DHANAMANJURI UNIVERSITY

DEPARTMENT OF CHEMISTRY
DHANAMANJURI UNIVERSITY, MANIPUR

NOTIFICATION

Imphal, 12th February 2026

No. 1/2/2025-CHEM-DEPT/DMU/Ph.D./3 : It is hereby notified for all concerned that the Qualifying Entrance Test (QET) for admission to Pre-Ph.D. Programme-2026, Chemistry, DMU will be held as per the information given below:

A.	**Written Test**		
	1.	Date	: 18th February 2026
	2.	Reporting Time	: 10 a.m.
	3.	Time	: 11 a.m.–1 p.m.
	4.	Venue	: Department of Chemistry, DMC Sc., DMU
B.	**Interview**		
	1.	Date	: 23rd February 2026
	2.	Time	: 10 a.m. till end
C.	**Issue of Admit Card**		: 13th -16th February 2026 (10 a.m. – 2 p.m.) (Dept. of Chemistry, DMC Sc., DMU)

Notes:

1. The Qualifying Entrance Test (QET) will consist of 25 multiple-choice questions (MCQ), each carrying 2 marks, focused on Research Methodology, and 25 multiple-choice questions (MCQ), each carrying 2 marks, based on subject-specific topics from the M.Sc. Chemistry syllabus (Semester-I & II) of Dhanamanjuri University which can be downloaded from University Website (www.dmu.ac.in)./Dept. Notice Borad.
2. The minimum qualifying marks for the Interview are 50% of the total marks of the QET for unreserved candidates, and 45% for candidates in the SC/ST/OBC/EWS/Differently-abled categories and other categories of candidates as per the decision of the Commission/State Government from time to time.
3. Only candidate who qualified in QET shall be allowed for Interview for the final selection.
4. Dhanamanjuri University may admit students who qualify for fellowship/scholarship in UGC-JRF/NET/UGC-CSIR-JRF/NET/DBT-JRF/GATE and similar National level tests and who have passed M/Phil. Course and shall be exempted from appearing written entrance test and shall be selected based on an interview.
5. The final selection of candidates shall be made based on the performance in the interview only (QET qualified & QET exempted candidates). The interview shall carry 50 marks consisting of two components, viz., a presentation (power point presentation) on a research proposal of their choices (20 marks) and a personal interview (30 marks).
6. Candidates should bring all the relevant original documents at the time of interview.
7. Syllabus for Research Methodology is annexed as **Annexure-I.**

12/2/2026

(Prof.R.K. London Singh)
Chairman
Pre-Ph.D. Admission Committee
Department of Chemistry
Dhanamanjuri University, Manipur

Copy to:

1. PS to Vice-Chancellor, DMU
2. Registrar, DMU
3. Dean, School of Mathematical and Physical Sciences, DMU
4. Finance Officer, DMU
5. Controller of Examinations, DMU
6. Webmaster, DMU- for kind upload to University Website
7. Notice board
8. Guard file

12/2/2026

(Prof.R.K. London Singh)
Chairman
Pre-Ph.D. Admission Committee
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Annexure-I

Syllabus of Research Methodology

Meaning of Research; Objectives of Research; Types of Research; Significance of Research; Challenges and Problems during research; Basic principles of experimental designs; Selection of Research Topics; Design of synopsis writing; Preparation of literature review; Methods of collecting primary and secondary data; Importance and methods of editing and data validation; Writing of results and discussions; Preparation of References/bibliography; Basic concept of thesis writing and report generation; Preparation and writing of research and Review papers.

CHEMISTRY SYLLABUS FOR QET PRE-PH.D. PROGRAMME-2026, DMU

SEMESTER I

Unit.1 Statistics and Numerical Methods

Mean and Standard Deviation. Un-weighted and Weighted averages, Absolute and Relative Errors. Statistical treatment of Random Errors. Least squares fitting: linear and non-linear, Correlation Coefficient. Numerical Differentiation and Integration (Trapezoidal Rule, Simpson's Rule), Ordinary Differential Equations (Runge-Kutta methods).

Unit.2 Calculus

Functions, derivatives, limits, physical significance, maxima and minima and application in chemistry. Exact and inexact differentiation, curve sketching, partial differentiation, rules of integration, integration by Substitution, integration by Parts, integrals using Partial Fractions

Unit.3 Matrices and Linear Equations

Matrix algebra: addition and multiplication, inverse, adjoint and transpose of matrices, unit and diagonal matrix, Hermitian matrix. Simultaneous linear equation, homogeneous linear equation, non-homogeneous equation, condition for consistency.

Unit.4 Differential equations and Vectors

Separation of variables, homogeneous, exact, linear equation of second order series solution method. Vectors, dot, cross, triple products; gradient, divergence and curl, Eigen values and Eigen vectors, diagonalization of matrices.

Unit.1 Coordination Chemistry

Crystal field theory and limitations, Jahn-Teller effect, tetragonal distortion. Ligand field theory, Experimental evidence of metal-ligand orbital overlap, Nuclear Magnetic resonance, Infrared, Nephelauxetic effect, intensities of d-d transition. Molecular orbital theory of octahedral and tetrahedral complexes (only qualitative principles involved). Theoretical failure of ionic model in coordination complexes**.**

Unit.2 Radiochemistry and applications

Radiochemistry, different types of nuclear reactions, interactions of radiations with matter, Q-energy, cross section, G-M and Scintillation Counters. Typical reactions involved in preparation of radioisotopes (^{3}H, ^{14}C, ^{22}Na, ^{137}I, ^{99m}Tc and ^{32}P). Applications of radioisotopes, radio diagnostics and radiopharmaceuticals, physiochemical applications, diffusion coefficients, solubility of substances agricultural and analytical applications, neutron activation analysis and X-ray fluorescence.

Unit.3 Inorganic Reactions-I

Nature of substitution reactions, classification of nucleophilic substitution reaction (ligand substitution reaction), mechanism of ligand substitution reactions, and their reaction profiles (energy profiles). Factors affecting the rate of ligand substitution reactions. Lability and inertness of the octahedral complexes based on VBT and CFT. Acid hydrolysis and base hydrolysis reactions of Co (III) complexes.

Unit.4 Environmental Chemistry

Atmosphere: Vertical structure and its chemical composition, reaction of air in stratosphere, mesosphere and ionosphere, stratospheric chemistry, particles, ions and radicals.
Air Pollution: Gases and particulate pollutants formation and its effects.
Water Pollution: Toxicity and biochemical effects of arsenic, cadmium, lead, mercury. Biochemical effects of pesticides-DDT, organophosphate, organochlorine and malathion; algae nutrients and eutrophication. Water quality parameters and waste water treatment (primary, secondary and tertiary), objective of water analysis
Soil pollution: Industrial and urban waste, agricultural practice, municipal garbage; adjustment of soil acidity, ion-exchange in soil.

Unit.1 Study of Reactive Intermediates

Carbocations: Classical and non-classical, structures, stability and reactivity, neighboring group participations, molecular rearrangement in acyclic and monocyclic systems.
Carbanions: generation, structure and stability; ambident ions and their general reactions, HSAB principle and its applications.
Free radicals: Generation, structure, stability and reactions, Cage effects,
Carbenes: Formation and structure, reactions involving carbenes
Nitrenes: Generation, structure, and reactions
Benzynes: Generation, structure and rearrangements, Ipso-effects.

Unit.2 Green chemistry

Definitions of Green chemistry, Tools of green chemistry, twelve principles of green chemistry, Solvent free reactions, microwave assisted reactions, role of ionic liquids in green chemistry, cleaner technology with supercritical fluids, catalytic approach to green chemistry.

Unit.3 Organic Reaction Mechanism

Introduction to elimination reactions, formation of alkenes by elimination with proton loss and by other elimination reactions, Saytzeff and Hoffmann elimination, elimination vs substitution. Elimination addition to multiple bonds, direction and stereochemistry of addition, other trans-additions, cis-additions and addition-elimination reactions in organic synthesis, synthesis of aromatic compound.
Aromaticity, n-annulenes and hetero annulenes, Electrophilic substitution to aromatic hydrocarbons: benzene, naphthalene, n-annulene heteroannulene, fullerene (C_{60})

Unit.4 Molecular Symmetry and Stereochemistry

Molecular symmetry and chirality, stereogenicity, homotopic, enantiotopic and diastereotopic relationships, pro-chiral relationships Asymmetric synthesis-enantioselective and diastereoselective synthesis, regio-selectivity, stereospecificity, stereoselectivity, molecular dissymmetry and chiroptical properties, CD and ORD curves, Octant rule, resolution of enantiomers. Conformational analysis of acyclic systems and cyclohexane derivatives. Atropismerism-nomenclature and reactivity, stereoisomerism in biphenyl systems.

Unit.1 Statistical Thermodynamics-I

Basic postulates of statistical thermodynamics, Relationship between entropy and thermodynamic probability, Different types of ensembles. Sterling's approximation, Derivation of Maxwell Boltzmann distribution equation for energy. Evaluation of Boltzmann Constant, Applications of Maxwell-Boltzmann distribution law.

Unit.2 Chemical Kinetics

Review of elementary principles, Potential energy reaction coordinated diagram. Decomposition of O_3 and N_2O_5, thermal decomposition of ethane. Chain reactions (H_2-Br_2), Branched chain reactions (H_2-O_2), Explosions, Oscillatory reactions (B-Z reaction). Experimental techniques for fast reactions (Temperature Jump method, Flash photolysis and Stopped-flow method).

Unit.3 Quantum Mechanics-I

Some basic mathematical concepts. Failure of classical mechanics and origin of quantum theory. Postulates of quantum mechanics. Wave function and its interpretation: well behaved functions, orthonormal functions. Linear and Hermitian Operators. Schrodinger equation and its applications to a particle in one dimensional box, harmonic oscillator, the rigid rotor and H-atom. Eigen function, Eigen values and Eigen equation. Normalization and orthogonality of wave functions.

Unit.4 Quantum mechanics-II

Schrodinger equation for a particle in three-dimensional box and its solution: average values of position, energy and momentum. Probability of finding particle, Quantum numbers and concept of degeneracy. Application of one-dimensional problem to π-conjugated systems. Tunneling and idea on scanning tunneling microscope.

SEMESTER II

Unit.1 Introduction to Fortran

Representation of various data types. Characters, Constants and Variables in Fortran. Arithmetic Operations and symbols. Arithmetic Expressions. Unformatted and Formatted Input-Output Statements. Control statement: GOTO, IF, WHILE-DO, DO, CONTINUE, END and STOP statements. Arrays and Subscripted variables. Functions and Subroutines.

Unit.2 Fortran Programming Related to Chemistry

Development of FORTRAN programmes of (i) Linear and Non-linear Regressions using Least Squares Methods and computation of Correlation Coefficient (ii) Linear Equations (iii) evaluation of integral using Trapezoidal or Simpson's 1/3 rule and (iv) Mean and Standard Deviation. Illustration and hand on calculations of methods with examples related to Chemistry using Personal Computers.

Unit.3 Software related to Chemistry

Molecular specification in different file formats: (i) .gjf (ii) .pdb (iii) .mol (iv) .cif. Introduction to visualization software: (i) Chem Draw (ii) Chemsketch (iii) Gauss View (iv) Avogadro. Basic geometrical description of molecules: (i) Cartesian coordinate and (ii) Z-matrix.

Unit.4 Calculation of Molecular Energies

Quantum mechanical methods of calculations: Hartee-Fock, Density Functional Theory, and Configuration Interactions. Introduction to calculation software GAMES and Gaussian and their input

formats. Single Point and Geometry Optimization calculations. Many electron systems. Slater Type Orbital and Gaussian Type Orbital. Hand on calculation of some simple systems.

Unit.1 Magnetochemistry-I

Classification of magnetic substances, origin of magnetic properties. Spin-orbit coupling, quenching of orbital momenta, temperature-independent paramagnetism, determination of magnetic susceptibility using Guoy's method, Term symbols for metal ions, crystal field theory and its applications to explain magnetic properties of coordination compounds, spin crossover, magnetic and optical properties.

Unit.2 Organometallic Chemistry-I

Synthesis, structure, bonding and reactivity of complexes with CO, NO and N_2. Organometallic reagents in homogeneous catalytic reactions. Metallocene- synthesis of cyclopentadienyl compounds, reaction of ferrocene-like molecules and structure of cyclopentadienyl compound.

Unit.3 Metal Ligand Equilibria in solution

Equilibria involving complexes and their distribution diagram. Formation constant (stepwise and overall). Factor affecting the stability of metal complexes with reference to nature of metal ion and ligand, chelate effect and its thermodynamic origin. Determination of composition and stability of complex ion in solution by spectrophotometric and pH-metric method, conditional stability constant and their importance in complexometric (EDTA) titration and solvent extraction of metal ion.

Unit.4 Inorganic Reactions-II

Electron transfer reactions-definition, types of reactions and their mechanisms, one electron and two electron transfer reactions, factor affecting the rates of direct electron transfer reactions, complementary and non-complementary electron transfer reactions. Isomerization and racemization reactions.

Unit.1 Chemistry of Carbonyl Compounds

Nucleophilic and acyl substitution, 1,3-dithiane reactivity, Umpolung effect, nucleophilic acyl addition, nucleophilic addition-elimination, reaction of α, β-unsaturated carbonyl compounds (conjugate addition reactions), reactions at the α-carbon.

Unit.2 Heterocyclic Compounds-I

Five membered heterocycles (2 heteroatoms): Synthesis of 1,2-azoles and 1,3-azoles, nucleophilic and electrophilic substitution reactions.

Small ring heterocycles. Three membered heterocycles: ring strain and reactivity, synthetic methods of epoxides, aziridines and thiranes, nucleophilic and electrophilic ring opening, heteroatom extrusion and rearrangements. Four membered heterocycles: synthesis of oxetane, azetidine, thietanes, (β-Lactones and β-Lactams), ring openings (nucleophilic and electrophilic).

Unit.3 Photochemistry

General principles, orbitals symmetry consideration related to photochemical reaction, photochemistry of carbonyl groups, Norish Type I and Type II cleavage, photochemistry of alkenes and dienes, photochemistry of aromatic compounds and cycloaddition, Paterno-Buchi reaction.

Unit.4 Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Woodward-Hoffmann correlation diagrams. Frontier molecular orbital and Perturbational molecular orbital approach. Electrocyclic reactions: conrotatory and disrotatory motions. Cycloaddition: antarafacial and suprafacial additions. 4n and 4n + 2 systems, 2 + 2 addition of ketenes, 1,3-dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements.

Unit.1 Quantum Treatment of Hydrogen Atom

Schrodinger equation of hydrogen atom in cartesian and polar co-ordinates (R, θ, φ), separation of variables, *R, theta* and *phi* equations. Solution to *R* and *theta* equations in terms of associated Laguerre and Legendre polynomials and emergence of quantum numbers. Spherical harmonic, Harmonic oscillator and rigid rotator, Hermite polynomials. Development of mathematical forms of the solution, radial and angular parts, development of s, p and d orbitals, radial distribution functions, shape size and energy of the orbitals. Space quantization and electron spins.

Unit.2 Quantum Treatment of Many electron atoms

Many electron atoms and their wave functions, symmetrical and antisymmetrical wave functions. Pauli's exclusion principle with special reference to the ground and excited state of helium. Slater determinant and Slater Type Orbitals (STO) with few examples.

Unit.3 Macromolecular Chemistry

Number average and weight average molecular weights. Theory and instrumentation of determination of molar mass by viscometer, light scattering and ultracentrifugation. General idea about kinetics and mechanism of polymerization reactions. Stereochemistry and average end to end distance of polymers.

Unit.4 Rotational (Microwave) Spectroscopy

Classification of molecules, interaction of radiation with rotating molecules, moment of inertia and energy of rotating molecules, degeneracy of rotational energy levels, selection rule and rotational spectra of rigid diatomic molecules. The intensity of spectral lines, effect of isotopes on rotational spectra, spectrum of a non-rigid rotator.

Unit.1 Introduction to Nanomaterials and Nanotechnology

History and development of nanomaterials and nanotechnology. Discussion on various phenomenon at nanoscale, such as size, shape, surface, surface energy, surface stabilization, self-assembly, defects, size quantization, surface plasmon, conductivity, magnetism.

Unit.2 Preparation of Nanomaterials

Nucleation and growth of nanostructures: Homogenous and heterogeneous, Top down and bottom-up approaches. Chemical route: Chemical precipitation, Sol-gel, Microemulsions or Reverse micelles, Solvothermal/hydrothermal, Electrochemical, Self-Assembly Monolayers (SAM), Physical routes: Inert gas condensation, Sputtering, Laser ablation, Ball Milling, Molecular beam epitaxy, Chemical and Molecular vapor deposition methods, Lithography.

Unit.3 Characterization of Nanomaterials

Characterization of nanomaterials by: UV-Visible Spectroscopy, Fourier Transform Infra-Red Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), Energy Dispersive X-Ray Spectroscopy (EDAX), Transmission Electron Microscopy (TEM), X-ray Diffraction (XRD), X-ray Photoelectron Spectroscopy (XPS), Scanning Tunnelling Microscopy (STM), Dynamic Light Scattering (DLS) and Atomic Force Microscopy (AFM).

Unit.4 Applications of Nanomaterials

Nanocatalysis: homogeneous vs heterogeneous catalysis, effect of surface area, effect of particle size, shape and morphology, effect of composition, bimetallic system.

Nanomaterials for photo-catalysis: Dye degradation, water splitting, organic transformations, plasmon assisted photo-catalysis, band gap tuning.

Applied Nanobiotechnology and Nanobiomedical Science: Toxicity tests, Drug delivery, Drug targeting, Hyperthermia, Neutron capture therapy, Bioimaging, Biosensor materials.

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