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

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

Post-graduate students shall have to register for any one of the following courses, in the second semester, which may be offered by the respective school.

**Courses offered under the framework of Amrita Values Programme:**

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

**Insights from the Ramayana**
Historical significance of Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Misinterpretation of Ramayana by Colonial powers and its impact on Indian life - Relevance of Ramayana for modern times.

**Insights from the Mahabharata**
Historical significance of Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance – Importance of Dharma in society – Message of the Bhagavad Gita - Relevance of Mahabharata for modern times.

**Insights from the Upanishads**
Introduction: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – Ultimate reality – the nature of Atman - the different modes of consciousness - Sanatana Dharma and its uniqueness - The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, Satyakama Jabala, Aruni, Shvetaketu.

**Insights from Bhagavad Gita**

**Swami Vivekananda and his Message**
Brief Sketch of Swami Vivekananda’s Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message to Indians about our duties to the nation.

**Great Spiritual Teachers of India**
Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramanujacharya, Sri Madhvacharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi

**Indian Arts and Literature:**
The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre, Paintings, Sculpture and architecture – the wonder language, Sanskrit and ancient Indian Literature

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

**Appreciation of Kerala’s Mural Art Forms:**
A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. A distinguishing characteristic of mural painting is that the architectural elements of...
the given space are harmoniously incorporated into the picture. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries CE when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Practicing Organic Farming
Life and nature are closely linked through the healthy practices of society for maintaining sustainability. When modern technological knowhow on microorganisms is applied in farming using the traditional practices we can avoid damage to the environment. The course will train the youth on modern practices of organic farming. Amma says “we have to return this land to the coming generations without allowing even the slightest damage to happen to it”. Putting this philosophy to practice will bring about an awakening and enthusiasm in all to strive for good health and to restore the harmony in nature”

Ancient Indian Science and Technology
Science and technology in ancient and medieval India covered all the major branches of human knowledge and activities, including mathematics, astronomy, physics, chemistry, medical science and surgery, fine arts, mechanical, civil engineering, architecture, shipbuilding and navigation. Ancient India was a land of sages, saints and seers as well as a land of scholars and scientists. The course gives an awareness on India’s contribution to science and technology.

15CHY501 GROUP THEORY AND QUANTUM CHEMISTRY 3 1 0 4

Unit 1 Quantum Chemistry I
Origin of quantum mechanics, de Broglie relationship, postulates of quantum mechanics, operators and eigen functions, operators for momentum, energy and angular momentum, expectation values, time dependent and independent Schrodinger equation, stationary states, the uncertainty principle (no derivation), application of Schrodinger wave equation to particle in one dimensional box and three dimensional box, degeneracy, application of Schrodinger wave equation to harmonic oscillator, free particles, quantum entanglement, quantum dots.

Unit 2 Quantum Chemistry II
Application of Schrödinger wave equation to rigid rotator and H atom, shapes of atomic orbitals from solutions of H atom, many electron atoms, approximation methods, independent particle model, variation methods, perturbation methods, application to the ground state of Helium atom, SCF method, the exclusion principle,

REFERENCES:

REFERENCES:
SYLLABI Master of Science - Chemistry 2015 admissions onwards


15CHY502 CHEMICAL THERMODYNAMICS AND EQUILIBRIA 3 1 0 4

Unit 1 Chemical Thermodynamics
First and second laws of thermodynamics, thermodynamic functions, heat capacity, thermo chemistry, need for second law of thermodynamics, entropy and free energy functions, calculation of changes in thermodynamic function for ideal and non-ideal gases in isothermal and adiabatic process, relation between thermodynamic functions - Maxwell relations, Joule Thomson effect, coefficient of thermal expansion and compressibility factor, applications of free energy function to physical and chemical changes, equilibrium in chemical reactions, third law of thermodynamics - need for third law, calculation of absolute entropy, unattainability of absolute zero, thermodynamic systems of variable composition - fugacity functions, partial molar quantities, thermodynamics of ideal solutions, real solutions and regular solutions, dilute solutions of nonelectrolytes, Henry's law, Raoult's law, Gibb's-Duhem equations, Gibbs-Duhem-Margules equations, and activity and standard states of non electrolytes.

Unit 2 Irreversible Thermodynamics
Examples for irreversible process, entropy production, non-equilibrium, steady state and near equilibrium conditions, linear relation, phenomenological coefficients, Onsager reciprocal relations, one component systems with heat and matter transport, application of irreversible thermodynamics to thermal diffusion, thermal osmosis etc., electro kinetic effects, the Glansdorf-Pregogine equation.

Unit 3 Statistical Thermodynamics
Statistical concept, probability and thermodynamic states, entropy and probability, canonical ensemble, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein Statistics, electron gas concept, Bose-Einstein condensation, relation among MB, FD & BE Statistics, partition function, partition function for free linear motion, free motion in a shared space, linear harmonic vibration, translational, rotational and vibrational partition function, molecular partition functions, partition functions and thermodynamic properties, calculation of equilibrium constant, heat capacity of gases, mono atomic solids, Einstein's and Deby's theory.

Unit 4 Equilibrium
Gibb’s free energy, direction of spontaneous change of a reaction, chemical potential, chemical potential and equilibrium, ?G in terms of K, equilibrium constants.

REFERENCES:

SYLLABI Master of Science - Chemistry 2015 admissions onwards

- real gases and real reactions, equilibrium respond to catalyst, temperature, pressure and PH, application of ?G and K – extraction of metals from their oxides, Ellingham diagram, and thermodynamics of ATP & respiration, biological energy conversion.

Unit 5 Phase Equilibrium
Gibb’s Phase rule, one component system, two component systems, vapor pressure diagrams and their interpretation, lever rule, temperature-composition diagrams, liquid-liquid phase diagrams, distillation of partially miscible liquids, azeotropes, liquid-solid phase diagrams, phase diagram for the system Na/K/Na2K, phase diagram - steel, alloys, Fe-C system, zone refining, three component system, triangular coordinates, three component system – partially miscible liquids - H2O/CHCl3/CH3COOH, phase diagram - NH4Cl/(NH4)2SO4/H2O

TEXTBOOKS:

15CHY503 MOLECULAR SPECTROSCOPY 3 1 0 4

Unit 1 Rotational and Vibrational Spectroscopy
Introduction to spectroscopy, rotation spectra - diatomic and polyatomic molecules, selection rules, intensities of spectral lines, stark effect, instrumentation of micro wave spectroscopy, applications and structural determinations, vibration spectra of diatomic molecules, harmonic and anharmonic vibrations, diatomic vibrating rotor, selection rule, breakdown of Born Oppenheimer approximation, rotational character of vibration spectra, different modes of vibrations, vibration-rotation spectra, Fermi resonance, vibration spectra of polyatomic molecules, IR spectra of organic and inorganic compounds, phase, temperature and solvent dependence, FTIR technique, instrumentation, Raman spectra (including the use of laser) - theory, relation with IR spectroscopy, mutual exclusion principle, resonance Raman, stimulated hyper and inverse Raman effects, instrumentation and applications of Raman spectroscopy.

Unit 2 UV-Visible and Fluorescence Spectroscopy
Electronic spectra of atoms - single and multi electron systems, jj and L-S coupling,
electronic spectra of diatomic and polyatomic molecules, its relation to electronic arrangement and symmetry of molecules, application of group theory in electronic spectra, selection rules, nature of electronic excitation, principles of absorption spectroscopy, Beer-Lambert law, presentation of spectra, chromophores, forbidden transition, different types of electronic transitions, p-p*, n-p* etc transitions, nature of transitions in carbonyl compounds, the effect of conjugation, effect of conjugation on alkenes, HOMOs and LUMOs, Woodward-Fieser rules for dienes, spectra of carbonyl compounds, enones, Woodward rule for enones, spectra of aromatic compounds, effect of substituents, structural information from electronic spectra, excited states of molecules, Jablonski diagram, fluorescence and phosphorescence, life time of excited state, quantum yield, photochemical and photo physical properties, application of UV-Visible and Fluorescence Spectroscopy for structural elucidation of organic compounds, diffuse reflectance spectra.

Unit 3 NMR Spectroscopy
Nuclear magnetic resonance phenomenon - theory, relaxation effects, NMR uses active nuclei, Fourier Transformation in NMR, measurement of relaxation time, chemical shift, magnetic anisotropic effect, multiplets in NMR, spin-spin splitting, n + 1 rule, Pascal's triangle, tree-diagram, spin-spin splitting constant, J, 2J and 3J and long-range coupling, measurement of J, Karplus relationship, first and second order spectra, AX, AB, AX2, AX3, A2X3, AMX type spectra, double resonance and spin ticking, chemical shift reagents, spectra in higher fields, spectra of conformational isomers, homotopic, enantiotopic and diastereotopic systems, C13 spectra, factors related to C13 spectra, H1 coupled C13 spectra, H1 decoupled C13 spectra, chemical shift values, nuclear Overhauser effect (NOE), cross-polarization, off-resonance resonance decoupling, application of H1 and C13 NMR spectroscopy for the structural elucidation of organic compounds, B11, N15, F19 and P31 NMR spectra, spectra of paramagnetic complexes, magnetic susceptibility, contact shift, fluxional molecules and their studies using NMR, solid state NMR.

Unit 4 ESR, NQR and Mossbauer Spectroscopy
ESR spectroscopy - theory, hyperfine and superfine splitting, ESR active simple organic systems, ESR of inorganic systems like Cu2+ and VO2+ complexes, 'g' markers like DPPH and TCNE, evaluation of spin Hamiltonian like A, g11, g2, covalency factor in Cu2+ complexes, analysis of ESR spectra of VO2+ complexes, NQR spectroscopy - theory, relationship between electric field gradient and molecular structure, quadrupole coupling constant and structural information of compounds, Mossbauer spectroscopy, principle, Doppler effect, isomer shift, Zeeman splitting, quadrupole splitting, application of Mossbauer spectroscopy for studying Fe and Sn compounds and phase transformation, application of ESR spectroscopy.

Unit 5 Mass Spectroscopy and PES
Mass spectroscopy, base peak and molecular ion peak, isotope ratio data, fragmentation patterns of alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, phenols, aldehydes, ketones, esters, carboxylic acids, amines, methods of desorption and ionization (EI, CI, LD, MALDI, PD, FAB, SIMS), MS/MS and determination of molecular formula, metastable ions and their significance, study of fragment ion formation, application of MS in structural elucidation and other frontiers of science, application of MS for quantitative analysis, photoelectron spectroscopy (PES), principle, application of PES.

TEXTBOOKS:

REFERENCE:
chemistry, closo, nido and arachno structure, carboranes, metallocene carboranes, B-N compounds, interstitial compounds, metal carbides, nitrides and hydrides, fullerences, functionalized fullerenes, C-nanotubes

Unit 4 Inorganic materials II
Inorganic chains and polymers, rings, cages, and clusters, sulphur-nitrogen compounds, polymeric sulphur nitride, isopoly anions, heteropoly anions, Keggin and Dawson polyoxometalates, borazines, metal clusters, nature of Si-Si bonds, silicates, silicates with zero-, one-, two- and three-dimensional structures, structure of elemental P, phosphonitrilic compounds, polymers with P-N bonds, interhalogen and pseudo halogens, intercalation chemistry, intercalation in layered materials like graphite, xenon fluorides & other xenon compounds.

Unit 5 Chemistry of f-block elements
The lanthanides and actinides, stable oxidation states, the lanthanide and actinide contractions, the f-orbitals, spectral and magnetic properties - comparison with inner transition and transition metals, separation of lanthanides, use of lanthanide compounds as shift reagents, photo-emission of lanthanide compounds, organometallic compounds of lanthanides and actinides and their structural features, reactions of lanthanide and actinide compounds, mineral sands of south west India - Ilmenite, Monazite, etc.

TEXTBOOKS:

REFERENCES:
Unit 1 Aromaticity and Structure Activity Relationship
Bronsted and Lewis acids and bases, pH and pKa, Huckel's rule and modern theories of aromaticity and anti-aromaticity with suitable examples, study of [n]annulenes, fullerences, nonbenzenoid aromatics, catenanes and rotaxanes, structure activity relationships with special emphasis on the effect of structure on acidity and basicity, solvent effects, linear free energy relationships, mechanisms and methods of determining them (kinetic and non-kinetic methods), application of frontier orbital theory in organic reactions, molecular orbitals and frontier orbitals, application in studying radical and ionic reactions, HSAB concept, Mobius strip, aromaticity in transition state.

Unit 2 Stereochemistry
Optical and geometrical isomerism, absolute and relative configuration, Cahn-Ingold-Prelog system, prochirality, prochiral centre, atoms, groups and faces, designations, asymmetric synthesis, stereospecific and stereoselective synthesis, regioselective and regiospecific reactions, atropisomerism, optical isomerism in biphenyls, allenes, spirans and "ansa" compounds, compounds containing chiral nitrogen and sulfur atom, geometrical isomerism of cyclic compounds, cumulenes and oximes.

Unit 3 Conformational Analysis
Conformational analysis of cyclic and acyclic systems with special emphasis on six membered rings, conformational effects on the reactivity of acyclic and cyclic systems - elimination, substitution and addition, strain, structure and stability of small, medium, and large rings, anomeric effect - cycloalkenes and cycloalkynes, stereochemistry of SN1, SN2, SNi, E1 and E2 - kinetically and thermodynamically favoured products.

Unit 4 Active Reaction Intermediates and Mechanisms
Generation, structure and reactivity of carbocations (including non-classical carbocations), carbanions, carbon radicals, radical ions, Baldwin ring-closure rules, generation, structure and reactivity of carbenes, nitrenes, arynes, nitrelium ions, mechanism of nucleophilic, electrophilic and free radical substitutions on aliphatic carbons (saturated and unsaturated) and on aromatic carbon, benzyne mechanism, addition and elimination reactions and their mechanisms, olefin metathesis.

Unit 5 Rearrangements Involving Electron Deficient Carbon, Nitrogen & Oxygen
or orbital interpretations, comparison of different theories in coordination compounds, Guo and Faraday methods, effects of temperature on magnetic behavior, spin cross over systems, Kotani plots.

**Unit 3** Reactions, Mechanisms, Stereochemistry and Photochemical properties
Complex equilibrium - formation constants, chelate and macrocyclic effects, factors affecting stability of complexes, methods of determination of stability constants, stability of complex ions in solutions, inert and labile complexes, mechanisms of ligand displacement and addition reactions in octahedral complexes and square planar complexes of platinum cis- and trans effect, substitution reactions, mechanisms of substitution, kinetic consequences of reaction pathways, dissociation, interchange, association, dissociation, linear free energy relationships, conjugate base mechanism, stereochemistry of reactions, substitution in trans-complexes, substitution in cis-complexes, isomerisation of chelate rings the trans-effect, sigma-bonding and pi-bonding effects, oxidation-reduction reactions, inner and outer sphere reactions, conditions for high and low oxidations numbers, reactions of coordinated ligands, hydrolysis of esters, amides and peptides, template reactions, electrophilic substitution, Photochemical reactions of coordination compounds.

**Unit 4** Classification and Structural aspects of Organometallic Compounds
Historical development, classification, nomenclature, hapticity, electron counting scheme, capping rule, 18 and 16 electron rules, structure prediction based on 18-electron rule, bond energies, stability and classification of ligands, main group elements, methods of formation, reactions, compounds of alkali metals, alkaline earth metals and groups 12 to 15 metals, transition elements, electronic structure and classification, ligands with 2, 3, 4, 5, 6, 7 or 8 electron donors, compounds involving metal ligand s-bonds and p-bonds, metal carbyns, synthesis of metal carbonyls, bonding in metal carbonyls, stabilization of metals in unusual oxidation states, polynuclear carbyns with and without bridging groups, IR spectra of terminally bound and bridging type CO's, carbonyl hydride, metal nitrosyl, dinorogen complexes, iso-cynide, tertiary phosphines and tertiary arsenic complexes of transition metals, metal dioxygen and dinitrogen complexes, structural features of the above compounds, co-ordination compounds containing SO2, CO2 and N-heterocycles, complexes with weakly co-coordinating anions, 7, 8 and 9 co-ordination complexes, organometallic compounds with metal-metal bonds and containing metal clusters, metal-carbon sigma-bond, complexes with chain pi-donor ligands, structures of olefins, acetylenes and pi-allyl complexes, complexes with cyclic pi-donors, cyclopentadiene, benzene, cycloheptatriene, cyclobutadiene and cyclooctatetraene.

**Unit 5** Bonding and Structural features of Organometallic Compounds
Fragment molecular orbitals (FMO) of various organic moieties/fragments like CH3,
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15CHY582   INORGANIC QUANTITATIVE ANALYSIS LAB.  0 0 6 2

1. Estimation of Calcium (Permanganometry)
2. Estimation of Barium (Iodometry)
3. Estimation of Calcium as Calcium Carbonate (Gravimetry)
4. Estimation of Zinc using oxine (Gravimetry)
5. Estimation of Iron as Ferric Oxide (Gravimetry)
6. Analysis of Brass
7. Estimation of Copper and Nickel in a Mixture
8. Estimation of Copper and Iron in a Mixture
9. Preparation and Determination of Ferrous Oxalate
10. Estimation of Different Types of Hardness in the Given Water Sample
11. Estimation of Different Types of Alkalinites in the Given Water Sample
12. Estimation of Dissolved Oxygen in the Given Water Sample
13. Complexometric Estimations

TEXTBOOKS:

REFERENCES:

15CHY585   ORGANIC QUALITATIVE ANALYSIS LAB.  0 0 6 2

1. Separation of binary mixtures
Includes separation, preliminary investigations, determinations of saturation/unsaturation, detection of elements by Lassaigne's test, functional group identification, derivative preparation, determination of melting points of the derivatives and calculation of RF values from TLC.

The following mixtures can be given -
(a) Acid and hydrocarbon
(b) Phenol and aldehyde
(c) Phenol and acid
(d) Phenol and amine
(e) Acid and ester
(f) Halo compound and aldehyde
(g) Acid and aldehyde

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15CHY586   ORGANIC QUANTITATIVE ANALYSIS LAB.  0 0 6 2

A. Estimations:
1. Estimation of equivalent weight of an acid
2. Estimation of glucose
3. Estimation of phenol
4. Estimation of acetone
5. Estimation of acid value of an oil
6. Estimation of iodine value and sap value of an oil
7. Estimation of Nitrogen – Kjeldahl method
8. Estimation of formaldehyde
9. Estimation of aniline
10. Estimation of ester

B. Preparations of Organic Compounds
Double stage preparations
(a) m-nitro benzoic acid from ethyl benzoate
(b) p-bromobenzanilide from aniline
(c) p-nitro acetanilide from aniline

Single stage preparations

REFERENCES:
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Master of Science - Chemistry
2015 admissions onwards

(a) Benzimidazole
(b) Benzophenone oxime
(c) Dibenzilidene acetone (chalcone)
(d) Benzalacetophenone
(e) Benzanilide
(f) Acetanilide
(g) Acetyl salicylic acid (aspirin)

Name Reactions
(a) Benzil-Benzilic acid rearrangement
(b) Cannizaro reaction
(c) Claisen condensation

For all preparations
1. TLC to be done and Rf values of each compound to be reported
2. Melting point of pure compounds to be found
3. A small portion should be recrystallised from suitable solvent
4. Purified products to be displayed
5. Mechanisms for each preparation should be suggested

REFERENCES:

15CHY601 PHYSICAL METHODS IN CHEMISTRY 3 1 0 4

Unit 1 Ultraviolet and Visible spectroscopy
Orbitals involved in electronic transition, effect of solvents on the absorption of molecules, applications of electronic spectroscopy to conjugated compounds, a, ß unsaturated carbonyl compounds, aromatic compounds and heterocyclic systems, effects of substituents on the electronic spectra of aromatic compounds, electron releasing and electron withdrawing effects, substituents capable of p-conjugation, disubstituted benzene derivatives, stereo chemical factors in electronic spectroscopy, model compound studies, the nature of structural information that can be obtained from electronic spectroscopy, application of UV-visible spectroscopy for structural characterization of organic compounds.

Unit 2 Infrared Spectroscopy
The IR absorption process, instrumentation details, dispersive IR spectrometer, FTIR spectrometer, sample preparations, stretching and bending modes of various groups and corresponding IR absorptions, combination bands, difference bands, bond properties and absorption trends, the effect of reduced mass on the IR absorptions, correlation charts, characteristic group absorption of organic molecules and identification of functional groups, C-H stretching mode, O-H vibrations, C-H bending, C=C stretching, conjugation effect, ring-size effect, IR spectra of compounds containing substituted double bonds, carbonyl compounds, factors influencing C=O stretching vibrations, study of the IR spectra of normal, branched and cyclic alkanes, alkenes, alkynes, aromatic compounds, alcohols, phenols, ethers, epoxides, peroxides, aldehydes, ketones, carboxylic acids and derivatives and compounds containing N, P and S, IR spectra of inorganic systems, IR of anions like NO3-, ClO4-, SO42- in ionic form and also in coordinated forms due to symmetry, application of IR spectra for structural characterization.

Unit 3 NMR and ESR spectroscopy
Instrumentation details, factors influencing chemical shift, integrals in proton NMR spectra, splitting of NMR signals, magnitude of coupling constants, AMX, ABX and ABC systems, factors influencing geminal and vicinal coupling, heteronuclear coupling, chemical and magnetic equivalence, deuterium exchange, lanthanide shift reagents, peak assignments in 13C NMR, 13C - 1H spin coupling, DEPT, 2D NMR - shift correlation spectra - COSY HETCOR and HMQC, structural applications of 1H and 13C NMR techniques, CIDNP, spectra of compounds containing other important nuclei like 19F, 31P, 15N, 17O and 29Si, ESR spectroscopy, derivative curves, g values, hyperfine (hf) and superfine (shf) splitting, hf and shf splitting constants, structure and bonding parameters from ESR spectra.

Unit 4 Mass Spectrometry
Instrumentation details, structure and recognition of the molecular ion, molecular formula from the molecular ion, nature of metastable ion, calculation of m/z values, significance of metastable ions, basic fragmentation types and rules, fragmentation associated with functional groups, nitrogen rule, nature of fragmentation patterns, nature of fragment ions for alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols and phenols, ethers, aldehydes, ketones, esters, carboxylic acids, amines, S and N compounds, nitro compounds, iso-octane substitution by mass spectrometry, time of flight, quadrupole and tandem mass spectrometry, GC-MS, HPLC-MS, application of MS for structural characterization of organic compounds. Conjoint IR, UV/VIS, NMR and MS problems, applications of spectroscopic techniques in organic and inorganic chemistry, structural elucidation by using several spectroscopic techniques, aliphatic compounds, aromatic compounds, distinguishing structural isomers from spectral techniques, CD spectra and its applications.

Unit 5 Analytical Chemistry
(a) Complexometric Titrations
Classical methods of analysis, titrimetric analysis, theory of indicators, acid-base
equilibrium in non-aqueous solvents, buffers, titration curves, titration in non-aqueous solvents, complexometry, factors favouring complexation, theory of complexometric titrations, metal-ion indicators, masking and demasking, applications of complexometric titrations, solubility product, gravimetric determination.

(b) Separation Techniques
Distribution law, liquid-liquid extractions, factors favouring solvent extraction, synergistic extraction, countercurrent extraction, super critical fluids, electrophoresis - theory and applications, chromatography, theory, instrumentation and applications of column, paper, TLC, HPLC, GPC and ion exchange chromatography, gas chromatography, CHN analysis by GC.

(c) Thermal, Diffraction and Electroanalytical Techniques
Theory, instrumentation and applications of TG, DTA, DSC, XRD, electron diffraction, and neutron diffraction, theory, instrumentation and applications of conductometry, potentiometry, amperometry, voltammetry, polarography, electrogravimetry, coulometry and ion selective electrodes.

(d) Miscellaneous Techniques
Refractometry and interferometry, polarimetry, CD and ORD, nephelometry and turbidimetry, atomic absorption and flame emission spectrometry, XRF, chemical analysis of surfaces - ISS, SIMS, AES, ESCA.

REFERENCES:

TEXTBOOKS:
rechargeable Zn-alkaline batteries, reserve batteries – zinc-silver oxide, lithium anode cell, thermal batteries, advanced batteries for electric vehicles – metal/air, Zn-Br, sodium-beta and lithium/iron sulphide batteries, Fuel Cells – carbon, hydrogen-oxygen, methanol, molten carbonate, solid polymer electrolyte and biochemical fuel cells, alkaline fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, proton exchange membrane fuel cells, solar cells – photovoltaic and photo electrochemical cells, photo biochemical conversion cell.

Unit 4 Chemical Kinetics I
Reaction rates and order of reactions, determination of order of reactions, complex reactions, reversible, consecutive and concurrent reactions, reactions of variable order, steady state treatment, reaction mechanism and molecularity, theories of unimolecular reactions and termolecular reactions, Arrhenius equation, collision theory and transition state theory, comparative study of the theories of reaction rates, free energy of activation, effect of solvent on rate of reactions, ionic reactions and effect of ionic strength - salt effect, effect of pressure on velocity of gas reactions.

Unit 5 Chemical Kinetics II
Reaction dynamics, fast reactions, flash photolysis and relaxation methods, catalysis and inhibition, homogeneous catalysis, acid, base and enzyme catalysis, kinetics of enzyme catalyzed reaction - the Michaelis-Menten equation, photochemical kinetics, steady state treatment of photochemical reactions, Semenov-Hinshelwood theory of chain reactions and explosions, free radical reactions - the Rice-Herzhfeld mechanism.

TEXTBOOKS:

REFERENCES:

15CHY611 COMPUTATIONAL CHEMISTRY 2 1 0 3

Unit 1
Models, Approximation and Reality - Fundamental principles - energy, electrostatics, atomic units, thermodynamics, quantum mechanics, statistical mechanics.
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Master of Science - Chemistry
2015 admissions onwards

Unit 2 Heterocyclic Compounds
Nomenclature and general characteristics of heterocyclic compounds, study of three and four-membered ring heterocycles containing one heteroatom, structure and synthesis of penicillin and cephalosporin-C, structure and synthesis of reserpine, heteroaromatic compounds (five and six-membered rings) containing one and two heteroatoms, fused ring compounds - indole, quinoline, isoquinoiline, coumarin, flavones, purine and pyrimidine, bases present in nucleosides.

Unit 3 Carbohydrates
Structure of ribose, glucose, fructose, maltose, sucrose, lactose, starch, cellulose and cyclodextrins, preparation of aldital, glycosides (O, C and N), deoxysugars, synthesis of vitamin C from glucose, structure and synthesis of nucleic acids, genetic code, recombinant DNA, biosynthesis of shikimic acid.

Unit 4 Chemistry of Natural Products
Alkaloids - classification, structure elucidation based on degradative reactions (quinine and atropine), Terpenoids - classification, structure elucidation and synthesis of abietic acid, Steroids - classification, structure of cholesterol, conversion of cholesterol to progesterone, androsterone and testosterone, classification, structure and synthesis of prostaglandins, biosynthesis of fatty acids, prostaglandins, terpenoids and steroids.

Unit 5 Amino acids, Peptides and Enzymes
Synthesis of amino acids - Strecker and azalactone synthesis, enantioselective synthesis of amino acids, reactions of amino acids, structure of proteins, introduction to enzymes and coenzymes with special reference to the function of chymotrypsin, NAD, thiamine, pyridoxal, in vitro and in vivo synthesis of peptides, solid phase synthesis, biosynthesis of quinine and papaverine.

TEXTBOOKS:

REFERENCES:
Unit 5 Bioinorganic Chemistry II

TEXTBOOKS:

REFERENCES:
SYLLABI  Master of Science - Chemistry  2015 admissions onwards

**Unit 3** Immobilized enzymes
Immobilization methods - nanopolymerizing covalent immobilization, Crosslinking with bifunctional reagents. Properties of immobilized enzymes, immobilized enzyme reactions, theoretical treatment of packed bed enzyme reactors.

**Unit 4** Antibodies
Structural and functional properties of antibodies, Polyclonal and monoclonal antibodies Antibody-antigen interactions, analytical application of secondary antibody-antigen.

**Unit 5** Biosensors

**TEXTBOOKS:**

**REFERENCE:**

15CHY634  CHEMISTRY OF BIOMOLECULES  3 0 0 3

**Unit 1** Amino acids, Proteins and Peptides
Classification, Stereochnical aspects, physical properties, Ionic properties, spectral properties, chemical reactions of amino acids, Industrial preparation and chemical synthesis of amino acids. Ionic properties of proteins, protein structure, protein purification, protein structure determination, proteomics and protein function, solid phase peptide synthesis, biologically important peptides.

**Unit 2** Enzyme chemistry
Introduction to Enzymes, Classification of enzymes, mechanism of enzyme action, immobilized enzymes and enzyme technology, enzyme analog built polymers, design of molecular clefts, enzymes in synthetic organic chemistry.

**Unit 3** Molecular biology and bioinformatics
Structure of nucleic acids, genes and genome complexity, functions of nucleic acids, isolation and separation of nucleic acids, molecular analysis of nucleic acid sequences, nucleotide sequencing of DNA.

SYLLABI  Master of Science - Chemistry  2015 admissions onwards

**Unit 4** Immunochemical techniques
Production of antibodies, purification and fragmentation of immunoglobulins, immunoprecipitation, labeling antibodies, immunoblotting, immunoassays, immunohisto/ cytochemistry.

**Unit 5** Recombinant DNA and genetic analysis
Constructing gene libraries, cloning vectors, hybridization and gene probes, application of gene cloning, expression of foreign genes, pharmacogenomics.

**REFERENCES:**

15CHY634  INDUSTRIAL CHEMISTRY  3 0 0 3

**Unit 1** Water treatment
Softening of water, Ion exchange process, Lime soda process, Modified Lime soda process, Zeolite process, Chemical and physical method of sterilization, Desalination, Boiler problems. Corrosion of boiler units, industrial water treatment, water analysis.

**Unit 2** Fuels
Calorific value, determination of Calorific value, classification of fuels, Solid fuels, Properties of fuels, classification of coal, coking and non coking coals, advantages and disadvantages of solid fuels. Liquid fuels, gaseous fuels, analysis of fuel gases, Distillation of petroleum. Processing & purification of petroleum and petroleum products, Flash point, Fire point, Knocking, antiknocking, Getane number, octane number, natural gasoline, cracking, polymerization, alkylation, isomerisation, rocket fules, fossil fules, nuclear fuels.

**Unit 3** Energy resources
Renewable and non renewable sources of energy, conventional and non conventional sources of energy, solar energy, solar technology, solar photovoltaic cell - application, PV lantern system. Radiotelephone system, Application of solar energy, Environmental implication, Nuclear energy, nuclear fuel cycle in India, Energy conservation and waste heat boilers, Fuel cells, hydrogen cells.

**Unit 4** Paints and Pigments
White pigment, blue, green, yellow, black and red pigments - manufacture, physical properties, characteristics, Manufacture of paints, setting of paints, requirement
for good paints, emulsion paint, latex paint, luminescent paint, fire retardant paints, heat resistant paints, varnishes, manufacture of varnishes, enamels, lacquers.

Unit 5 Explosives and Toxic Chemical Weapons

TEXTBOOKS:

REFERENCES

15CHY635 INDUSTRIAL STOICHIOMETRY 3 0 0 3

Unit 1 Introduction to process calculation - dimensions and systems of units - fundamental quantities of units, derived quantities, definition and units of force, volume, pressure, work, energy, power, heat-unit conversions in FPS, MKS and SI systems.


Unit 3 Description and simple material balance calculation of physical processes such as drying, distillation, absorption, mixing, crystallization, Evaporation.

SYLLABI Master of Science - Chemistry 2015 admissions onwards

15CHY636 MATERIAL SCIENCE AND NANO CHEMISTRY 3 0 0 3

Unit 1 Introduction to Nanomaterials
Introduction to Material Science, Interdisciplinary nature, Structure of nanomaterials, Length scales, de-Broglie wavelength & exciton Bohr radius, Foundations of Quantum Mechanics: wave function, Schrödinger equation, uncertainty principle, quantum wells, quantum wires, quantum dots, articles.

Unit 2 Nanomaterials: Synthesis, Properties
Size effect and properties of Nanoparticles - Particle size - Particle shape - Particle density, Specific surface area and pore - Composite structure, Crystal structure - Functionality of nanostructures and their characteristic evaluation - Optical properties - Catalytic property; Synthesis - Methods and Strategies, Top-down and bottom-up approaches, Chemical vapour deposition, Laser ablation, Electric-arc, Sol-Gel Processing, Lithography - Surface modification of inorganic nanoparticles by organic functional groups.
Unit 3 Surface Science and Characterization of Nanomaterials

Unit 4 Nanotechnology: Applications and Devices
Nanoscale materials, Nano transfer printing, Biomaterials applications, MEMS and NEMS, self-organisation, nanoscale (opto) electronics, Fullerenes, Devices - Actuators and motors for nanodisplacements, Nanosensors, development of optical memory using semiconductor nanoparticles - Nozzle-free inkjet technology - Dendrimers and their application to organic electronics devices - Nanomedicines, Bio-imaging with quantum dots.

Unit 5 Environmental Issues in Nanotechnology
Nanoparticles and environment - Nanoparticles in atmosphere - Ground water, exhaust gases – wastewater and Indoor environments; Safety of nanoparticles - Problems caused by nanoparticles, Safety assessment for the nanoparticles; Removal of nanoparticles.

TEXTBOOKS:

REFERENCES:

Unit 1 Physicochemical properties of drugs in relation to biological action
Acid-Base Properties, Water solubility, Partition coefficient, drug administration, drug distribution, metabolism (Phase I and Phase II) and toxicity of drug receptor interaction, conformational flexibility and multiple mode of action, optical isomerism

Unit 2 Essentials of drug design
Molecular mimetics, drug-lead modification, drug design using QSAR and computer assisted design, assessment of drug activity, receptors and drug action, mechanism of drug action, drug metabolism pathways, Drug potentiation, drug antagonism and drug resistance

Unit 3 Medicinal agents from natural products
History of the use of natural products as therapeutic agents, medicinal plants, active principle, Isolation methods of alkaloids, terpenes, antioxidants, natural oils from plants

Unit 4 Medicinal agents
Medicinal agents belonging to alkaloids, steroids, polypeptides, modified nucleic acid bases, sulphonamide and sulpha drugs, antibacterials - sulpha drugs, substituted sulphonamides, anticonvulsants, anticoagulants, antiamebic agents, antihelminthic agents, anti-malarial agents, diuretics and cardiac vascular agents, drugs for AIDS, medicinal agents affecting CNS, analgesics, antipyretics, antiinfective and disinfectants, Histamine and anti-histaminic agents, antibiotics - cell wall biosynthesis, antibiotics inhibiting cell wall biosynthesis, inhibitors of β-lactam rings, antibiotics inhibiting protein synthesis, isolation, structure elucidation, synthesis, structure-activity relationship and mode of action of penicillin, streptomycin, tetracycline and chloramphenicol, synthesis of penicillin G & V, ampicillin, amoxicillin and cephalosporin

Unit 5 Infectious and Non infectious diseases
Infectious diseases:
A) Malaria: Life cycle stages of malaria parasite and molecular pathways for therapeutic intervention.
   a) Artemisinin class of compounds, mode of action, advantages and drawbacks; chemical modifications to improve therapeutic profile and new leads (to demonstrate the importance of natural products in drug development).
   b) Proteases as drug targets in the rational design of new anti-malarials (to expose students to protease function, mechanism, homology modeling and rational drug design)

B) AIDS: Protease and reverse transcriptase as drug targets.
C) Leishmaniasis: Polyene macrolides (Membrane disrupting agents); Toxicity issues, Drug delivery, Therapeutic index

Non-infectious diseases:
A) Cancer chemotherapy:
  b) Anti-metabolite strategy in drug development. 5-fluorouracil.
  c) Drugs targeting DNA: Bleomycin, Anthracyclines and Enediyne anti-tumor agents (Calicheamicins and Dynemicin A).
B) Nervous System and neurotransmitters. Acetylcholine analogs as Agonists and antagonists with examples

TEXTBOOKS:

REFERENCES:
2. V. K. Ahiwualia, Lalita S. Kumar and Sanjiv Kumar, ‘Chemistry of Natural Products’, Ane Books India.

Unit 1 Introduction to Supramolecular Chemistry
From molecular to supramolecular chemistry: Factors leading to strong binding, hydrogen bonding and stacking interactions, Bottom-up approach, Top-Down Approach, Energy and Signals Semiochemistry, photo switching devices, electro switching devices, mechanical switching processes,

Unit 2 Processing of Energy and Signals by Molecular and Supramolecular system
Fundamental principles of photo induced electron and energy transfer, Molecular electronics, Molecular photonics, Molecular Chemionics, Molecular electro photonics, Molecular Photochemionics.

TEXTBOOKS:

REFERENCES:

Unit 3 Molecular Recognition

Unit 4 Electrochemistry of Supramolecular Systems
Electroluminescent systems as sensors and devices, Redox controlled molecular switches, Biohybrid electrochemical devices, Dendrimers as multielectron storage devices, Redox-active Metal-Polypyridine dendrimers as light harvesting antennae.

Unit 5 Molecular Scale Mechanical Devices
Introduction to mechanical devices, Spontaneous mechanical like motions, Allosteric movements, Tweezers and Harpoons, A natural proton pump, Twisters, Tweezers, Threading-Dethreading movements, Ring switching processes in Rotaxanes and Catenanes, Molecular valves, Molecular Muscles.

TEXTBOOKS:

REFERENCES:

Unit 1 Introduction to Nanomaterials: Size dependence of properties – Surface to volume ratio and Quantum confinement; Microscopic techniques to study nano structures - SEM, AFM – TEM and STM; Spectroscopic techniques to characterize nanostructures - Raman, XPS, Auger, EDAX;

Unit 2 Synthetic approaches: Colloidal, Self-Assembly (Self-assembled monolayers -
SAMs) and electrostatic self-assembly, electrochemical methods (cathodic and anodic processes), sol-gel, Langmuir-Blodgett (LB) technique, chemical vapour deposition, plasma arcing and ball milling, lithography;

Unit 3
Electrical, optical, mechanical, chemical and magnetic properties of nanomaterials; Carbon Clusters: Synthesis, properties and biomedical applications of Fullerenes, Carbon nanotubes and Graphenes.

Unit 4
Quantum Dots, wells and wires (metallic and semiconducting) - Preparation, properties and biomedical applications; Dendrimeric structures and their applications;

Unit 5 Biofunctionalisation of nanomaterials - Surface Plasmon resonance – Fluorescence Resonance energy transfer (FRET).

TEXTBOOKS/ REFERENCES:

15CHY640 INDUSTRIAL METAL FINISHING PROCESSES 3 0 0 3

Unit 1
Background Theory: Review of reversible and irreversible processes - electrodes, indicator and reference - Nernst and Butler-Vohmer equation - phenomenon of polarization - factors influencing - Tafel experiment and Tafel plot - Significance.

Unit 2
Electrodeposition: Industrial plating of copper-nickel (dull and bright) - chromium on mild steel – operating conditions and sequence – pre-treatment processes - plant layout – electroplating of zinc on MS and post plating chromating, yellow and blue passivation processes – decorative plating of silver and gold on non-ferrous metals – brief discussion on nano plating of metals and micro structure of the deposition.

Properties of deposits: Tests for adhesion, hardness, thickness, uniformity and corrosion resistance of the electro deposits.

Electroless deposition: Nickel, copper, gold on metal components – bath composition and operating conditions - immersion plating - plating on plastics – pre-treatment processes – long duration plating – electroforming, operating conditions and sequence.

Unit 3

Nano anodizing of titanium, aluminium and tantalum – application to sensor field.

Plasma electrolytic oxidation: power supply requirements – baths used – process sequence for aluminium, magnesium and titanium – properties of the coating and industrial applications.

Unit 4
Electropolishing: Mechanism of electropolishing – electropolishing of ferrous and non-ferrous metals – industrial baths used – operating conditions and sequence - industrial applications.

Unit 5
Electrochemical etching: Etching of ferrous and non-ferrous metals – special properties of matt and satin finish – DC and AC processes – operating conditions and sequence.

Special Topics: Electrochemical and chemical metal colouring of ferrous and non-ferrous metals.


TEXTBOOK:

REFERENCES:

**15CHY681 ADVANCED PHYSICAL CHEMISTRY LAB. 0 0 5 2**

1. To construct the phase diagram for three component system.
2. Determination of equivalent conductance at infinite dilution of weak electrolytes.
3. Determination of order of reaction for ion exchange reaction.
4. Extraction efficiency of solute from a solution by immiscible solvent method.
5. Determination of calorific value using Bomb calorimeter.
7. Determination of the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometrically.
8. Determination of flash point, fire point of a lubricant.
9. Determination of cloud point and pour point of a lubricant.

**TEXTBOOKS:**

**REFERENCE BOOKS:**

**15CHY682 INSTRUMENTAL METHODS OF ANALYSIS LAB. 0 0 5 2**

1. Determination of strengths of halides in a mixture potentiometrically.
2. To find the redox potential of the given sample using cyclic voltammetry.
3. Determination of half wave potential of Cd & Zn by polargraphy.
4. Determination of pKa of an indicator in aqueous and micellar medium using UV-Vis spectroscopy.
5. Determination of stoichiometry and stability constant of inorganic (ferric-salicylic acid) and organic (amine iodine) complexes using UV–Vis spectroscopy.
6. Determination of copper and cadmium in a mixture by electrogravimetry.
7. Determination of rate constant for enzyme kinetics-inversion of sucrose.

**SYLLABI** Master of Science - Chemistry 2015 admissions onwards

**15CUL501 CULTURAL EDUCATION 2 0 0 P/F**

**Objective:** Love is the substratum of life and spirituality. If love is absent life becomes meaningless. In the present world if love is used as the string to connect the beads of values, life becomes precious, rare and beautiful like a fragrant blossom. Values are not to be learned alone. They have to be imbied into the inner spirit and put into practice. This should happen at the right time when you have vitality and strength, when your hearts are open.
The present course in value education is a humble experience based effort to lead and metamorphosis the students through the process of transformation of their inner self towards achieving the best. Amma's nectarous words of wisdom and acts of love are our guiding principles. Amma's philosophy provides an insight into the vision of our optimistic future.

1. Invocation, Satsang and Question - Answers
2. Values - What are they? Definition, Guiding Principles with examples Sharing own experiences
3. Values - Key to meaningful life. Values in different contexts
4. Personality - Mind, Soul and Consciousness - Q and A. Body-Mind-Intelect and the Inner psyche Experience sharing
5. Psychological Significance of samskara (with eg. From Epics)
6. Indian Heritage and Contribution and Q and A; Indian Ethos and Culture
7. Self Discipline (Evolution and Practice) – Q and A
8. Human Development and Spiritual Growth - Q and A
9. Purpose of Life plus Q and A
10. Cultivating self Development
11. Self effort and Divine Grace - their roles – Q and A; - Vedanta and Creation - Understanding a spiritual Master
12. Dimensions of Spiritual Education; Need for change Lecture – 1; Need for Perfection Lecture - 2
13. How to help others who have achieved less - Man and Nature Q and A, Sharing of experiences

REFERENCES:
1. Swami Amritaswaroopananda Puri - Awaken Children (Volume VII and VIII)
2. Swami Amritaswaroopananda Puri - Amma's Heart
3. Swami Ramakrishnanda Puri - Rising Along the Razor's Edge
4. Deepak Chopra - Book 1: Quantum Healing; Book 2: Alpha and Omega of God; Book 3: Seven Spiritual Rules for Success
5. Dr. A. P. J. Abdul Kalam - 1. Ignited Minds 2. Talks (CD)
6. Swami Ramakrishnanda Puri - Ultimate Success
7. Swami Jnanananda Puri - Upadesamrittham (Trans: Malayalam)
8. Vedanta Kesari Publication - Values - Key to a meaningful life
9. Swami Ranganathananda - Eternal values for a changing society
10. David Megginson and Vivien Whitaker - Cultivating Self Development
11. Elizabeth B. Hurlock - Personality Development, Tata McGraw Hill
12. Swami Jagatamananda - Learn to Live (Vol.1 and 2), RK Ashram, Mylapore