Unit IV
Arabic Criticism

Mdoule 1.
- Definition of Literature and Criticsm,

Mdoule 2.
- Development of criticsm in Pre Islamic, Islamic and Umayyath Period, Nabigathu Dubyani

Mdoule 3. Abbasid Period
- Ibnu Quthaiba, Qudamathu bin Jafar, Al Jahiz, Ibnu Sllamul Jumahi,

Mdoule 4.
- Shauqi daif, Thaha Hussain, Sayyid Quthub, Anvarul Jundi

Mdoule 5.
- Appollo Movement, Dewaan movement

Mdoule 6.
- Mahjar Literature, Rabithathul Qalamiyya, Usbathul Undulusiyya, Rabithathul Adabiyya, Jubran Khaleel Jubran, Mikhael Nuaima, Eliya Abu Madi, Naseeb Areeda, Mishael Ma'loof

Unit V
Indo Arabic Literature

Module 1. Arabic Literature in India
- Development of Arabic literature in India, Arrival of Islam in India, Important works in Arabic
- Islamic Institutions Sha Valiyulla al-Dahlavi, Abul Hassan Ali Nadvi and Gulam Ali Azad Balgrami, Anwar Shah Kashmeeri

Module 2. Arabic Literature in Kerala
- Role of Makhdoom Family, Umar Qaazi, Abu Laila, Muhyudeen Aluvayil, N K Ahammed Moulavi

Unit VI
Translation

Module 1. Journal Arabic
- A passage from an Arabic newspaper followed by 5 questions to be answered.

Module 2. Modern Technology
- Match the following questions with Arabic Words related to modern information technology on one side and its translation on other side.

Module 3. Travel and Tourism
- Odd one out (2 questions)
- Select the correct translation (3 questions)

Module 4. Translation (English to Arabic)
- Select the most apt translation of the English phrases below: (English Phrases consisting of at least three words to be given)

Module 4. Translation (Arabic to English)
- Select the most apt translation of the Arabic phrases below: (Arabic Phrases consisting of at least three words to be given)

03. Botany

Unit I
Diversity of Life Forms I

Module 1. Bacteria
- Classification, Ultra structure of cell, flagella, pili, metabolism, growth, reproduction and genetic exchange - transformation, transduction and conjugation

Module 2. Viruses
- Classification, Structure, reproduction. Bacteriophages, lysogenic and lytic cycles. viroids, virions, prions, retroviruses.

Module 3.Phycology
- Classification of algae, General structure, reproduction and life cycle of different groups-Cyanophyceae, Chlorophyceae, Bacillariophyceae, Xanthophyceae, Phaeophyceae, Rhodophyceae. Economic importance of Algae

Module 4.Mycology
- Classification of fungi, General structure, reproduction and life cycle of different groups- Myxomycetes, Zygomycetes, Oomycetes, Ascomycetes, Basidomycetes and Deuteromycetes. Economic importance

Module 5. Lichenology
- Classification, General structure and reproduction , Economic importance

Module 6. Bryology

- Classification, General characters, reproduction and life cycle of different groups- Hepaticopsida, Anthocerotopsida and Bryopsida. Economic importance.

Module 7.Pteridology

- Classification, General characters, reproduction and life cycle of different groups- Psilopsida, Lycopsida, Sphenopsida and Pteropsida, stelar evolution, telome concept Economic importance, Fossil Pteridophytes - Rhynia, Lepidodedron.

Module 8. Gymnosperms

- Classification, General characters, reproduction and life cycle of different groups- Cycadales, Coniferales, Ginkgoales, Gnetales, Fossil Gymnosperms, Economic importance

Unit II
Diversity of Life Forms II

Module 1. Morphology

- Morphological variation in angiosperms with respect to stem, leaf, inflorescence, flower and fruit

Module 2. Taxonomy of Angiosperms

- Artificial (Linnaeus), Natural (Bentham & Hooker) and Phylogenetic (Bessey, Takhtajan), APG system of classification. Plant Nomenclature- Rules of ICBN, Author citation, Typification, Rule of Priority. Publication of names, Keys, autonym, homonym, basionym, and *nomen nudum*. Herbarium, Botanical survey of India, Botanical gardens and their roles in taxonomic studies. Modern trends in taxonomy - Anatomy, Embryology in relation to taxonomy, Chemotaxonomy, cytotaxonomy, numerical taxonomy, Molecular taxonomy. Origin and evolution of Angiosperms. Study the following families using morphological and floral features with economic importance- Annonaceae, Nymphyaceae, Polygalaceae, Brassicaceae, Portulacaceae, Dipterocarpaceae, Malvaceae, Fabaceae, Asteraceae, Rubiaceae, Asclepiadaceae, Solanaceae, Verbenaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Urticaceae, Orchidaceae, Scitamineae, Arecaceae, Poaceae

Module 3. Economic Botany

- Study Binomial, family, morphology of useful parts and utility of,
- Cereals and millets (Rice and Maize), Pulses (Soy bean, Cow pea, Green gram), Oil yielding plants (Coconut, Ground nut, Oil palm), Sugar yielding plants (sugar cane, Sweet potato), Spices and condiments (Turmeric, Cinnamomum, Pepper, Nutmeg and Ginger), Fibre (Cotton, Jute), Dye yielding plants (Indigo, Henna , Annatto), Tuber crops (Tapioca, Potato), Gum and resins(Asafoetida, White dammar, Gum Arabic), Medicinal plants (*Ocimum*, Neem, *Rauwolfia*), Timber yielding Plants (Rose wood, Teak wood, Ailanthus), Narcotics (Opium, Cannabis), Vegetables (Tomato, Brinjal, Cucumber), Rubber (Para rubber)

Module 4. Ethnobotany

- Definition, History and scope of Ethnobotanical studies

Module 5. Histology

- Vascular cambium structure, origin and functions, Normal primary and secondary growth of stem and roots. Structure of wood- Heart, Sap wood,Hard and soft wood. Anomalous secondary growth in the stems of – *Boerhaavia*, *Bignonia* and *Dracaena*, Nodal anatomy and root stem transition, Floral anatomy

Module 6. Microtechnique and Histochemistry

- Killing, Fixing and staining of plant tissues- principles and purposes, Important fixatives and their properties, FAA, Carnoys fluid and Flemmings fluid, Dehydrating agents. Microtome- rotary, sledge, cryotome and ultratome. Different types of stains, Tissue processing techniques for Scanning and transmission electron microscope, Types of micro slide preparations- Temporary, semi-

permanent, permenant- smears and squashes, Methods of embedding plant materials in Paraffin wax – TBA method, Double stained and serial section preparations, Histochemistry and Enzymology- Localization of carbohydrates (PAS) lipids (Sudan Black) and proteins (Coomassie Brilliant Blue) , Principle and protocol of Localization of peroxidase

Module 7. Reproductive Biology

- Asexual reproduction-adventive embryony, nonrecurrent apomixis. Diplospory, apospory, parthenogenesis, androgenesis, apomixis ; Sexual reproduction – microsporogenesis, male gametophyte-pollen fertility, sterility; Megasporogenesis, female gametophyte, types ; Pollination Biology-Primary and secondary attractants of pollination, ultra-structural and histochemical details of style and stigma, Pollen pistil interaction, Fertilization-barriers, incompatibility and methods to overcome it (intra ovarian pollination and *in vitro* fertilization, embryo rescue technique; Embryo, endosperm and seed development, polyembryony and parthenocarpy, Recent advances in palynological studies, Pollen allergy, economic importance of pollen, Melissopalynology, role of apiaries in crop improvement

Unit III
Functional Plant Biology and Analysis Plant Physiology:

Module 1

- Water movements in plants and inorganic nutrition: Diffusion and facilitated diffusion-pressure driven bulk flow, Osmosis driven by water potential gradient, Role of aquaporins, cavitation and embolism, Soil-plant-atmosphere-continuum; physiology of stomatal function.
- Nutrient elements: Physiological roles. Nutrient uptake: diffusion, facilitated diffusion and apparent free space. Passive and active transport. Transport proteins: carriers, Michaelis-Menten Kinetics. Channels: Voltage dependent K+ channels, voltage gated channels, Calcium channels, Vacuolar malate channels. ATPase activity and electrogenic pumps. Patch clamp studies. Application of Nernst equation. Active transport and electrochemical potential gradients.

Module 2. Metabolism

- Nitrogen metabolism: Nitrogen and bio-geocycle, nitrate and ammonia assimilation, biological nitrogen fixation, nitrogenase activity, pathways and enzymes - GS, GOGAT and GDH. Transport of amides and ureides.
- Photosynthesis : Light absorption, electron transfer in chloroplast membranes, ATP synthesis in chloroplast. Photosynthetic carbon reduction and photorespiratory cycles. C4 and CAM metabolism. Starch and sucrose synthesis. Allocation and partitioning: Phloem loading and unloading. Concept of osmotically generated pressure flow. Importance of plasmodesmata in symplastic transport.
- Respiration: Glycolytic reactions, citric acid cycle, electron transfer system and ATP synthesis. unique electron transport enzymes of plant mitochondria: external NAD(P)H dehydrogenase, rotenone and cyanide insensitive respiration.

Module 3. Growth, differentiation and development

- Analysis of plant growth: production of cells, growth velocity profile. Cytological and biochemical events. Differentiation: secondary cell wall formations, multinet growth hypothesis of cell wall. Development: initiation and regulation of development, genes involved in the control of development, role of protein kinases. Types of development: flowering-floral induction, evocation and morphogenesis. Floral organ identity genes. Biochemical signaling: Theories of flowering. Control of

flowering-phytochrome, cryptochrome and biological clock. Factors affecting flowering: Photoperiodism and thermoperiodism. Fruit development and ripening: physiology of ripening- cell wall architecture and softening, enzymes involved in biochemical changes.

- Seed development and germination physiology: deposition of reserves during seed development, desiccation of seeds: hormones involved, desiccation tolerance. Classification of seeds, seed dormancy. Seed germination and reserve mobilization- metabolism of carbohydrates, lipids, proteins and phytins; physiology of seed dormancy.
- Plant growth regulators: Auxins, Gibberellins, Cytokinin, Abscisic acid and Ethylene - biosynthesis, transport, physiological roles, mode of action, commercial uses.

Module 4. Photoreceptors

- Phytochromes - photochemical and biochemical properties, localisation in cells and tissues, phytochrome induced whole plant responses, Ecological functions. Mechanisms of phytochrome regulated differentiation. Signal transduction pathways, role in gene expression. Cryptochromes: blue light hormones photophysiology, effect on stem elongation, gene expression, stomatal opening, proton pumps, phototropism, role of carotenoids.
- Signal transduction. Classes of signals; receptors, signal perception, signal amplification and transduction reactions, role of Ca++ as second messengers, role of Calmodulin .

Module 5. Stress physiology and senescence:

- Water deficit and drought resistance, heat stress and heat shock, chilling and frost, salinity stress, high light stress and heavy-metal pollution stress. Genes associated with senescence, metabolism during senescence.

Module 6. Chemical bonds

- Concept of hybridization, bonding in organic molecules, effect of bonding on reactivity, polarity of bonds-bond length-bond angle-hydrogen bond, dissociation and association constant.
- pH and buffers – Henderson-Hasselbalch equation, pH, pKa, Kw, proton hopping, buffers in living system, common buffers.

Module 7. Carbohydrate

- Specific categories and their properties, metabolism of starch, cellulose and glycogen. Glycolysis, TCA cycle, terminal oxidation, gluconeogenesis, glyoxylate pathway, PPP pathway, glycoproteins and proteoglycans, biosynthesis of peptidoglycan, metabolic mill.

Module 8. Amino acids and proteins

- amino acids – classification, properties, optical activity, unusual amino acids, ninhydrin reaction; basics of biosynthesis and breakdown of amino acids, classification and conformation of proteins, Ramachandran plot, Brief account on the biosynthesis of protein.

Module 9. Lipids

- classification, brief account on compound and derived lipids with examples, classification of fatty acids, biosynthesis of fatty acids (microbes, plants and animals), alpha, beta and omega oxidation of fatty acids, omega fatty acid and functional food, trans-fatty acids and their dangers.

Module 10. Nucleic acid

- : Biosynthesis and break down of purines and pyrimidines. Enzymes for synthesis and degradation; Vitamins: classification, structure, function and source of vitamins, vitamins as coenzymes

Module 11. Enzymology

- structure, function and classification of enzymes, coenzymes, substrate specificity, regulation of enzyme activity, active sites, inhibitors, allosteric enzymes, kinetics, negative and positive co-operativity, multienzyme, isoenzymes, ribozyme, abzyme

Module 12. Energy metabolisms

- concept of free energy, entropy, enthalpy, chemical equilibria, principles of thermodynamics, thermodynamics of phosphate compounds, thermodynamics of life; thermodynamics, kinetics and mechanisms of membrane transport, energy rich bonds, redox reactions.
- Principles and application of tracer techniques in biology, Radio isotopes, radiation dosimetry, radioactive decay, Cerenkov radiation, radiations and their applications in biology.

Module 13

- Principles and applications of light and electron microscopy, phase contrast, fluorescence, scanning and transmission electron microscopy, cytophotometry, flow cytometry, micrometry, camera lucida, photomicrography.
- Instrumentation, principles and functioning of: colorimetry and spectrophotometry, atomic absorption spectroscopy, plasma emission spectroscopy, ORD/CD, centrifugation, ultracentrifugation, electrophoresis, isoelectric focusing, autoradiography, chromatography (TLC, gel filtration, ion exchange, affinity, GC, GC-MS, HPLC, FPLC), NMR, X-ray crystallography, MRI, tools in nanotechnology (Atomic Force Microscopy, Scanning Tunneling Microscope, Scanning Probe Microscope), Fluorescent Microscopy, Flow cytometry, Liquid scintillation.

Module 14

- Measures of central tendencies- mean, median and mode. Skewness and curtosis. Measures of variations- range, quartile deviation, mean deviation- variance and standard deviation. Standard error and Coefficient of variation; Probability: addition theorem and multiplication theorem, conditional probability; Theoretical distributions: binomial, poisson and Normal; Tests of significance- z, t and $\chi 2$ tests; F-distribution and Analysis of variance; Correlation and regression analysis; Factor analysis.

Unit IV
Molecular Cell Biology and Heredity

Module 1. Cell

- Structural organization of cell membrane: chemical composition, structure and function of membrane proteins, lipids and carbohydrates, functions of cell membrane. Structure and functions of cell organelles and sub-cellular particles, Endosymbiont hypothesis, Structure, assembly and disassembly of filaments involved – actin filaments, microtubules and intermediate filaments. Molecular motors- kinesins, dyneins and myosins.

Module 2. Organization of genetic material in eukaryotes

- Phases of cell cycle, cell cycle control mechanisms – extracellular and intracellular signals, cell cycle check points – DNA damage check points, centrosome duplication check points, spindle assembly check points, Cell Division –details of mitosis and meiosis, significance. Apoptosis – mechanism and regulation

Module 3. Cell Cycle

- Structure of chromatin and chromosomes, histones and non-histone proteins, nucleosome structure, chromatin packaging, structure of metaphase chromosome, molecular structure of centromere and telomere, Chromosomal aberrations: Structural and numerical aberrations, Phenotypic effects of chromosomal aberrations, Special types of chromosomes: lamp brush and polytene chromosomes

Module 4. Cell communication and signaling

- General principles of cell communication, signaling molecules and their receptors, cell surface receptors - ion channel linked

receptors, G-protein coupled receptors and Tyrosine Kinase Linked receptors, steroid hormone receptors, Signal transduction pathways, second messengers, regulation of signaling pathways

Module 5. Genetic material: structure, replication and repair

- Experiments which proved that DNA is the genetic material, Chargaff's rule, experiment which proved that DNA replication is semi conservative , Structure of the nitrogen bases, structure of nucleotides, Watson and Crick model of DNA: salient features, alternative forms of DNA, Transposons – types, transposition mechanism; DNA replication(in both prokaryotes and eukaryotes): process, proteins and enzymes involved, end replication problem and the role of telomerases; DNA repair: DNA proof reading, mismatch repair, nucleotide excision repair, base excision repair, direct repair, SOS response and error prone repair

Module 6. Gene expression

- Central dogma of molecular biology, concept of gene, one gene one enzyme hypothesis; Transcription in Prokaryotes: Promoters, RNA polymerase – structure and function, initiation complex, rho dependent and independent termination mechanisms; Transcription in eukaryotes: Promoters, enhancers, and silencers, different types of RNA polymerase and their function, transcription factors – structure and function, elongation factors, termination mechanism; Post transcriptional modification of RNA: Structure, formation and function of 5′ cap and 3′ tail, RNA splicing – types of introns, mechanisms of exon splicing, alternative splicing, exon shuffling, RNA editing ; Translation: salient features of mRNA, tRNA and ribosomes (prokaryotic and eukaryotic), SD sequence and Kozak sequence, tRNA charging , process of translation (prokaryotic and eukaryotic), mRNA surveillance; Genetic code: deciphering the genetic code, salient features of the genetic code, exceptions to the Universal code; Protein sorting and trafficking

Module 7. Gene regulation

- Gene regulation: objectives, different levels; Viral gene regulation: gene regulation in lysogenic repression and lytic cascade; Prokaryotic gene regulation: operon – general structure and types, structure and functioning of *lac* operon and *trp* operon, attenuation and antitermination; Eukaryotic gene regulation: Changes in chromatin and DNA structure, chromatin remodeling, heterochromatization and DNA methylation, RNA silencing, Epigenetics

Module 8. Principles of inheritance

- Mendel's experiments and laws of inheritance, monohybrid and dihybrid crosses – phenotypic and genotypic ratios, back cross and test cross, Mendalian traits in man, Extensions of Mendelism, co-dominance, incomplete dominance, epistasis, complementary interaction of genes, multiple alleles and their inheritance, penetrance and expressivity, cytoplasmic inheritance

Module 9. Linkage and recombination

- Linkage groups, double cross over and interference, two point and three point test crosses, construction of linkage map

Module 10. Population Genetics

- Gene pool, phenotype and genotype frequency, factors affecting gene frequency, Hardy- Weinberg equilibrium

Module 11. Immunology

- Innate and acquired immunity; Humoral and cellular immunity; antigens, epitopes, antigen processing and presentation; activation and differentiation of B cells, role; T cells , types, role; T cell receptors; MHC; monoclonal and polyclonal antibodies, vaccines

Unit V
Ecology and Environment

Module 1. Basic Principles of Ecology

- Basic ecological concepts and approaches – levels of organization – environment, habitat; basic ecological process – biogeochemical cycles, trophic levels, energy flow, ecological pyramids; ecological succession

Module 2. Ecological objects

- Population, community and ecosystems; Population characteristics – distribution, mortality, natality, carrying capacity, population structure and dynamics; genecology, ecads and ecotypes; Community characteristics – classification of plant communities – Clementsian concepts of climax, Raunkiaer's system, Vegetation concept of Gleason, Phytosociological methods; Ecosystem characteristics - food chain, food web, ecological niche, biodiversity – genetic, species and ecosystem diversity, alpha, beta and gamma diversity; major ecosystems of the world and their characteristics; Biomes and Biosphere characteristics – ecosystem degradation – deforestation and desertification

Module 3. Environmental Pollution

- Concept of pollution, Environmental quality parameters and standards, different categories of pollution – air, soil and water; air water and soil quality parameters; pollutants – primary and secondary pollutants – heavy metal pollution – biocide residues - biomagnification; prevention and control of pollution and pollution abetment – primary, secondary and tertiary water treatment

Module 4

- Global environmental issues – ozone depletion, acid rains, global warming and climate change – greenhouse gases and emission control – global conventions on carbon dioxide emissions; radiation fallout, noise pollution – occupational hazards

Module 5. Basic principles of conservation and preservation

- Conservation strategies – *in situ* and *ex situ* conservation – botanical gardens – wildlife sanctuaries, national parks and biosphere reserves – International conventions on biodiversity – role of IUCN and the criteria of species conservation, categories of species under conservation – threatened and endangered species – red data book – CITES

Module 6. Natural resources

- Conservation of natural resources – conservation agriculture – mixed farming, natural farming, ecofarming, organic farming, natural measures of pest control, biofertilizers, energy conservation – nonconventional energy resources – biomass energy – biogas – biofuels – biodiesel

Module 7. Phytogeography

- Basic concepts and significance - static and dynamic phytogeography geological history of plant distributions – theories of plant distributions – continental drift and glaciations - paleotropic and neotropic vegetation – different kinds of plant distributions - circumaustral – circumpolar – pantropic – cosmopolitan - floristic provinces and vegetational belts – soil, climate and vegetation of India

Module 8. Evolution

- Origin of the universe – big-bang theory – origin of life and origin of species – Oparin's theory - theories of evolution of life – *elan vitae* – comparative accounts of evolutionary concepts of Lamark and Darwin – role of mutation in evolution – forces and mechanisms of evolution of life – speciation – isolation mechanisms – co-evolution of species into communities - molecular evolution

Unit VI
Applied Botany

Module 1. Biotechnology

- Tissue culture techniques; Explants, culture media, differentiations, micropropagation, meristem culture, callus culture, shoot tip, nodal culture, organogenesis, cell suspension culture, cell line selection, hairy root culture; Somaclonal variation; Somatic embryogenesis- artificial seeds, protoplast culture, somatic hybridization; Haploid production- anther and ovule culture, dihaploids & polyploids, applications; Cryopreservation, Bioreactor technology, cell immobilization, Genomic and organelle DNA isolation, vector mediated and vectorless methods of gene transfer, PCR, restriction digestion, ligation, DNA sequencing, Genomic and cDNA libraries; Analysis and expression of cloned genes
- DNA markers, RFLP, RAPD, ISSR, SSR, SNPs, AFLP, LCR, Genetic engineering; Transgenic biology, allopheny, transformation techniques, gene targeting, RNAi technology
- Microbial biotechnology; Major products of industrial microbiology, compounds use in medicine, health- antibiotics, amino acids, organic acids, vitamins, sex hormones, Bioploymers, biosurfactants, biopesticides; Bioconversion processes- biotransformation, biodegradation and bioleaching; GMO- Bt plants, Herbicidal reistance, viral coat protein, satellite RNA , Flavr savr tomato, golden rice, Biofortification; Social ethical issues IPR, patents, biopiracy and bioregulations

Module 2. Bioinformatics

- Biological databases ; EMBL, GEN BANK, DDBJ, Protein sequence data bases- PIR, SWISS-PROT, Secondary data bases (PROSITE); Protein structure databases (PDB), Data base mining, data bases similarity searches- comparing nucleotide and amino acid sequence – BLAST, FASTA, Sequence analysis- global alignment, local alignment, pairwise analysis, scoring matrices, multiple sequence analysis , phylogenetic analysis, structure analysis tool – RASMOL, Molecular phylogenetic programmes- CLUSTAL, Pharmacogenomics; Application of Bioinformatics Transcriptomics, metabolomics, Pharmocogenomics, Genomics, types, structural and functional, genome annotation, gene finding, single nucleotide polymorphism.

Module 3. Horticulture

- Plant growing structures-Green house, mist chambers, glass house; Plant propagation-seed, vegetative- natural and artificial; Artificial methods of vegetative propagation-cutting, layering, grafting, budding, Cultural practices – thinning, training, trimming and pruning; Commercial horticultural-nurseries, orchards, floriculture, indoor plants, arboriculture- pruning, bracing, transplanting; Bonsai: Principles and procedure

Module 4. Plant Breeding

- Plant introduction, Vavilos centres of origin, genetic erosion, gene bank, NBPGR, selection (Mass and pureline and clonal) hybridization - interspecific and intergeneric
- Incompatibility and crop improvement, Backcross breeding, Inbreeding consequences, idiotype breeding Polyploidy breeding; auto and allopolyploid, chromosome addition and substitution, achievements, Mutation breeding; Objectives, procedures, chemical and physical mutations and achievements; Resistance breeding; Principles, methodology- structural, biochemical, physiological and genetic, vertical and horizontal resistance; Seed certification-Plant breeder's right act, National Biodiversity policy

Module 5. Plant Diseases and Management

- Host parasite interactions, Etiology of the following diseases- False smut of Paddy, Powdery mildew of Rubber, Coffee rust, Red rust of tea, Leaf spot of Mango, Yellow vein

mosaic of ladies finger, quick wilt of pepper, Defense mechanism- systemic acquired resistance and induced systemic resistance, Quarantine., Plant disease controls-chemical, physical and biocontrol agents

04. Chemistry

Unit I
Inorganic Chemistry

Module 1. Periodicity and Chemistry of Main Group Elements

- Periodic properties of elements and periodic trends in physical and chemical properties. Anomalies in periodic properties of the nonmetals and post transition metals. Concepts of resonance and hybridization. VSEPR model. General discussion on main group elements. Noble gas compounds. Classification, Preparation, Properties, Application and Structure of borides, carbides, nitrides, silicates, silicones and, fullerenes. Inter halogen and pseudo-halogen compounds. Boron hydrides and carboranes- Styx numbers and Wade's rule. Borazines, P-N compounds,S-N compounds and molecular sulfides of phosphorus.

Module 2. Chemistry of transition and inner transition elements

- Transition Elements - Electronic configuration, oxidation state and general characteristics. First, second and third rows of transition elements and their important compounds. Isopoly and heteropoly acids of Mo and W. Lanthanides and Actinides - Occurrence, electronic configuration, oxidation state, atomic and ionic radii, ions. Difference between 4*f* and 5*f* orbitals. Separation of Lanthanides and Actinides Lanthanide and Actinide contractions and their consequences. Use of Lanthanide complexes. NMR shift reagents. Magnetic and spectral properties. Applications of Lanthanides, Actinides and their compounds. Trans actinide elements. Super heavy elements.

Module 3. Co-ordination chemistry

- Nomenclature of coordination compounds. Isomerism and stability. HSAB Principle.VB theory, Spectrochemical series and crystal field theory. Splitting of levels in Cubic, Td, Oh, TBP, square pyramidal and Tetragonal ligand fields, MO theory (Tetrahedral and Octahedral complexes with sigma and pi bonding). Reaction mechanism – Dissociative, Associative and Conjugate Base mechanisms. Electron transfer reactions- Inner sphere and outer sphere mechanisms. *Trans* -effect. Jahn- Teller effect and its consequences. Electronic spectra of transition metal complexes, selection rules, Term symbols, Orgel diagram, Racah parameters. Nephelauxetic effect. Charge- transfer spectra. Magnetic properties of transition metal complexes, Spin- only formula, quenching of orbital magnetic moment, Spin orbit coupling. Measurement of magnetic moment. Paramagnetism, diamagnetism, ferromagnetism, ferrimagnetism and antiferromagnetism.

Module 4. Organometallic chemistry

- Types of organometallic compounds, 18 electron rule and Hapticity. Metal carbonyls General properties, nature of bonding ,structure and shapes of metal carbonyls of V, Cr, Mn, Fe, Ru, Co, Rh, Ni, metal alkane and alkene complexes, metal sandwich compounds - ferrocene, dibenzene chromium. Fluxional organometallics. Metal carbenes. Metal clusters as catalysts. Applications of organometallic compounds Hydrogenation, hydroformylation, Wacker's process, Ziegler- Natta catalysis, Monsanto acetic acid process.

Module 5. Bioinorganic chemistry

- Metals and non- metals in biological systems. Metal ion excess and deficiency.Role of alkali- and alkaline earth metal ions in biological systems. Na/K pump. Ca pump. Role of Iron, Copper, Zinc, Manganese,