973.
E.R. Davidson, Reduced Density Matrices in Quantum Chemistry, Academic Press, 1976.
L.P.Kadanoff and G. Baym, Quantum Statistical Mechanics, W.A. Benjamin, 1976.
M.S. Child, Molecular Collision Theory, Academic Press, 1974.

CH 846 Atomic and Molecular Relativistic Quantum Mechanics   3 0 0 6

Klein-Gordon equation, charge conjugation, non-relativistic limit. Dirac equation, relativistic invariance and the Lorentz groups, free particle solutions, hydrogen atom, charge conjugation and the Dirac-hole theory. Non-relativistic limit and Foldy-Wouthuysen transformation. The Breit interaction.

Atomic numerical solutions, atomic hyperfine structures, atomic analytic solutions, one center expansions. Molecular Dirac-Fock analysis. Symmetry of molecular spinors. Relativistic effective potentials. Relativistic density functional treatment.

Lodwin contractions and non-relativistic approximations to the Dirac equation. Relativistic virial theorem. Variational stability. Improved Dirac-Fock theory. Fluid-dynamical representations and fluid-dynamical interpretations of the Dirac theory.

 Texts/References

G.Baym, Lectures on Quantum Mechanics, W.A. Benjamin, Inc, New York, 1973.
H.A. Betne and E.E. Salpeter, Quantum Mechanics of one-and two-electron Atoms, Springer Verlag, Berlin, 1957.
A.Messiah, Quantum Mechanics, Vol.II, North Holland, Amsterdam, 1962.
Selected papers from Literature.

CH 864 Biopolymers   3 0 0 6

Amino acids, chemical nature of polypeptides, amino acid analysis. Protein sequences and evolution. Conformational characteristics of polypeptides. Conformational predictions. Proteins in solution. Interactions with other molecules.

Nucleosides and nucleotides. Coenzymes. Physical characteristics. Conformational features. hydrogen bonding and base stacking. The double helix. DNA polymorphism. RNA-structure. RNA-protein interaction. Higher organization of DNA.

Brief survey of Relication, Transcription and translation. Protein biosynthesis. Covalent modification and topogenesis. Site-directed mutagenesis. Perspectives of chemical synthesis. Functional group protection-deprotection. Condensing reagents. Solution vs solid phase synthesis.

Texts/References

T.E.Creihton, Proteins: Structure and molecular properties, W.H. Freeman and Co., 1984.
W.Saenger, Principles of nucleic acid structure, Springer, 1984.
M.Bodanszky, Peptide Chemistry, Springer, 1988.