UNIVERSITY OF NORTH BENGAL

Raja Rammohunpur, Dist. Darjeeling,
Pin: 734 013

FYUGP syllabus

B.Sc. 4-YEAR UNDER GRADUATE PROGRAM (FYUGP) WITH CHEMISTRY AS **MAJOR** SUBJECT UNDER THE NEW CURRICULUM AND CREDIT FRAMEWORK, **2024**

WITH EFFECT FROM THE **2024-2025**

ACADEMIC SESSION

LAYOUT OF SYLLABUS FOR CHEMISTRY AS MAJOR SUBJECT

SEMESTER	*COURSE TYPE*	*PAPER DESCRIPTION*
1	MAJOR-1	ORGANIC CHEMISTRY-I
	MAJOR-2	INORGANIC CHEMISTRY-I
2	MAJOR-3	PHYSICAL CHEMISTRY-I
	MAJOR-4	ORGANIC CHEMISTRY-II
3	MAJOR-5	INORGANIC CHEMISTRY-II
	MAJOR-6	PHYSICAL CHEMISTRY-II
3	SEC	PHARMACEUTICAL CHEMISTRY
4	MAJOR-7	ORGANIC CHEMISTRY-III
	MAJOR-8	INORGANIC CHEMISTRY-III
5	MAJOR-9	PHYSICAL CHEMISTRY-III
	MAJOR-10	ORGANIC CHEMISTRY-IV
	MAJOR-11	INORGANIC CHEMISTRY-IV
	MAJOR-12	PHYSICAL CHEMISTRY-IV
6	MAJOR-13	ORGANIC CHEMISTRY-V
	MAJOR-14	INORGANIC CHEMISTRY-V
	MAJOR-15	PHYSICAL CHEMISTRY-V
	MAJOR-16	SPECTROSCOPY
7	MAJOR-17	RESEARCH METHODOLOGY
	MAJOR-18 (HONS. WITHOUT RESEARCH)	GREEN CHEMISTRY
	MAJOR-18 (HONS. WITH RESEARCH)	PROJECT/ DISSERTATION/ LITERATURE SURVEY
	MAJOR-19	PHYSICAL CHEMISTRY-VI
8	MAJOR-20	ORGANIC CHEMISTRY-VI
	MAJOR-21	INORGANIC CHEMISTRY-VI
	MAJOR-22 (HONS. WITHOUT RESEARCH)	BIOCHEMISTRY
	MAJOR-22 (HONS. WITH RESEARCH)	PROJECT WORK
	MAJOR-23 (HONS. WITHOUT RESEARCH)	POLYMER CHEMISTRY & ANALYTICAL CHEMISTRY
	MAJOR-23 (HONS. WITH RESEARCH)	PROJECT WORK

Semester-2

COURSE TYPE: MAJOR-3

PAPER CODE	PAPER DESCRIPTION
UCHEMAJ12003	PHYSICAL CHEMISTRY-I
Credit	Paper Type
4	TH + PLB
Paper Levels	Full Marks
100	75

COURSE TYPE: MAJOR-4

PAPER CODE	PAPER DESCRIPTION
UCHEMAJ12004	ORGANIC CHEMISTRY-II
Credit	Paper Type
4	TH + PLB
Paper Levels	Full Marks
100	75

Semester-2

MAJOR-3

Paper Code: UCHEMAJ12003

Paper Description: PHYSICAL CHEMISTRY-I

Paper Type: TH + PLB (Credits: Theory-03, Practical-01)

Total Marks: 75 [Theory (ESE – 40); Practical (ESE – 20); CE – 10; Attendance – 05]

Theory: 45 Lectures [Each Lecture is 1 hour in duration]

Practical: 15 classes [Each class is 2 hours in duration]

PHYSICAL CHEMISTRY-I

UNIT I: Gaseous state

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation, Concept of temperature and Gas Laws from KTG. Collision Number, Collision frequency, Collision diameter, Mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η, variation of viscosity with temperature and pressure.

Maxwell distribution of speeds in one, two and three dimensions and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and heat capacity from equipartition principle.

Behavior of real gases: Deviations from ideal gas behavior, compressibility factor, *Z*, and its variation with pressure for different gases. Causes of deviation from ideal behavior, van der

Waals equation of state, its derivation and application in explaining real gas behavior, mention of other equations of state (Berthelot, Dietirici), virial equation of state, van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with Van der Waals isotherms, continuity of states, critical state, relation between critical constants and Van der Waals constants, law of corresponding states.

(22 Lectures)

UNIT II: Liquid state

Physical properties of liquids, vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. **(5 Lectures)**

UNIT III: Solid state

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices, X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals. **(18 Lectures)**

Reference Books:

- Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry*, 10th Ed. Oxford University Press, 2014.
- Ball, D. W. *Physical Chemistry*, Thomson Press, India, 2007.
- Castellan, G. W. *Physical Chemistry*, 4th Ed. Narosa, 2004.
- Mortimer, R. G. *Physical Chemistry*, 3rd Ed. Elsevier, NOIDA, UP, 2009.
- Engel, T. & Reid, P. *Physical Chemistry*, 3rd Ed. Pearson, 2013.

PRACTICAL

PRACTICAL (PHYSICAL CHEMISTRY-I): (<u>any two</u>) (30 HOURS)

1. Surface tension measurements:

(a) Determination of the surface tension of a liquid/ ethanol solution by Drop number method.

(b) Determination of composition of an unknown solution by Drop Number Method using solutions of known composition (solutions of ethanol may be used).

2. Viscosity measurement using Ostwald's viscometer:

(a) Determination of viscosity of aqueous solutions of polymer / ethanol / sugar at room temperature.

(b) Determination of composition of an unknown solution by Ostwald Viscometer using solutions of known composition (solutions of ethanol, Sucrose may be used).

3. Indexing of a given powder diffraction pattern of a cubic crystalline system.

<u>End Semester Examination (ESE)</u>

At the end of the semester, a practical examination will be conducted as per the following guidelines:

Marks distribution

Experiment	15 marks
Practical record notebook	03 marks
Viva-voce	02 marks

Reference Books:

- Khosla, B. D., Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co. New Delhi, 2011.
- Garland, C. W., Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry*, 8thEd. McGraw-Hill, New York, 2003.
- Halpern, A. M. & Mc Bane, G. C. *Experimental Physical Chemistry*, 3rd Ed. W.H. Freeman & Co. New York, 2003.

Semester-2

MAJOR-4

Paper Code: UCHEMAJ12004

Paper Description: ORGANIC CHEMISTRY-II

Paper Type: TH + PLB (Credits: Theory-03, Practical-01)

Total Marks: 75 [Theory (ESE – 40); Practical (ESE – 20); CE – 10; Attendance – 05]

Theory: 45 Lectures [Each Lecture is 1 hour in duration]

Practical: 15 classes [Each class is 2 hours in duration]

ORGANIC CHEMISTRY-II

UNIT I: Stereochemistry

Tetrahedral carbon, chirality, Fischer Projection, Newman and Sawhorse Projection formulae, and their interconversions; Geometrical isomerism: *cis–trans* and *syn-anti* isomerism *E/Z* notations with C.I.P rules. *Re/Si* face, topicity: Homotopic, Heterotopic, Enantiotopic, Diasterotopic group.

Optical activity, specific rotation, Chirality. Asymmetry/Disymmetry, Enantiomers, Molecules with two or more chiral centres, Distereoisomers, Meso compounds, Racemic modification and resolution. Relative and absolute configuration: D/L and *R/S* designations, *threo-erythro* form, Atropisomerism. **(12 Lectures)**

UNIT II: Cycloalkanes and Conformational Analysis

Conformation and physical properties, conformation of ethane, propane, and butane (including substituted variety). Types of cycloalkanes and their relative stability, Baeyer strain theory,

Conformation analysis of cycloalkanes (cyclobutane, cyclopentane, cyclohexane, and mono and di-substituted cyclohexanes): Relative stability: Energy diagrams: Chair, Boat and Twist boat forms of cyclohexane. **(12 Lectures)**

UNIT III: Dynamic Stereochemistry

Introduction (Stereo-selective and stereo-specific reaction), dynamic stereochemistry of acyclic and cyclic molecules, nucleophilic substitution, elimination reactions and addition reactions. **(6 Lectures)**

UNIT IV: Chemistry of Halogenated Hydrocarbons:

Alkyl halides: Naming and structure of alkyl halides, methods of preparation, allylic bromination of alkenes, nucleophilic substitution reactions–SN1, SN2, and *SNi* mechanisms with stereochemical aspects and effect of solvent; nucleophilic substitution vs. elimination.

Aryl halides: Preparation, including preparation from diazonium salts, nucleophilic aromatic substitution; SNAr, cine Substitution.

Relative reactivity of alkyl, allyl/benzyl, vinyl, and aryl halides towards nucleophilic substitution reactions. **(15 Lectures)**

Reference Books:

- Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London, 1994.
- Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, New Age International, 2005.
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Clayden J, Greeves N & Warren S, *Organic Chemistry*, 2nd Ed. Oxford University Press Inc, New York, 2001.
- Carruthers, W. *Some Modern Methods of Organic Synthesis*, 4th Ed., Cambridge University Press, 2004

PRACTICAL

PRACTICAL (ORGANIC CHEMISTRY-II): (<u>any three</u>) (30 HOURS)

1. Detection of special elements in solid or liquid organic compounds.
2. Perform an Iodoform reaction with ethanol/Isopropanol/acetone/any suitable compound.
3. Preparation of Aryl halide involving diazonium salt.
4. Bromination of acetanilide by conventional method.
5. Bromination of acetanilide by green method (Bromate-bromide method).
6. Preparation of 1,3,5-tribromo benzene.

<u>End Semester Examination (ESE)</u>

At the end of the semester, a practical examination will be conducted as per the following guidelines:

Marks distribution

Experiment	15 marks
Practical record notebook	03 marks
Viva-voce	02 marks

Reference Books:

- Furniss, B.S. Hannaford, A.J. Smith, P.W.G. Tatchell, A.R. *Practical Organic Chemistry*, 5th Ed. Pearson, 2012.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education, 2009.