SYLLABUS FOR COMPUTER BASED TEST-TO BE HELD ON MARCH 19, 2017 (SUNDAY)
ENGAGEMENT OF FIXED TERM PROJECT ASSISTANTS

I. CHEMISTRY

General Chemistry, Organic, Inorganic, Physical Chemistry covering
Catalysis, Chemical kinetics, thermodynamics, electrochemistry, organic reactions, surface chemistry, spectroscopy, analytical chemistry, co-ordination and inorganic complexes, organometallics and so forth.

II. Chemical Engineering & Petroleum Refining

Process Calculations and Thermodynamics

Steady and unsteady state mass and energy balances including multiphase, multicomponent, reacting and non-reacting systems. Use of tie components; recycle, bypass and purge calculations; Gibb's phase rule and degree of freedom analysis. First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

Fluid Mechanics and Mechanical Operations

Fluid statics, Newtonian and non-Newtonian fluids, shell-balances including differential form of Bernoulli equation and energy balance, macroscopic friction factors, dimensional analysis and similitude, flow through pipeline systems, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds, Turbulent flow: fluctuating velocity, universal velocity profile and pressure drop. Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitation and mixing; conveying of solids.

Heat Transfer

Steady and unsteady heat conduction, convection and radiation. Thermal boundary layer and heat transfer coefficients Boiling, condensation and evaporation Types of heat exchangers and evaporators and their process calculations, cooling towers, furnace calculations. Design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.

Mass Transfer

Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; Stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts Design and operation of equipment for distillation (flash, multi-

component distillation etc), absorption and stripping, leaching, liquid-liquid extraction, drying, membrane separation, humidification, dehumidification and adsorption.

Chemical Reaction Engineering

Theories of reaction rates ; Kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; Development of rate laws, Residence time distribution, single parameter model; Non-isothermal reactors; Catalysis and catalytic reactions, catalyst deactivation and regeneration, Kinetics of heterogeneous catalytic reactions; Diffusion effects in catalysis. Different type of industrial reactors - Fixed bed, fluidized bed, trickle bed, slurry bed.

Instrumentation and Process Control

Measurement of process variables ; Sensors, transducers and their dynamics ; Process modeling and linearization; Transfer functions and dynamic responses of various systems, systems with inverse response, process reaction curve, controller modes (P, PI, and PID); Control valves; analysis of closed loop systems including stability, frequency response, controller tuning, cascade and feed forward control.

Plant Design and Economics

Principles of process economics and cost estimation including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow, Interest and investment costs, taxes and insurance, material selection and equipment fabrication Computer aided design, Optimization in process design and sizing of chemical engineering equipments such as compressors, heat exchangers, multistage contactors, reactors etc.

Chemical Technology

Inorganic chemical industries (sulfuric acid, phosphoric acid, chlor-alkali industry) Fertilizers (Ammonia, Urea, SSP and TSP) Natural products industries (Pulp and Paper, Sugar, Oil, and Fats) Petroleum refining and petrochemicals Polymerization industries (polyethylene, polypropylene, PVC and polyester synthetic fibers).

Transport Phenomena

Transport of momentum, heat and mass by molecular motion – Newton's law of viscosity, Fourier's law of heat conduction and Fick's law Transport properties – Viscosity, Thermal conductivity and Mass diffusivity. One-dimensional mathematical models for transfer processes using shell balance of momentum,heat &mass. Development of general differential equations for transfer of momentum, heat and mass and their applications in solving one-dimensional steady and unsteady problems. Boundary layer theories. Turbulent transport and Interphase transport.

III. Microbiology

Microbiology and Biotechnology
Microbial Identification, Microbial Nutrition, Microbial growth, Microbial metabolites, Microbial enzymes,

Environmental Microbiology /Biotechnology
Biodegradation, Bioremediation, Role of Microbiology in effluent treatment, Applications of biosensors in environmental monitoring

Bioprocess technology
Bioreactors, Types of fermentations, Scale-up, Lignocellulosic Biofuels production, Biomass pretreatment, Enzymatic hydrolysis

Analytical Instrumentation and methods
Analytical instrumentation in microbiology / biotechnology research. HPLC, GC, Spectrophotometry, Biomass analysis, Biofuels analysis, Analytical method development.

IV. Molecular Biology

Basics of Molecular Biology
DNA, RNA, Proteins, Genes, Enzymes
Microbial Molecular Biology
DNA isolation techniques, Microbial identification, Microbial recombinant hosts, Mutagenesis, Basics of Cloning and screening
Separation of DNA and proteins
SDS PAGE, Agarose Gel Electrophoresis, Sample preparation, Types of Chromatography, Gel staining and imaging,
Molecular Techniques and Instrumentation
DNA amplification techniques, Gene transfer methods, PCR, electroporators, Protocol for DNA, RNA and protein estimations.