Important Information - About Computer Based Test (CBT)

The computer based test (CBT) is scheduled to be held on Sunday, 14th October,2018 for the following streams only

i. **FTPA: BSC/MSc**
   Chemistry/Microbiology/Biotechnology
ii. **FTPA**: **Diploma**
   Chemical Engineering/Chemical Technology/Petroleum Refining
iii. **FTRA**: **M-Tech Chemical Engineering**
   Chemical Engineering/Petroleum Refining & Petrochemicals
iv. **FTRA: M-Tech Electrical/Electronics/Mechanical Engineering**

- **Admit card with venue details and other instructions shall be sent to the candidates after review of the application, subject to the meeting of eligibility criteria.**
- **The admit card shall be sent to the registered e-mail id and has to be brought to the test centre.**
- **Candidates are required to download admit card online as no separate physical copy of the admit card will be dispatched.**
- **For Queries related to CBT/Admit Card etc Candidates can contact helpline No: 022-62507717, Email:** hpcloct18@onlineregistrationform.org

Syllabus for Fixed Term Project Assistants

1. BSC/MSC -Chemistry Exam Syllabus

Inorganic Chemistry	Chemical periodicity, Structure and bonding in homo- and heteronuclear molecules, VSEPR Theory, Concepts of acids and bases, Main group elements and their compounds: synthesis, structure and bonding, Transition elements and coordination compounds, spectral and magnetic properties, Organometallic compounds: synthesis, bonding and structure, reactivity and catalysis, Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods, Characterization of inorganic compounds by IR, Raman, NMR, EPR, UV-vis, MS, electron spectroscopy and microscopic techniques, Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques
Physical Chemistry	Basic principles of quantum mechanics: Postulates; operator algebra; particle-in-a-box, harmonic oscillator, hydrogen atom, tunneling; Atomic structure and spectroscopy; MO and VB theories; Chemical applications of group theory; symmetry elements; point groups, Molecular spectroscopy: Rotational, vibrational spectra; electronic spectra; IR and Raman Spectra – selection rules; magnetic resonance, Chemical thermodynamics: Laws, state and path functions; Maxwell's relations; spontaneity and equilibria; Le Chatelier principle; phase equilibria and phase rule; thermodynamics of gases, and solutions. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; Electrochemistry, Chemical kinetics: Empirical rate laws, temperature dependence; steady state approximation; determination of reaction mechanisms; collision and transition state theories, enzyme kinetics, Colloids and surfaces; isotherms and surface area; heterogeneous catalysis Solid state: Crystal structures; Bragg's law; Polymer chemistry, Data analysis: Mean and standard deviation; absolute and relative errors
Organic Chemistry	IUPAC nomenclature, stereochemistry: Configurational and conformational isomerism; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction. Aromaticity, Organic reactive intermediates: carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes: Organic reaction mechanisms: addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Common named reactions and rearrangements. Organic transformations: Functional group interconversion; common catalysts and reagents, Chemo, regio and stereoselective transformations. Asymmetric synthesis,substrate, reagent and catalyst controlled reactions; enantiomeric resolution – optical and kinetic; Pericyclic reactions; photochemical reactions, heterocyclic compounds; Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids, structure determination by IR, UV-Vis, 1H & 13C NMR and Mass spectroscopic techniques.

2. BSC/MSC -Microbiology/Biotechnology Exam Syllabus

Microbiology/Biotechnology	Microbiology- bacteria, yeast and fungus, Culturing methods, Alcohol and acid fermentations, Bioconversion, Lignocellulosic biofuels, 3G fuels, bioprocesses, upstream and downstream processing, Fundamentals of Microbial molecular biology and techniques, molecular biology instruments, Basic biochemistry.

3. Diploma- Chemical Engineering/Chemical and Petroleum Refining Exam Syllabus

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, Non-isothermal reactors
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.

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).

Syllabus for Fixed Term Research Associates

1. M.Tech -Chemical Engineering Exam Syllabus

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 and 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.

2. M.Tech -Mechanical Engineering Exam Syllabus

Tribology of engine lubricants	Basic concepts of Applications of lubricant, Thick and thin lubrications, Lubrication mechanisms, Properties of Lubricants, Lubricant Additives
Basic and applied thermodynamics	Zeroth Law, Fundamental Concepts of thermodynamics, Different Kind of Energies, First and second laws of thermodynamic -their Corollaries. Concept of entropy, Availability, irreversibility and Available Energy. Properties of Pure Substances. Gas power cycles and performance of Internal combustion engines.
Solar energy	Solar energy systems, solar thermic fluids & their properties,
Heat transfer:	Basic modes of heat transfer and their governing equations. Mechanisms of conduction convection and radiation. Heat exchangers – effectiveness, overall heat transfer coefficient, compact heat exchangers. Heat transfer of solar thermic fluids
Nano technology for engineering applications	Nano materials, their special properties and Nano technology for engineering applications

3. M.Tech -Electrical/Electronic Engineering Exam Syllabus

Control System	Mathematical modeling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Stability analysis, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, State transition matrix.
Signals and Systems	Signals and Systems Representation of continuous and discrete-time signals, Shifting and scaling operations, Linear Time Invariant and Causal systems, Fourier series representation of continuous periodic signals, Sampling theorem, Applications of Fourier Transform, Laplace Transform and z-Transform
Electric & Hybrid vehicles	Introduction of electric & hybrid vehicles, Architecture and control of HEVs, Power Electronics in HEVs, Battery chargers for EVs & PHEVs.

Battery Management Systems	Application of power electronics in rechargeable batteries, Battery charge management, Cell balancing, SOA of battery power electronics.
Electric Drives	Introduction to electric drives, characteristics, advantages, speed control methods of drives.
Renewable energy sources	Introduction, advantages, their effect on environment, solar and wind energy.
Network Theory	Network graph, KCL, KVL, Node and Mesh analysis, Transient response of dc and ac networks, Sinusoidal steady-state analysis, Resonance, Passive filters, Ideal current and voltage sources, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem, Two-port networks, Three phase circuits, Power and power factor in ac circuits.
Power Electronics	Characteristics of semiconductor power devices: Diode, Thyristor, Triac, GTO, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost converters; Single and three phase configuration of uncontrolled rectifiers, Line commutated thyristor based converters, Bidirectional ac to dc voltage source converters, Issues of line current harmonics, Power factor, Distortion factor of ac to dc converters, Single phase and three phase inverters, Sinusoidal pulse width modulation.
Programming Language	Basics of C and C++, programming in C, Programming in C++
Power System	Power generation concepts, ac and dc transmission concepts, Models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential and distance protection; Circuit breakers, System stability concepts, Equal area criterion.
Machine	DC machine, induction machine, alternator, transformer: principles, characteristics and applications