PROPOSED STRUCTURE & MARKS DISTRIBUTION FOR THE NEW B.Sc. PROGRAMME IN CHEMISTRY (NEHU)

(ONLY CHEMISTRY PAPERS MENTIONED)

First Semester — *Total: 100 Marks*

Chem EH 101: *Part A* Inorganic, Organic & Physical Theory – 75 marks — **Total: 100 marks**
Part B Practical (Organic - Elective) – 25 marks

Chem H 101: Practical (Organic - Honours) – 25 marks

(**Chem EH 101** is both *Honours* and *Elective*; **Chem H 101** is purely *Honours*)

Second Semester — *Total: 100 Marks*

Chem EH 201: *Part A* Inorganic, Organic & Physical Theory – 75 marks — **Total: 100 marks**
Part B Practical (Physical) – 25 marks

Third Semester — *Total: 100 Marks*

Chem EH 301: *Part A* Inorganic, Organic & Physical Theory – 75 marks — **Total: 100 marks**
Part B Practical (Inorganic-I) – 25 marks

Fourth Semester — *Total: 100 Marks*

Chem EH 401: *Part A* Inorganic, Organic & Physical Theory – 75 marks — **Total: 100 marks**
Part B Practical (Inorganic-II) – 25 marks

Fifth Semester — *Total: 200 Marks*

Chem H 501: *Part A* Inorganic Theory – 50 marks — **Total: 100 marks**
Part B Organic Theory – 50 marks

Chem H 502: *Part A* Physical Theory – 50 marks — **Total: 100 marks**
Part B Practical (Organic) – 25 marks
Part C Practical (Physical) – 25 marks

Sixth Semester — *Total: 200 Marks*

Chem H 601: *Part A* Inorganic Theory – 50 marks — **Total: 100 marks**
Part B Organic Theory – 50 marks

Chem H 602: *Part A* Physical Theory – 50 marks — **Total: 100 marks**
Part B Practical (Inorganic) – 35 marks
Part C Seminar – 15 marks

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Note: **H** stands for Honours alone; **E** stands for Elective alone; **EH** stands for both Elective Honours. The above assignments of Course Numbers (e.g. **Chem E 201**) is only tentative

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First Semester

Total: 100 Marks

Chem EH 101

PART A *Inorganic, Organic & Physical Theory*

75 marks

Section 1 (*Inorganic*)

19 Marks

Unit I

(a) Structure of Atom: Limitations of Bohr's atomic model; idea of the de Broglie matter waves, Heisenberg's uncertainty principle; Schrodinger's wave equation and its importance; quantum numbers; concept of wave function; physical concepts of Ψ and Ψ^2; radial and angular wave functions; shapes of s, p and d-orbitals, Aufbau principle, Pauli's Exclusion Principle, Hund's rule, electronic configurations of atoms, screening effect and effective nuclear charge, extra stability of half-filled and completely filled orbitals.

(b) Nucleus and Radioactivity-I: Nuclear particles; nuclear binding energy, mass defect and packing fraction; natural and artificial radioactivity; radioactive disintegration series; first order rate equation of radioactive disintegration; half life and average life period, group displacement law , unit of radioactivity; neutron-proton ratio and its implications, importance of radioactive isotopes, elementary concepts of fusion and fission.

(c) Chemical Periodicity: Long form of periodic table, modern periodic law, types of elements on the basis of electronic configuration; periodic variation in properties – atomic and ionic radii, ionization enthalpy, electro gain enthalpy and electro negativity; diagonal relationship.

Unit II

(a) Covalent Bonding: Basic idea of valence bond theory and its limitations; Concept of hybridization of orbitals; valence shell electron pair repulsion (VSEPR) theory and shapes of molecules and ions: BeF_2, BF_3, H_3O^+, NH_3, H_2O, H_2S, O_3, CO_2, BO_3^{3-}, PCl_3, PCl_5, SF_4, SF_6; polarity of covalent bonds and dipole moment. LCAO-MO theory and its application to nonuclear diatomic molecules (H_2, N_2, O_2, O_2^{-2}, O_2^-, O_2^+, Ne).

Bonding: Ionic structures; radius ratio effect; limitation of radius ratio rule; concept of
3. Qu nergy and Born-Haber cycle; polarizing power; polarizability of ions and Fajan's rule.

(c) Bonding in Metals, Semiconductors and Hydrogen Bond: Qualitative idea of free electron theory and band theory in solids; elementary ideas on semiconductors (n and p types); hydrogen bonding – concept and types of H-bonding – application to inorganic molecules.

Section 2 (*Organic*) *19 Marks*

Unit III *9½ marks*

(a) Structure, Bonding & Properties: Hybridisation of orbitals, implications of hybridisation on the concept of bond length, bond energy, bond angles, shape of the molecules with following examples: (i) CH_4, H_3O^+, $^-CH_3$, RNH_2 ; (ii) C_2H_4, $^+CH_3$, BF_3, $AlCl_3$, carbonyl compounds, and (iii) C_2H_2, R-CN, allene, ketene.

Nature of covalent bond and its orbital representation in molecules listed above.

Bronsted-Lowry and Lewis concepts of acids and bases, electronegativity, polarity of bonds and dipole moment, inductive effect and its role in substituted aliphatic carboxylic acids, effect of H-bonding on boiling point and solubility of organic compounds.

Conjugation, resonance, hyper-conjugation (propene and toluene), homolytic and heterolytic bond cleavage. Types of reagents – electrophiles and nucleophiles. Reactive intermediates: carbocatons, carbonions, free radicals, carbenes - stability and examples.

(b) Organic Stereochemistry-I: Concept of isomerism, types of isomerism - configuratonal and conformational isomerism. Fischer, Newman and sawhorse projections with suitable examples, geometrical isomerism, configuration of geometrical isomers, E and Z nomenclature, geometric isomers of oximes; optical isomerism – optical activity, chiral carbon atom, enantiomers, diastereomers, meso compounds, racemic mixture, resolution of racemic mixtures.

Unit IV *9½ marks*

(a) Alkanes and Cycloalkanes: Nomenclature, methods of formation (with special reference to mechanism of Kolbe, Corey-House and Wurtz reactions), chemical reactivity (oxidation, cracking, aromatization). Reaction profile, activation energy, transition state and intermediate mechanism of chlorination, relative reactivity of halogens towards different types of alkanes, nitration, sulphonation.

General method of preparation of cycloalkanes (upto cyclohexane) and their rection with halogens and HX. Baeyer's strain theory- its limitations and modifications.

(b) Alkenes and Alkynes: Nomenclature of alkenes, methods of formation, chemical reactivity, mechanisms of hydrogenation, bromination, hydration, halohydration, hydroboration and Markownikoff's rule, mechanism of radical addition, peroxide effect, oxidation reactions, epoxidation, ozonolysis, hydroxylation. Polymerization.

Nomenclature, structure and bonding in alkynes, methods of formation, chemical reactivity, electrophilic addition reactions (halogenation,hydration, HX, HOX), ozonolysis, alkynides (Na, Cu and Ag) and polymerization; compare acidity of ethane, ethene and ethyne.

(c) Aromatic Hydrocarbons and Aromaticity: Structure of benzene, molecular orbital picture of benzene, stability of benzene ring, resonance energy, aromaticity, Huckel's (4n+2) rule and its application to simple molecules and ions, electrophilic, substitution reactions in aromatic hydrocarbons and general pattern of the mechanism, effect of substituent groups (activating and deactivating groups, directive influence) – mechanism of nitration, sulphonation, halogenation nuclear and side chain, formylation (Gattermann and Gattermann-Kotch), Friedel-Craft's alkylation and acylation.

Section 3 (*Physical*) *18 Marks*

Unit V *9 Marks*

(a) Gaseous State-I: Kinetic theory of gases - postulates of kinetic theory, collisions and gas pressure, average kinetic energy, root mean square speed and absolute temperature of gas, Boltzmann constant, gas laws and kinetic theory. Real gases - deviation from ideality, compressibility factor, van der Waals equation of state, virial equation of state.

(b) Liquid State-I: Qualitative description of the structure of liquids, Physical properties of liquids - vapour pressure, surface tension, viscosity, refractive index (definitions and descriptions), Liquid crystals- elementary discussion on structure and types of liquid crystals.

Unit VI *9 marks*

(a) Crystalline State-I: Law of constancy of interfacial angles, crystal planes, law of rational indices, Miller indices, space lattice and unit cell, packing in crystals, crystal defects.

(b) Colloids: Classification of colloids, preparation of colloids – peptisation, Bredig's method and condensation methods, purification of colloids, properties of colloids – Tyndall effect, Brownian movement, electrophoresis and electro-osmosis, protective colloids and gold number.

Chem EH 101 Part B : Practical (*Organic – Elective Only*) 25 Marks (7:18)

Laboratory Course (Organic Chemistry)

Total Time Practical Exams: 6 hours

1. Qualitative Analysis *10 marks*

Systematic qualitative analysis of organic compounds containing **one** functional group:

(a) Detection of elements (N, Cl, Br, I)

(b) Determination of one of the following functional groups (with systematic reporting)
-COOH, $-NH_2$, $-NO_2$, -OH (phenolic), -CHO and –CO-

(c) Preparation of the derivative

2. Viva Voce *5 marks*

3. Laboratory Record (Internal Assessment) *3 marks*

Chem H 101: Practical (*Organic – Honours Only*) 25 Marks (7:18)

Laboratory Course (Organic Chemistry)

Total Time Practical Exams: 6 hours

1. Qualitative Analysis *10 marks*

Systematic qualitative analysis of organic compounds containing **two** functional groups:

(a) Detection of elements (N, Cl, Br, I and S)

(b) Determination of any two of the following functional groups present in a single organic compound (with systematic reporting)
-COOH, -OH (phenolic), -CHO, -CO-, $-NH_2$, $-NO_2$, $-CONH_2$, $-SO_3H$

(c) Determination of the melting point/boiling point of the compound

(d) Identification of the compound with help of a reference book

(e) Preparation of the derivative and determination of its melting point

2. Viva Voce *5 marks*

3. Laboratory Record (Internal Assessment) *3 marks*

Note: Chem EH 101 Part B and **Chem H 101** have different question papers.

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