CY-699 NANOSENSORS

Classification of sensors: Optical sensors, Chemical sensors, Electrochemical sensors, Mass sensitive sensors, Biosensors, mechanism of chemical and biological recognition: biomimetic systems, (bio) chemical selectivity, immobilization techniques. Nanosensor Synthesis- Bottom up approach: (a) Nanosphere Synthesis: microemulsion, Ostwald ripening, Electrical: Zeta potential Measurement, steric hindrance, aggregation kinetics, Particle stability, role of thermodynamics and kinetics in determining shape and size.(b) Nanoparticle Separation: Rate Zonal Centrifugation, Chromatography & electrophoresis .Nanoparticle Surface Modification: Stabilization against aggregation, Phase transfer: Ligand exchange, Ligand modification, Polymer coatings, Silanization, Particle functionalization: Chemical functional groups Biomolecules, Fluorescent dyes, Multi-functional nanoparticles. Optical nanosensors: Optical absorption properties of nanomaterials, colorimetric sensing strategies, Noble Metal Nanoparticles, Colorimetric Gold Nanoparticle Spectrophotometric Sensor, Fluorescent pH-Sensitive Nanosensors, Quantum Dots as fluorescent labels, Techniques of optical detection: absorptiometry, UV-visible apsorption spectroscopy, reflectometry, luminescence spectroscopy, light scattering techniques, direct and indirect methods, indicator based systems. Analytical figures of merit: selectivity, sensitivity, precision, accuracy, response time, repeatability, reversibility. Applications of nanosensors: Applications in detection of ions, small organic molecules, cancer cells, proteins.

CY-602 ADVANCED RESEARCH METHODOLOGY

Planning Your Project: From topics to questions, from questions to problems, from problems to sources, using sources . Making Claims and Support it: Making Good Arguments: an overview, Qualifying claims to enhance your credibility, Reasons and Evidence; Acknowledgments and Responses, warrants. Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Mechanics of Writing a Research Report . Drafting and Revising: Planning and Drafting, Using Quotation and Paraphrase, Revising Your Organization and Argument, Titles and Abstracts, Introductions and Conclusions, Establishing Common Ground, Stating Your Problem, Stating Your Response, Conclusions, Communicating Evidence Visually, Tables vs. Figures, Constructing Tables, Constructing Figures, Revising Style: Telling Your Story Clearly, Judging Style, A First Principle: Stories and Grammar, A Second Principle: Old Before New, Choosing between Active and Passive, Complexity Last, Spit and Polish(Comprehensive and critical review of the published literature in the proposed field of study.)

CY-603 DESIGN OF EXPERIMENTS

Controllable and Uncontrollable Factors, Single Factor Experiment, ANOVA, Randomized Blocks, Latin Squares, Introduction to Factorial Designs, 2k Factorial Design, Two-Level and Three-Level Full Factorial Experiments, Blocking, Confounding, Two-Level and Three-Level Fractional Factorial Designs, Mixed-Level Factorial and Fractional Factorial Designs, Fitting Regression Models, Experiments with Random Factors. Plackett-Burman designs, Design efficiency, design resolution, statistical power of a design, Design augmentation; practical strategies for cost-effective screening, Using DoE to set raw material specifications. Case studies from related publications.

CY-604 RETROSYNTHETIC ANALYSIS

Organic Reactions for Retro Synthesis: Functional Group Interconversion, Reverse of polarity, Cyclization reactions, Chemoselectivity, Regioselectivity and stereoselectivity, Protection and deprotection of some functional groups, Rearrangements. Disconnection Approach (One group disconnection): One group C-X disconnection, One group C-C disconnection of alcohol, One group C-C disconnection of carboxyl

compounds. Disconnection Approach (Two group disconnection): Two group C-X disconnection, Two group disconnection/ Diel's Alder Reactions, Two group disconnection/1,3 Difunctionalized compound and α , β-unsaturated carbonyl compound, Two group disconnection/1,3 Difunctionalized compound, Micheal addition and Robinson Annelation, Two group disconnection:1,2-, 1,4- and 1,6- Difunctionalized compounds. Reconnections: Amine synthesis, Alkene synthesis, 3,4,5 and 6 membered rings, pericyclic reactions, aromatic heterocycles, Use of acetylenes, carbonyl condensation.Biocatalysis: Basics and principles, Combining biocatalysis with chemo-catalysis, Development of biocatalysts (New technologies), Applications of biocatalysts in target molecule synthesis, Application of synthetic biology tools. Retrosynthetic Considerations and Syntheses of Complex, Biologically Active Molecules: Synthesis of Racemic Chloramphenicol, Synthesis of Racemic Menthol, Relationship of Asymmetric and Nonstereoselective Syntheses, Non-stereoselective Synthesis of Sertraline, Stereoselective Synthesis of Racemic α - and β -Lycorane.

CY-605 ADVANCED CHROMATOGRAPHY AND MASS SPECTROMETRY

Advanced theoretical treatment of chromatographic separation and the underlying distribution and adsorption equilibria. Instrumentation and theoretical concept for chromatographic separation with selective detectors. Molecular mechanism and theory of analyte-column interactions for liquid and gas chromatography. The theory of ionization, fragmentation, mass separation, detection and data-analysis for all kind of mass spectrometers and ionization techniques in common use coupled to gas chromatography, liquid chromatography and capillary electrophoresis.laboratory exercises including liquid chromatographic separation and mass spectrometric detection of nanoclusters.

CY-608 ADVANCED ORGANIC SYNTHESIS

Functional Group Chemistry: Acylation, alkylation, halogenation, oxidation and reduction of the olefinic group, acetylenic group, nitriles group and the carbonyl groups. Reaction in Organic Synthesis: Gattermann Koch reaction, Riemer-Tiemann reaction, Claisen condensation, Dieckmann condensation, Aldol condensation, Knoevenagal reaction, Perkin reaction, Stobbe reaction, Micheal addition reaction, Mannich reaction, Wittig reaction, Diels-Alder reaction, Hunsdiecker reaction. Selectivity in Reactions: Chemoselectivity, Regioselectivity and Stereoselectivity. Organometallic Chemistry: Bonding and reactions in transition metal complexes, use of palladium in homogenous catalysis, Heck reaction, Cross coupling of Organometallics and halides, Palladium catalyzed reaction of aromatic rings, Alkenes coordinated to Palladium are attacked by nucleophiles. Green Chemistry: Future challenges in working with chemical processes, environmental friendly reaction, Nontoxic Solvents and Auxiliaries.

CY- 609 ADVANCED SPECTROSCOPIC TECHNIQUES AND THEIR APPLICATIONS

Mass Spectrometry: Instrumentation and sampling, Fragmentation patterns, Ionization techniques, elemental composition from mass spectrum. NMR Spectroscopy: Interpretation of 1H- and 13C-NMR spectra, factors affecting the chemical shifts and coupling constants. Advanced NMR Techniques: Recent advances and structure elucidation of organic molecules from 1D and 2D NMR spectroscopy including J-resolved, shift correlated and multiple quantum spectra, inverse measurements, nuclear Overhauser effect and its applications. Practical Aspects of NMR: Practical Sampling, Recording, Software handling, monitoring of Reaction proceeding, Product purity.

CY-610 MICROWAVE ASSISTED ORGANIC SYNTHESIS

Microwave Assisted Organic Synthesis (MAOS): Theory, Loss factors of different solvents, Microwave Effects, Processing techniques, Difference b/w Conventional & MW Heating, Advantages of MOAS, Higher Temperatures, Scalability, Homogeneity, Reproducibility, Flow chemistry, Open and Closed Vessel Techniques. Microwave Instruments: History, Overview of different types Domestic MW Reactors,

Dedicated MW reactors, Comparison of advantages and applications of different instruments, Synthesizer, Initiators, CEM, Single and Multimode Reactors.Types of Reactions:Theory and Practical approach Transition-Metal-Catalyzed CC Bond Formations Reactions, Transition-Metal-Catalyzed Carbon–Heteroatom Bond Formation Reactions.

CY-611 ELECTROCHEMISTRY AND APPLICATIONS

Electrochemical Techniques: Controlled potential micro electrode techniques including potential step and potential sweep process, reversible, irreversible, and quasi-reversible systems. Controlled current micro electrode techniques at planar and spherical electrodes, Concentration profiles, Polarography and Voltammetry. Forced Convection-Hydrodynamics Methods: Impedance based circuits, equivalent circuits, kinetic parameters, A.C. voltammetry, A.C. polarography. Bulk Electrolysis Methods: Classification, Controlled potential methods, electro gravimetric and electro-separation methods. Experimental aspects: Potentiometry, polarography, voltammetry, amperometry, chronopotentiometry, coulometry, and electrophoresis, computer software used in electrochemistry.

CY-612 MICROBIAL ASSAY RESEARCH TECHNIQUES

Culture Preparation: Preparation of various types of culture media; sub culturing of common aerobic and anaerobic bacteria, fungus and yeast. Sterilization techniques: Various types of Sterilization techniques and their validation. Isolation and Purification: Isolation of microorganism from the soil, study of production of microbial enzymes such as amylases and proteases etc. Biological Evaluation: Antimicrobial testing by using agar well, tube dilution and disk diffusion method and micro titer plate method. Determination of MIC and MBC. Introduction to tissue culture technique. Determination of cytotoxicity and anticancer activity. Determination of antiviral activity. Determination of antioxidant activity by DPPH method. Determination of anti-biofilm activity.

CY-616 NANOMATERIALS

Nanomaterials, classification, Fundamentals, Clusters and Superamolecular, Structure and Bonding in Nanomaterials, Bulk to Surface transition, surface, reconstruction, Self-assembly and thermodynamic, Nanomaterial Synthesis, Chemical routes, Electrochemical Methods, Vapour growth, Thin Film Method, Carbon nanotubes, fullerenes, nanowires, porous silicon, Bio-inspired synthesis. Nanocomposite fabrication, Nanolithography, Nanomaterial Characterization Techniques including Scanning and Transmission Electron Microscopy, Scanning Probe Microscopies, Atomic Force, scanning tunneling microscopy, Diffraction and scattering techniques, Vibrational Spectroscopy, Surface Techniques, Applications as Nano-electronics, Nano optics, Nanoscale Chemical- and bio-sensing Biological/biomedical applications, Photovoltaic, fuel cells, batteries and energy related applications.