

BOARD OF INTERMEDIATE AND SECONDARY EDUCATION, JESSORE

BANGLADESH

Serial No. JBAT 4025087



Grade	Class Interval	Grade Point
A+	80-100	5
A	70-79	4
A-	60-69	3.5
B	50-59	3
C	40-49	2
D	33-39	1
E	0-32	0

JBCS No : 140-081643

ACADEMIC TRANSCRIPT

Secondary School Certificate Examination, 2014

Name of Student : Md. Mamunur Rahaman

Father's Name : Md. Idris Ali

Mother's Name : Mrs. Monira Parvin

Name of Institution : V. J. Govt. Secondary School, Chuadanga

Name of Centre : Chuadanga - 376

Type : Regular

Roll Number : 116135

Registration No. : 1113388592/2012-2013

Group : Science

Date of Birth : 22/09/1998

Sl. No.	Name of Subjects	Letter Grade	Grade Point	GPA (Without additional subject)	GPA
1	Bangla	A+	5.0	4.63	5.00
2	English	A	4.0		
3	Mathematics	A+	5.0		
4	Social Science	A+	5.0		
5	Religion (Islam)	A+	5.0		
6	Physics	A	4.0		
7	Chemistry	A+	5.0		
8	Higher Mathematics	A	4.0		
Additional Subject :					
9	Biology	A+	5.0	GP above 2 3.00	

Compared by

Handwritten signature

Date of Publication of Result : 17 May, 2014

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Controller of Examinations

Handwritten notes and stamps

BOARD OF INTERMEDIATE AND SECONDARY EDUCATION, JESSORE

BANGLADESH

Registration No : 1113388592 / 2012-2013



Serial No. JBC 4023501

Jbcs No : 140081686

SECONDARY SCHOOL CERTIFICATE EXAMINATION, 2014

This is to certify that *Mr. Mamunur Rahaman*
son/daughter of *Mr. Faris Ali and Mrs. Monira Parvin*
of *V. J. Govt. Secondary School*
bearing Roll *Chuadanga - 376* No. *116135* duly passed the *Secondary*
School Certificate Examination of 2014 in *Science* *Group and*
obtained G.P.A. 5.00 in the Scale of 5.00.

His/Her date of birth as recorded is *Twenty Second* *September*
Nineteen Hundred And Ninety Eight

Jessore

Date of Publication of Result : 17 May, 2014

Compared



Signature

Controller of Examinations

Attested

31.08.25

BOARD OF INTERMEDIATE AND SECONDARY EDUCATION, JESSORE
BANGLADESH

Serial No. JBAT **5246326**



Grade	Class Interval	Grade Point
A+	80-100	5
A	70-79	4
A-	60-69	3.5
B	50-59	3
C	40-49	2
D	33-39	1
F	0-32	0

JBCS No : 160-043240

ACADEMIC TRANSCRIPT

Higher Secondary Certificate Examination, 2016

Name of Student : *Md. Mamunur Rahaman*

Father's Name : *Md. Idris Ali*

Mother's Name : *Mrs. Monira Parvin*

Name of Institution : **Chuadanga Govt. College (115383)**

Name of Centre : **Chuadanga - 285**

Type : **Regular**

Roll Number : **411391**

Registration No. : **1113388592/2014-2015**

Group : **Science**

Sl. No.	Name of Subjects	Marks Obtained	Letter Grade	Grade Point	GPA (Without additional subject)	GPA
1	Bangla	155	A	4.0	4.08	4.42
2	English	140	A	4.0		
3	Physics	135	A-	3.5		
4	Chemistry	155	A	4.0		
5	Higher Mathematics	162	A+	5.0		
6	Information & Communication Technology	076	A	4.0		
Additional Subject :						
7	Biology	148	A	4.0	GP above 2 2.00	

Compared by

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Date of Publication of Result : 18 August, 2016

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Controller of Examinations

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BOARD OF INTERMEDIATE AND SECONDARY EDUCATION, JESSORE
BANGLADESH

Serial No. JBC 5421217

JBCS No. 160043247



Registration No: 1113388592 / 2014-2015

Higher Secondary Certificate Examination, 2016

*This is to certify that Md. Mamunur Rahman
son/daughter of Md. Idris Ali and Mrs. Monira Parvin
of Chuadanga Govt. College
bearing Roll Chuadanga - 285 No. 411391 duly passed the Higher
Secondary Certificate Examination of 2016 in Science Group
and obtained G.P.A. 4.42 in the Scale of 5.00.*

Jessore

Date of Publication of Result : 18 August, 2016

Examined:



Controller of Examinations

Attested
31.08.25



National University, Bangladesh

Bachelor Degree (Honours) Examination-2021

Consolidated Result

Student's Name MD. MAMUNUR RAHAMAN
Father's Name MD. IDRIS ALI
Mother's Name MRS. MONIRA PARVIN
Name of College [0801] CHUADANGA GOVT. COLLEGE
Exam. Roll 2129510
Registration No - Session 17228040298 - 2017-18
Subject Name 28 - CHEMISTRY
Credit (Completed/Total) 128/128
Result CGPA: 3.26

Course wise Letter Grade

First Year		Second Year		Third Year		Fourth Year	
Course Code(credit)	LG	Course Code(credit)	LG	Course Code(credit)	LG	Course Code(credit)	LG
211501(04)	B-	222707(04)	A-	232801(04)	C+	242801(04)	B+
212707(04)	C	222708(02)	A+	232803(04)	B+	242803(04)	B+
212709(02)	A-	222801(04)	B-	232805(04)	A	242805(04)	C+
212801(03)	C	222803(04)	B+	232807(04)	B-	242807(04)	B+
212803(03)	B-	222805(04)	A-	232809(04)	A-	242809(04)	B+
212805(03)	A-	222806(04)	A+	232811(04)	A	242811(04)	B+
212806(03)	A+	223707(04)	A-	232813(04)	A-	242813(04)	B
213709(04)	B	223708(02)	A-	232814(02)	A+	242815(04)	C+
213711(02)	B+	English=Pass		232816(02)	A+	242816(02)	A+
						242818(02)	A+
						242820(04)	A+
GPA: 2.96		GPA: 3.46		GPA: 3.38		GPA: 3.23	

sd/-

(Badruzzaman)

Controller of Examinations

BDR17H232

[Click here to Know CGPA Calculate system](#)

Attested
 31.08.25
 উদ্দেশ্যে মাশুমা পারভীন
 আইডি নং-১৬৩৩৪১৪১০১৪
 প্রভাষক, বঙ্গবান বিজ্ঞান
 চুয়াডাঙ্গা সরকারি কলেজ, চুয়াডাঙ্গা।

NUPC 20- 0317151

National University

Bangladesh



21-1-28-017979



Roll No. : 2129510

Regn.No. : 17228040298

Session. : 2017-18

PROVISIONAL CERTIFICATE

Bachelor of Science

This is to certify that

Mr. Mamunur Rahaman

Son/Daughter of

Mr. Idris Ali

and

Mrs. Menira Rahman

of

Chuadanga Govt. College, Chuadanga

obtained

Bachelor of Science

(Honours) degree

in

Chemistry

under National University in the examination

of

2021

with CGPA

3.26

out of 4.00.

National University, Bangladesh.

Date of Issue: December 11, 2023

N.B. This provisional certificate must be surrendered at the time of taking delivery of original certificate.

Controller of Examinations



রসায়ন বিভাগ

চুয়াডাঙ্গা সরকারি কলেজ, চুয়াডাঙ্গা।
CHUADANGA GOVERNMENT COLLEGE, CHUADANGA



তারিখ:

Umme Masuma Sharmin
Lecturer
Department of Chemistry
Chuadanga Govt. College
Chuadanga -7200
u1m10s85@gmail.com
+8801715317001

9 March 2025

Dear Members of the Admissions Committee,

I am writing to highly recommend Md Mamunur Rahaman for admission to your Master's program in Chemistry. I have had the pleasure of teaching Md Mamunur Rahaman in several advanced undergraduate chemistry courses during his time at Chuadanga Govt. College, and I can say without hesitation that he is one of the most dedicated and talented students I have encountered.

Md Mamunur Rahaman demonstrated an exceptional grasp of the subject matter, excelling in both theoretical and practical aspects of chemistry. His ability to analyse complex problems and develop innovative solutions in lab settings was particularly impressive. In the laboratory, he displayed strong technical skills and a keen understanding of experimental techniques, consistently producing high-quality results in a timely manner. Furthermore, his attention to detail and meticulous approach to research made him a standout in group projects and independent studies.

Beyond his technical abilities, Md Mamunur Rahaman exhibits a deep passion for chemistry and a natural curiosity that drives his academic pursuits. He regularly engaged in thoughtful discussions during class and showed a willingness to go beyond the curriculum to explore advanced topics in the field. His commitment to learning and his enthusiasm for research make him well-suited for graduate-level study.

Additionally, Md Mamunur Rahaman possesses excellent communication and teamwork skills. He is able to present complex concepts in a clear and concise manner, both in written reports and oral presentations. His collaborative nature makes him a valuable asset in group work, and he consistently shows respect for the ideas and contributions of his peers.

Based on my experience working with Md Mamunur Rahaman, I am confident that he will thrive in your master's program and contribute meaningfully to your academic community. I have no doubt that Md Mamunur Rahaman will continue to excel in his studies and go on to make significant contributions to the field of chemistry.

I wholeheartedly recommend Md Mamunur Rahaman for admission to your program, and I am certain that he will be an asset to your department.

Please feel free to contact me if you require any further information.


Sincerely, **উম্মে মাসুমা শারমিন**
আইডি নং-১৬১৩৪১৪১০১৯
Umme Masuma Sharmin
Lecturer, রসায়ন বিভাগ
চুয়াডাঙ্গা সরকারি কলেজ, চুয়াডাঙ্গা।

NATIONAL UNIVERSITY



First Year Syllabus Department of Chemistry

Four Year B.Sc Honours Course
Effective from the Session : 2013-2014

Attested
31.08.25

DR. ...
HEAD, DEPARTMENT OF CHEMISTRY
NATIONAL UNIVERSITY

National University
Subject: Chemistry
Syllabus for Four Year B.Sc Honours Course
Effective from the Session: 2013-2014

Year wise Papers and marks distributions

FIRST YEAR

Paper Code	Paper Title	Marks	Credits
212801	Physical Chemistry-I	75	3
212803	Fundamentals of Organic Chemistry	75	3
212805	Fundamentals of Inorganic Chemistry	75	3
212806	Chemistry Practical: Qualitative inorganic analysis, inorganic preparations and elementary crystal chemistry	75	3
213709	Fundamentals of Mathematics	100	4
213711	Calculus-I	50	2
212707	Physics-I (Mechanics, Properties of Matter, Waves & Optics)	100	4
212709	Physics-II (Heat, Thermodynamics and Radiation)	50	2
211501	History of the Emergence of Independent of Bangladesh	100	4
	Total =	700	28

Attested


31.08.25

National University

Subject: Chemistry

Syllabus for Four Year B.Sc. Honours Course

Effective from the Session: 2013-2014

Year wise Paper, Marks and Credit distribution

FOURTH YEAR

Paper Code	Paper Title	Marks	Credits
242801	Physical Chemistry-IV	100	4
242803	Selected Topics in Organic Chemistry	100	4
242805	Selected Topics in Inorganic Chemistry	100	4
242807	Nuclear Chemistry	100	4
242809	Organic Polymers	100	4
242811	Reaction Mechanism	100	4
242813	Separation Techniques	100	4
242815	Chemical Spectroscopy	100	4
242816	Practical Chemistry (Organic)	50	2
242818	Practical Chemistry (Industrial)	50	2
242820	Viva-voce	100	4
	Total =	1000	40

Attested
(Signature)
31.08.25

Dr. ...
...
...

NATIONAL UNIVERSITY



First Year Syllabus Department of Chemistry

Four Year B.Sc Honours Course
Effective from the Session : 2013–2014

National University
Subject: Chemistry
Syllabus for Four Year B.Sc Honours Course
Effective from the Session: 2013-2014

Year wise Papers and marks distributions

FIRST YEAR

Paper Code	Paper Title	Marks	Credits
212801	Physical Chemistry-I	75	3
212803	Fundamentals of Organic Chemistry	75	3
212805	Fundamentals of Inorganic Chemistry	75	3
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212709	Physics-II (Heat, Thermodynamics and Radiation)	50	2
211501	History of the Emergence of Independent of Bangladesh	100	4
	Total =	700	28

Detailed Syllabus

Paper Code	212801	Marks: 75	Credits: 3	Class Hours: 45
Paper Title	Physical Chemistry-I			

1. **State of Matter:** Microscopic and macroscopic system, properties of molecules, potential and kinetic energy of molecules, degrees of freedom of motion; transnational rotational and vibrational energy of systems, principle of equipartition of energy, state of aggregation of matter.
2. **Gaseous State:** properties of gases, the gas laws; ideal and real gases, ideal gas equation, kinetic theory and its application to ideal gases, pressure of ideal gases, boltzmann distribution of molecular energies, deviation from ideal behaviour, vander Walls equation, critical constants; principle of corresponding states, collision number, mean free path, dalton's law of partial pressure.
3. **Liquids and Solutions:** Physical properties and molecular structure, surface tension measurement of surface tension, viscosity, poiseuille's equation, measurement viscosity, molar refractivity and dipole moment, measurement vapour pressure, dependence of vapour pressure on temperature variation, solution, solubility, solubility product, molecular solution, ionic solution, units of concentration, raoult's law, ideal and nonideal solutions, colligative properties of solution, effect of electrolytes on colligative properties. henry's law determination of molecular weight by measuring colligative properties.
4. **Chemical Equilibrium:** Equilibrium in chemical reactions and the equilibrium law; k_p , k_c , and k_x measurements, degree of dissociation; effects of temperature, pressure and concentration changes of equilibrium, principle of Le Chatelier and Braun, Ostwald dilution law, dissociation of solid, solubility product, common ion effect, p_h and buffer solution.
5. **Energetics in Chemistry:** Work and heat; internal energy, the first law of thermodynamics, system, surrounding and boundery, state function and exact differentials, enthalpy, work of expansions reversible and adiabatic expansions, heat capacities at constant pressure and constant volume, Joule-Thompson's effect, inversion temperature enthalpy changes in various chemical and physical processes; hess's law and its application, born-haber cycle; bond enthalpy.
6. **Rates of Chemical reaction:** Rate of reaction, rate equation, order and rate constant, measurement of reaction rates, determination of order and rate constant, elementary and complex reaction, molecularity, effect of temperature on the rate of reaction. activation energy.

Book Recommended:

1. Physical chemistry, PW atkins
2. Physical Chemistry, G W Castellan
3. A text Book of Physical Chemistry, S Glasstone
4. Principles of Physical Chemistry, Haque & Nawab (Revised by Haque & Mollah)
5. General Chemistry, D Ebbing

Paper Code	212803	Marks: 75	Credits: 3	Class Hours: 45
Paper Title	Fundamentals of Organic Chemistry			

- Bonding in Organic Compounds:** Atomic orbitals; covalent bonds; sigma and pi bonds, hybridization of orbitals; shapes of molecules, classification of organic compounds based on their functional groups, polar and nonpolar molecules, nomenclature of organic compounds. formation of carbocations, carbanion, free radicals and their stabilities. homologous series.
- Hydrocarbons and their Classification:**
 - 2.1 Alkanes:** Structure; nomenclature, sources; preparation and reaction of alkanes and cycloalkanes, conformation of n-butane and cyclohexane, Wurtz reaction. free radical mechanism of halogenation. CFC.
 - 2.2 Alkenes:** Structure and orbital picture and sources, nomenclature, preparation and reaction of alkenes, geometrical isomerism of alkenes, cis-trans isomer and E.Z systems, mechanism of electrophilic addition, Markowikov's and Anti Markowniov's rule, stereo specific reactions.
 - 2.3 Dienes:** Structure and orbital picture, nomenclature; preparation and reactions of dienes, diels-Alder reaction; polymerization, conjugated dienes.
 - 2.4 Alkynes:** Structure and orbital picture; nomenclature, preparation, reactions of alkynes, electrophilic addition reaction, acidity of alkynes.
- Alkyl Halides:** Structure, nomenclature; preparation and properties of alkyl halides; mechanism of nucleophilic substitution reaction and elimination reactions, grignard reagent, its synthesis and application.
- Alcohols:** Structure, nomenclature, classification of alcohols, preparation, reactions of monohydric, dihydric and trihydric alcohols. reactions of alcohols, dehydration, substitution, oxidation and reduction. acidity and basicity of alcohols.
- Ethers and Epoxides:** Nomenclature, preparation, reactions of ethers; ethers as protecting groups; crownethers.
- Aldehydes and Ketones:** Nomenclature, orbital picture of carbonyl group. general methods of preparation and reactions of aldehydes and ketones; nucleophilic addition reaction of carbonyl compounds.
- Carboxylic Acids:** Structure and orbital picture; nomenclature; acidity, resonance effect and inductive effect on acidity, general methods of preparation and reactions of carboxylic acids

Books Recommended:

- Organic Chemistry, R.T. Morrison and R N Boyd, Sixth Edition
- Organic Chemistry, I.L. Finar, Vol.I. Longmans, 6th Ed.
- Modern Organic Chemistry, R.W Griffin Jr, McGraw Hill
- Principles of Organic Chemistry, J. English, H.G Cassidy and R.I Baird. McGraw Hill
- Basic Principles of Organic Chemistry, J.D. Roberts and M.C Casserio. W.W. Benjamin Inc.
- Organic Chemistry, McMurry. Brooks-Cole.

Paper Code	212805	Marks: 75	Credits: 3	Class Hours: 45
Paper Title	Fundamentals of Inorganic Chemistry			

1. Atomic Structure: Atomic nucleus, fundamental particles, nuclear forces, nuclear binding energy, nuclear stability, magic numbers, radioactivity, isotopes, atomic mass, mass spectrometry, cathode rays, mass and charge of an electron, α -particle scattering, Rutherford atom model, Planck's quantum theory, Bohr's theory for hydrogen atom, electromagnetic spectrum, absorption and emission spectra, emission spectrum of atomic hydrogen, quantum numbers, atomic orbitals, shapes and orientation of s, p and d orbitals, aufbau principle, Pauli exclusion principle.

2. Periodic Classification: Periodic law, periodic table, prediction of elements, naming of all elements, elements in groups, periods and blocks, electronic configuration of groups and periods, metals, nonmetals and metalloids, diagonal relationship, periodicity of atomic and molecular properties e.g. ionization energy, electron affinity, electronegativity, effective nuclear charge, atomic/ionic radii, etc., usefulness and limitation of periodic table.

3. Chemical Bonds: Chemical bond, types of chemical bonds, ionic bond: energetic of ionic bond formation, properties of ionic compounds, factors influencing the formation of ionic bond, radius ratio rule, lattice energy, Fajan's rule, covalent bond: sigma and pi bond, polar and non-polar covalent bonds, properties associated with covalent compounds, Lewis formulation, formal charge, valence shell electron pair repulsion (VSEPR) theory and molecular geometry.

4. Acids and Bases: Concepts on acids and bases, conjugate acids and bases, neutralization reactions, acid - base strength, leveling effect, hard and soft acids and bases, hard and soft acids and bases in qualitative analysis.

6. Types of Reactions: Oxidation -reduction reactions, oxidizing and reducing agents, assigning oxidation states to bonded atoms, redox half reactions, rules for balancing redox reactions, Ellingham diagram, standard reduction potential, the electrochemical series, disproportionation reactions, comproportionation reaction, addition reaction, elimination reactions, double decomposition reactions, substitution reactions, acid - base reactions.

Books Recommended:

1. General Chemistry, D. D. Ebbing, Houghton Mifflin Co.
2. Chemistry – The Molecular Nature of Matter and Change, M. Silberberg, WCB/McGraw-Hill.
3. General Chemistry, J. B. Russel, International Edition, McGraw-Hill Inc.
4. Modern Inorganic Chemistry, R. D. Madan, S. Chand & Company Ltd.
5. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, and P. L. Gaus, John Wiley & Sons.
6. Principles of Descriptive Inorganic Chemistry, G. Wulfsberg, University Science Books, Mill Valley.

Paper Code	212806	Marks: 75	Credits: 3	Class Hours: 45
Paper Title	Chemistry Practical: Qualitative inorganic analysis, inorganic preparations and elementary crystal chemistry			

1. Safety: The twelve rules of safety, safety in the laboratory.

2. Purification and Preparation of Inorganic Compounds:

- (i) Purification of commercial NaCl by recrystallization and salting out processes,
- (ii) Preparation of ferrous sulphate $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, Mohr's salt $[\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}]$, potash alum $[\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}]$, chrome alum $[\text{K}_2\text{SO}_4 \cdot \text{Cr}_2(\text{SO}_4)_3]$.

24H₂O], sodium carbonate Na₂CO₃.

3. **Model Making:** Seven crystal systems model.
4. **Systematic Semimicro Qualitative Analysis of Inorganic Salts:** Identification of inorganic basic and acid radicals, 5 radicals in a mixture taking at least two from both ion types.

Books Recommended:

1. A Text-Book of Macro and Semimicro Qualitative Inorganic Analysis, A. I. Vogel, 4th edition, Longmans, Green and Co. Ltd.
2. Semimicro Qualitative Analysis, F. J. Welcher and R. B. Hahn, D. Van Nostrand Co. Inc.
3. Qualitative Analysis, V. Alexeyev, Mir Publishers.

Paper Code	213709	Marks: 100	Credits:4	Class Hours: 60
Paper Title	Fundamentals of Mathematics			

1. **Real Number System:** Field and order properties, natural numbers, integers and rational numbers, absolute value and their properties, basic inequalities.
2. **Complex Number System:** Field of complex numbers, De Moivre's theorem and its applications.
3. **Theory of equations:** Relations between roots and coefficients, symmetric functions of roots, sum of the powers of roots, synthetic division, Des Cartes' rule of signs, multiplicity of roots, transformation of equations.
4. **Matrices and Determinants:**, Notion of matrix. types of matrices. algebra of matrices. determinant function and its properties. minors, cofactors, expansion and evaluation of determinants. elementary row and column operations and row-reduced echelon matrices. invertible matrices. diagonal, triangular and symmetric matrices.
5. **System of Linear Equations:** System of linear equations (homogeneous and non-homogeneous) and their solutions. gaussian elimination, application of matrices and determinants for solving system of linear equations. applications of system of equations in real life problems.
6. **Vector Spaces:** Euclidean n-space. real vector spaces. subspaces. linear combination of vectors. linear dependence of vectors. basis and dimension. linear transformations. matrix representation of linear transformation. kernel and image. eigenvalues and eigenvectors.
7. **Two-dimensional Geometry:** Transformation of coordinates, pair of straight lines (homogeneous second degree equations, general second degree equations representing pair of straight lines, angle between pair of straight lines, bisectors of angle between pair of straight lines), general equations of second degree (reduction to standard forms, identifications, properties and tracing of conics).
8. **Three-dimensional Geometry:** Three-dimensional coordinates, distance, direction cosines and direction ratios. planes and straight lines. vectors in plane and space. algebra of vectors. scalar and vector product. vector equations of straight lines and planes.

Books Recommended :

1. S. Bernard & J M Child- Higher algebra.

2. Howard Anton & Chris Dorres – Elementary Linear Algebra with Application.
3. Khosh Mohammad- Analytic Geometry and Vector Analysis.
4. Md. Abdur Rahman – Linear Algebra.

Paper Code	213711	Marks: 50	Credits:2	Class Hours: 30
Paper Title	Calculus-I			

1. Functions & their graphs : Polynomial and rational functions, logarithmic and exponential functions, trigonometric functions & their inverses, hyperbolic functions & their inverses, combinations of such functions.

2. Limit and continuity: Definitions and basic theorems on limit and continuity. Limit at infinity & infinite limits, Computation of limits.

3. Differentiation: Tangent lines and rates of change. Definition of derivative. One-sided derivatives. Rules of differentiation . Successive differentiation. Leibnitz's theorem. Related rates. Linear approximations and differentials.

4. Applications of Differentiation: Mean value theorem. Maximum and minimum values of functions. Concavity and points of inflection. Optimization problems.

5. Integration: Antiderivatives and indefinite integrals. Techniques of integration. Definite integration using antiderivatives. Fundamental theorems of calculus. Basic properties of integration. Integration by reduction.

6. Applications of Integration: Arc length. Plane areas. Surfaces of revolution. Volumes of solids of revolution. Volumes by cylindrical shells. Volumes by cross sections.

7. Approximation and Series: Taylor polynomials and series. Convergence of series. Taylor's series. Taylor's theorem and remainders. Differentiation and integration of series.

Books Recommended:

1. Howard Anton -Calculus (7th and forward editions).
2. E.W. Swokowski - Calculus with Analytic Geometry.
3. Md. A Matin & B Chakraborty, - Differential Calculus.

Paper Code	212707	Marks: 100	Credits: 4	Class Hours: 60
Paper Title	Physics-I (Mechanics, Properties of Matter, Waves & Optics)			

1. **Vector Analysis:** Vectors and scalars, Addition and multiplication of vectors, Triple scalar & vector products, Derivatives of vectors, Gradient, divergence and curl-their physical significance, Theorems of Gauss, Green & Stoke's.
2. **Work, Energy and Power:** Work energy theorem, Conservation of energy and linear momentum, Conservative and non-conservative forces and systems, Conservation of energy and momentum, Centre of mass, Collision problems.
3. **Rotational Motions:** Rotational variables, Rotation with constant angular acceleration, Relation between linear and angular kinematics, Torque on a particle, Angular momentum of a particle, kinetic energy of rotation and moment of inertia. Combined translational and rotational motion of a rigid body, Conservation of angular momentum.
4. **Gravitation:** Centre of gravity of extended bodies, Gravitational field and potential their calculations, Determination of gravitation constant and gravity, Compound and kater's pendulums, Motion of planets and satellites, Escape velocity.

5. **Elasticity:** Moduli of elasticity, poisson's ratio, Relations between elastic constants and their determination, Cantilever.
6. **Surface Tension:** Surface tension as a molecular phenomenon, Surface tension and surface energy, Capillary rise or fall of liquids, Pressure on a curved membrane due to surface tension, Determination of surface tension of water, mercury and soap solution, Effect of temperature.
7. **Fluid Dynamics:** Viscosity and coefficient of viscosity, Poiseuille's equation, Determination of the coefficient of viscosity of liquid by Stoke's method, Bernoulli's theorem and its applications, Toricelli's theorem, Venturimeter.
8. **Waves:** Mechanical waves, types of waves, travelling waves. The superposition principle. Wave speed, Power and intensity in wave motion. Interference of waves, Standing Waves and resonance.
9. **Oscillatory Motions:** Simple harmonic motion, Combination of harmonic motions, Damped harmonic motion, Forced oscillations and resonance.
10. **Geometrical Optics:** Fermat's Principles, Theory of equivalent lenses, Defect of images, Optical instrument, Dispersion rainbow.
11. **Nature and Propagation of light:** Properties of light, Wave theory and Huygene's Principle, Theories of light.
12. **Interference:** Young's experiment: Bi-prism, Newton's ring.
13. **Diffraction:** Fresnel's and Fraunhofer types, Diffraction through single slit and double slit, diffraction grating, Dispersive and resolving powers of gratings.
14. **Polarization:** Plane, Elliptical and circular Polarizations, Optical, Rotatory dispersion, Polarimeters.

Books Recommended:

- | | |
|---|---------------------------------|
| 1. R. S. Halliday, R. Resnick, and J. Walker | : Fundamentals of Physics |
| 2. Halliday, D. and Resnick, R. | : Physics |
| 3. Sears, F.W. , Zimansky, M.W. and Young, H.D. | : University Physics |
| 4. Mathur, D.S. | : Properties of Matter |
| 5. Newman, F.W. and Serale, V.H.L | : General Properties of Matter. |
| 6. A text Book of Light | : Choudhury, Saha & Pramanik |
| 7. Fundamentals of Optics | : F.A. Jenking & H.E. White |
| 8. A text Book of Light | : K.G. Mazumder |
| 9. Principles of Optics | : B.K. Mathur |

Paper Code	212709	Marks: 50	Credits: 2	Class Hours: 30
Paper Title	Physics-II (Heat, Thermodynamics and Radiation)			

1. **Thermometry:** Temperature, Concepts of thermal equilibrium, measurement of low and high temperature: Gas thermometers, Resistance thermometer, Thermocouple, Pyrometry, International temperature scale.
2. **Calorimetry:** Specific heats of solids, liquids and gases by method of mixture with radiation corrections: Newton's Law of cooling, Variations of specific heats, Atomic and molecular heats.
3. **Transmission of Heat:** Thermal conductivity, Determination of thermal conductivities of good and bad conductors.
4. **Thermodynamic Systems:** Concept of internal energy: The first law of thermodynamics, Work and specific heats, Isothermal and adiabatic processes.
5. **The second law of thermodynamics:** Reversible and irreversible processes: Carnot cycle, Efficiency of reversible engines, Absolute thermodynamic temperature scale, Change of phase: Clausius and Clapeyron equation, Porous plug experiment.
6. **Entropy:** Entropy of an ideal gas, Temperature-entropy diagram, Increase of entropy.

7. **Thermodynamic Functions:** The Maxwell's relations, Specific heat equations.
8. **Radiation:** Concept of black body radiation, Kirchhoff's law, Stefan-Boltzmann law, Wien's displacement Law, Rayleigh-Jean's law, Planck's Radiation law, Pyrometers, Temperature of the sun.

Books Recommended:

- | | |
|--|------------------------------|
| 1. Halliday, D. and Resnick, R. | : Physics |
| 2. A Text Book of Heat | : T. Hossain |
| 3. Principle of Heat, Thermodynamics and Radiation | : M. A. Haque |
| 4. A Text of Heat, Thermodynamics and Radiation | : M. Ishaque & A.M.Z. Islam |
| 5. A Text of Heat, Thermodynamics and Radiation | : Z.I. Bhuiyan & S. Rahman |
| 6. A text Book of Light | : Choudhury, Saha & Pramanik |
| 7. Heat and Thermodynamics | : N. Uddin & A. Kalam |
| 8. Tap O Tapagati Bijnan | : M.A. Jabbar |
| 9. Heat and Thermodynamics | : M. W. Zemansky |

Paper Code	211501	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	History of the Emergence of Independent Bangladesh			

স্বাধীন বাংলাদেশের অভ্যুদয়ের ইতিহাস

ভূমিকা: স্বাধীন বাংলাদেশের অভ্যুদয়ের ইতিহাস-পরিধি ও পরিচিতি

১। দেশ ও জনগোষ্ঠীর পরিচয়

- ক) ভূ প্রকৃতির বৈশিষ্ট্য ও প্রভাব
- খ) নৃতাত্ত্বিক গঠন
- গ) ভাষা
- ঘ) সংস্কৃতির সমন্বয়বাদিতা ও ধর্মীয় সহনশীলতা
- ঙ) অভিন্ন বাংলার পরিপ্রেক্ষিতে তৎকালীন পূর্ববঙ্গ ও বর্তমান বাংলাদেশের স্বকীয় সত্তা

২। অখণ্ড স্বাধীন বাংলা রাষ্ট্র গঠনের প্রয়াস ও উপমহাদেশের বিভক্তি, ১৯৪৭

- ক) ঔপনিবেশিক শাসন আমলে সাম্প্রদায়িকতার উদ্ভব ও বিস্তার
- খ) লাহোর প্রস্তাব, ১৯৪০
- গ) অখণ্ড স্বাধীন বাংলা রাষ্ট্র গঠনের উদ্যোগ, ১৯৪৭ ও পরিণতি
- ঘ) পাকিস্তান সৃষ্টি, ১৯৪৭

৩। পাকিস্তান: রাষ্ট্রীয় কাঠামো ও বৈষম্য

- ক) কেন্দ্রীয় ও প্রাদেশিক কাঠামো
- খ) সামরিক ও বেসামরিক আমলাতন্ত্রের প্রভাব
- গ) অর্থনৈতিক, সামাজিক ও সাংস্কৃতিক বৈষম্য

৪। ভাষা আন্দোলন ও বাঙালির আত্মপরিচয় প্রতিষ্ঠা

- ক) মুসলিম লীগের শাসন ও গণতান্ত্রিক রাজনীতির সংগ্রাম
- খ) আওয়ামী লীগের প্রতিষ্ঠা, ১৯৪৯
- গ) ভাষা আন্দোলন: পটভূমি ও ঘটনা প্রবাহ

ঘ) হক-ভাসানী-সোহরাওয়ার্দীর যুক্তফ্রন্ট, ১৯৫৪ সালের নির্বাচন ও পরিণতি

৫। সামরিক শাসন: আইয়ুব খান ও ইয়াহিয়া খানের শাসনামল (১৯৫৮-৭১)

ক) সামরিক শাসনের সংজ্ঞা ও বৈশিষ্ট্য

খ) আইয়ুব খানের ক্ষমতা দখল ও শাসনের বৈশিষ্ট্য (রাজনৈতিক নিপীড়ন, মৌলিক গণতন্ত্র, ধর্মের রাজনৈতিক ব্যবহার)

গ) আইয়ুব খানের পতন ও ইয়াহিয়া খানের শাসন, এক ইউনিট বিলুপ্তিকরণ, সার্বজনীন ভোটাধিকার, এলএফও (Legal Framework Order)

৬। জাতীয়তাবাদের বিকাশ ও স্বাধিকার আন্দোলন

ক) সাংস্কৃতিক আত্মসনের বিরুদ্ধে প্রতিরোধ ও বাঙালি সংস্কৃতির উজ্জীবন

খ) শেখ মুজিবুর রহমানের ৬-দফা আন্দোলন

গ) ৬-দফা আন্দোলনের প্রতিক্রিয়া, গুরুত্ব ও তাৎপর্য

ঘ) আগরতলা মামলা, ১৯৬৮

৭। ১৯৬৯-এর গণঅভ্যুত্থান ও ১১-দফা আন্দোলন

ক) পটভূমি

খ) আন্দোলনের কর্মসূচী, গুরুত্ব ও পরিণতি

৮। ১৯৭০ এর নির্বাচন, অসহযোগ আন্দোলন ও বঙ্গবন্ধুর স্বাধীনতা ঘোষণা

ক) নির্বাচনের ফলাফল এবং তা মেনে নিতে কেন্দ্রের অস্বীকৃতি

খ) অসহযোগ আন্দোলন, বঙ্গবন্ধুর ৭ই মার্চের ভাষণ, অপারেশন সার্চলাইট

গ) বঙ্গবন্ধুর স্বাধীনতা ঘোষণা ও গ্রেফতার

৯। মুক্তিযুদ্ধ ১৯৭১

ক) গণহত্যা, নারী নির্যাতন, শরণার্থী

খ) বাংলাদেশ সরকার গঠন ও স্বাধীনতার ঘোষণাপত্র

গ) স্বতঃস্ফূর্ত প্রাথমিক প্রতিরোধ ও সংগঠিত প্রতিরোধ (মুক্তিফৌজ, মুক্তিবাহিনী, গেরিলা ও সম্মুখ যুদ্ধ)

ঘ) মুক্তিযুদ্ধে প্রচার মাধ্যম (স্বাধীন বাংলা বেতার কেন্দ্র, বিদেশী প্রচার মাধ্যম ও জনমত গঠন)

ঙ) ছাত্র, নারী ও সাধারণ মানুষের অবদান (গণযুদ্ধ)

চ) মুক্তিযুদ্ধে বৃহৎশক্তি সমূহের ভূমিকা

ছ) দখলদার বাহিনী, শান্তিকমিটি, আলবদর, আলশামস, রাজাকার বাহিনী, রাজনৈতিক দল ও দেশীয়

অন্যান্য সহযোগীদের স্বাধীনতা বিরোধী কর্মকাণ্ড ও বুদ্ধিজীবী হত্যা

জ) পাকিস্তানে বন্দি অবস্থায় বঙ্গবন্ধুর বিচার ও বিশ্বপ্রতিক্রিয়া

ঝ) প্রবাসী বাঙালি ও বিশ্বের বিভিন্ন দেশের নাগরিক সমাজের ভূমিকা

ঞ) মুক্তিযুদ্ধে ভারতের অবদান

ট) যৌথ বাহিনী গঠন ও বিজয়

ঠ) স্বাধীনতা সংগ্রামে বঙ্গবন্ধুর নেতৃত্ব

১০। বঙ্গবন্ধু শেখ মুজিবুর রহমানের শাসনকাল, ১৯৭২-১৯৭৫

ক) স্বদেশ প্রত্যাবর্তন

খ) সংবিধান প্রণয়ন

গ) যুদ্ধ বিধবস্ত দেশ পুনর্গঠন

ঘ) সপরিবারে বঙ্গবন্ধু হত্যা ও আদর্শিক পটপরিবর্তন

History of the Emergence of Independent Bangladesh

Introduction: Scope and description of the emergence of Independent Bangladesh.
Writing on this topic.

1. Description of the country and its people.

- a. Geographical features and their influence.
- b. Ethnic composition.
- c. Language.
- d. Cultural syncretism and religious tolerance.
- e. Distinctive identity of Bangladesh in the context of undivided Bangladesh.

2. Proposal for undivided sovereign Bengal and the partition of the Sub Continent, 1947.

- a. Rise of communalism under the colonial rule, Lahore Resolution 1940.
- b. The proposal of Suhrawardi and Sarat Bose for undivided Bengal : consequences
- c. The creation of Pakistan 1947 .

3. Pakistan: Structure of the state and disparity.

- a. Central and provincial structure.
- b. Influence of Military and Civil bureaucracy.
- c. Economic , social and cultural disparity

4. Language Movement and quest for Bengali identity

- a. Misrule by Muslim League and Struggle for democratic politics .
- b. The Language Movement: context and phases .
- c. United front of Haque – Vasani – Suhrawardi: election of 1954, consequences.

5. Military rule: the regimes of Ayub Khan and Yahia Khan (1958-1971)

- a. Definition of military rules and its characteristics.
- b. Ayub Khan's rise to power and characteristics of his rule (Political repression, Basic democracy, Islamisation)
- c. Fall of Ayub Khan and Yahia Khan's rule (Abolition of one unit, universal suffrage, the Legal Framework Order)

6. Rise of nationalism and the Movement for self determination .

- a. Resistance against cultural aggression and resurgence of Bengali culture.
- b. Sheikh Mujibur Rahman and the six point movement
- c. Reactions : Importance and significance
- d. The Agartala Case 1968.

7. The mass- upsurge of 1969 and 11 point movement: background,programme and significance.

8. Election of 1970 and the Declaration of Independence by Bangobondhu

- a. Election result and centres refusal to comply
- b. The non co-operation movement, the 7th March , Address , Operation Searchlight
- c. Declaration of Independence by Bangobondhu and his arrest

9. The war of Liberation 1971

- a. Genocide, repression of women, refugees
- b. Formation of Bangladesh government and proclamation of Independence
- c. The spontaneous early resistance and subsequent organized resistance (Mukti Fouz, Mukti Bahini, guerillas and the frontal warfare)
- d. Publicity Campaign in the war of Liberation (Shadhin Bangla Betar Kendra, the Campaigns abroad and formation of public opinion)
- e. Contribution of students, women and the masses (Peoples war)
- f. The role of super powers and the Muslim states in the Liberation war.
- g. The Anti-liberation activities of the occupation army, the Peace Committee, Al-Badar, Al-Shams, Rajakars, pro Pakistan political parties and Pakistani Collaborators , killing of the intellectuals.
- h. Trial of Bangabondhu and reaction of the World Community.
- i. The contribution of India in the Liberation War
- j. Formation of joint command and the Victory
- k. The overall contribution of Bangabondhu in the Independence struggle.

10. The Bangabondhu Regime 1972-1975

- a. Homecoming
- b. Making of the constitution
- c. Reconstruction of the war ravaged country
- d. The murder of Bangabondhu and his family and the ideological turn-around.

সহায়ক গ্রন্থ

- ১. নীহার রঞ্জন রায়, বাঙালীর ইতিহাস, দে' জ পাবলিশিং, কলকাতা ১৪০২ সাল ।
- ২. সালাহ উদ্দিন আহমেদ ও অন্যান্য (সম্পাদিত), বাংলাদেশের মুক্তি সংগ্রামের ইতিহাস ১৯৪৭-১৯৭১, আগামী প্রকাশনী, ঢাকা ২০০২ ।

৩. সিরাজুল ইসলাম (সম্পাদিত), বাংলাদেশের ইতিহাস ১৭০৪-১৯৭১, ৩ খন্ড, এশিয়াটিক সোসাইটি অব বাংলাদেশ, ঢাকা ১৯৯২।
৪. ড. হারুন-অর-রশিদ, বাংলাদেশ: রাজনীতি, সরকার ও শাসনতান্ত্রিক উন্নয়ন ১৭৫৭-২০০০, নিউ এজ পাবলিকেশন্স, ঢাকা ২০০১।
৫. ড. হারুন-অর-রশিদ, বাঙালির রাষ্ট্রচিন্তা ও স্বাধীন বাংলাদেশের অভ্যুদয়, আগামী প্রকাশনী, ঢাকা ২০০৩।
৬. ড. হারুন-অর-রশিদ, বঙ্গবন্ধুর অসমাপ্ত আত্মজীবনী পুনর্পঠ, দি ইউনিভার্সিটি প্রেস লিমিটেড, ঢাকা ২০১৩।
৭. ড. আতফুল হাই শিবলী ও ড.মোঃ মাহবুবুর রহমান, বাংলাদেশের সাংবিধানিক ইতিহাস ১৭৭৩-১৯৭২, সুবর্ণ প্রকাশন, ঢাকা ২০১৩।
৮. মুনতাসির মামুন ও জয়ন্ত কুমার রায়, বাংলাদেশের সিভিল সমাজ প্রতিষ্ঠার সংগ্রাম, অবসর, ঢাকা ২০০৬।
৯. আতিউর রহমান, অসহযোগ আন্দোলনের দিনগুলি: মুক্তিযুদ্ধের প্রস্তুতি পর্ব, সাহিত্য প্রকাশ, ঢাকা ১৯৯৮।
১০. ড. মোঃ মাহবুবুর রহমান, বাংলাদেশের ইতিহাস, ১৯০৫-৪৭, তাম্রলিপি, ঢাকা ২০১১।
১১. ড. মোঃ মাহবুবুর রহমান, বাংলাদেশের ইতিহাস, ১৯৪৭-১৯৭১, সময় প্রকাশন, ঢাকা ২০১২।
১২. সৈয়দ আনোয়ার হোসেন, বাংলাদেশের স্বাধীনতা যুদ্ধে পরাশক্তির ভূমিকা, ডানা প্রকাশনী, ঢাকা ১৯৮২।
১৩. আবুল মাল আবদুল মুহিত, বাংলাদেশ: জাতিরাষ্ট্রের উদ্ভব, সাহিত্য প্রকাশ, ঢাকা ২০০০।
১৪. শেখ মুজিবুর রহমান, অসমাপ্ত আত্মজীবনী, দি ইউনিভার্সিটি প্রেস লিমিটেড, ঢাকা ২০১২।
১৫. সিরাজ উদ্দীন আহমেদ, একাত্তরের মুক্তিযুদ্ধ: স্বাধীন বাংলাদেশের অভ্যুদয়, ইসলামিক ফাউন্ডেশন, ঢাকা ২০১১।
১৬. জয়ন্ত কুমার রায়, বাংলাদেশের রাজনৈতিক ইতিহাস, সুবর্ণ প্রকাশন, ঢাকা ২০১০।
১৭. Harun-or-Roshid, The Foreshadowing of Bangladesh: Bengal Muslim League and Muslim Politics, 1906-1947, The University Press Limited, Dhaka 2012.
১৮. Rounaq Jahan, Pakistan: Failure in National Integration, The University Press Limited, Dhaka 1977.
১৯. Talukder Maniruzzaman, Radical Politics and the Emergence of Bangladesh, Mowla, Brothers, Dhaka 2003.
২০. মেসবাহ কামাল ও ঈশানী চক্রবর্তী, নাচোলের কৃষক বিদ্রোহ, সমকালীন রাজনীতি ও ইলা মিত্র, উত্তরণ, ঢাকা ২০০৮।
২১. মেসবাহ কামাল, আসাদ ও উনসত্তরের গণঅভ্যুত্থান, বিবর্তন, ঢাকা ১৯৮৬।

NATIONAL UNIVERSITY



Second Year Syllabus Department of Chemistry

**Four Year B.Sc. Honours Course
Effective from the Session : 2013-2014**

National University

Subject: Chemistry

Syllabus for Four Year B.Sc. Honours Course

Effective from the Session: 2013-2014

Year wise Paper, Marks and Credit distribution

SECOND YEAR

Paper Code	Paper Title	Marks	Credits
222801	Physical Chemistry-II	100	4
222803	Organic Chemistry	100	4
222805	Chemistry of the Representative Elements	100	4
222806	Quantitative Inorganic Analysis (Practical)	100	4
222707	Physics-III (Electricity and Modern Physics)	100	4
222708	Physics-IV (Physics Practical)	50	2
223707	Calculus-II	100	4
223708	Math Lab (Practical)	50	2
	Total =	700	28
221109	English (Compulsory)	100	Non-Credit

Detailed Syllabus

Paper Code	222801	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Physical Chemistry-II			Exam Duration: 4 hours

1. Thermodynamics: Scope and limitations of thermodynamics, the direction of spontaneous changes: degradation of energy: carnot cycle; second law of thermodynamics; entropy; Clasius-Clapyron equation; changes in u , h and s . with temperature and pressure; Gibb's- Helmholtz equation; heat engines; third law of thermodynamics; nernst's heat theorem; absolute entropy: maxwell's relations; temperature and pressure dependence of Gibbs function: chemical potential and fugacity, partial molar quantities; Gibbs-Duhem equation: thermodynamic derivation of colligative properties.

2. Electrochemistry:

2.1 Electrolytes: Electrolyte, nonelectrolyte, polyelectrolyte, electrolysis and Farady's laws; conductance; specific conductance, molar conductance; Kohlrausch's law.

2.2 Conductance: Conductance measurement, conductometric titration; ionic mobility, ion transport number and its determination. theories of strong electrolytes; Debye-Huckel limiting law.

2.3 Electrochemical Cells and Cell Potentials: Cells: concept, electrolytic and Galvanic cells; half cells; different types of electrodes and half cells, half cell reactions & cell reactions, standard hydrogen electrode, subsidiary and reference electrodes, electrode potentials, Nernst's equation, measurement of e.m.f of a cell, compensation method of measurement of electrode potential, thermodynamic functions from e.m.f. standard free energy changes, equilibrium constant. standard Weston cadmium cell. dry cell, alkaline cell, lead accumulator. polarization: over voltage and polarization. fuel cell.

3. pH, Buffer and Indicators: Definition of pH, buffer and indicator, K_w of water, buffer mechanism, preparation of buffer of definite pH, Acid-base PH titration curves, determination K_a from titration curve, theories of indicator, pH range of indicator, selection of indicator.

Books Recommended:

1. Physical Chemistry, P.W, Atkins, W.H. Freeman & Co.
2. Physical Chemistry, G.W. Castellan, Narosa Publishing House
3. Chemical Thermodynamics, Basic Concepts and Methods, I.Fqotz, I.M. Klotz and R.M. Rosenberg, John Wiley & Sons.
4. Electrochemistry, S. Glasstone, East-West Press Pvt. Ltd.
5. The Principles of Electrochemistry, D.A. MacLinnnes, Reinhold Publishing Corporation.
6. Modern Electrochemistry, J.O. Bockris and A.K.N. Reddy, Springes
7. Physical Chemistry, W.J. Moore, Longmans Green & Co.

8. Colloidal Science – A.E. Alexander and Johnson.
9. Colloidal Chemistry – B. Jigensons and M.E. Straumanis
10. Text of Colloidal Chemistry – A.B Weiser
11. Solid State Chemistry. N.B. Hannay
12. Solid State Chemistry. A.K. Galwey

Paper Code	222803	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Organic Chemistry			Exam Duration: 4 Hours

1. **Organic Acids and Bases:** Concepts, inductive, mesomeric and structural effects affecting the acidity and basicity; acid and base catalysis.
2. **Aromatic Hydrocarbons:** Source; structure and bonding in benzene; concept of aromaticity; Huckel's rule, nomenclature and their preparations, disubstitution in benzene ring; orientation in benzene ring and its derivatives, activation and deactivation in aromatic disubstitution, mechanism of electrophilic substitution in aromatic rings: halogenation, nitration, sulfonation, Friedel-Crafts alkylation and acylation. Benzene derivatives.
3. **Polynuclear Aromatic Hydrocarbons:** General methods of synthesis, reactions of naphthalene, anthracene, phenanthrene and their derivatives.
4. **Amines:** Aliphatic and aromatic, nomenclature, preparation and reaction of amines, Hofmann amine degradation, separation of amines, nomenclature, preparation and reactions of diazonium salt, coupling reaction.
5. **Heterocyclic Compounds Containing One Hetero atoms:** Aromatic character, chemistry and structure of heterocyclic compounds-furan, pyrrole, thiophene and pyridine.
6. **Stereochemistry:** A brief concept of stereoisomerism, geometric and optical isomerism, polarimetry, optical activity, molecular asymmetry, optical isomerism due to asymmetric carbon atoms, compounds with one and two or more asymmetric carbon atoms, racemic modification and their formation, resolution of racemic modifications.
7. **Bifunctional Compounds:** Chemistry of 1, 3-dienes, α - β unsaturated carbonyl compounds, hydroxy ketones, 1, 2- and 1, 3 – diketones, keto-enol tautomerism.

Books Recommended:

1. Organic Chemistry, I. L. Finar, Vol I & II, Longmans.
2. Advanced Organic Chemistry, B. S. Bahl and A. Bahl, S. Chand & Co. Ltd.
3. Organic Chemistry, T.W.G. Solomons, Wiley.
4. Organic Chemistry, W.H. Brown, C.S. Foote and B.L. Iverson Brooks Cole.

Paper Code	222805	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Chemistry of the Representative Elements			Exam Duration: 4 Hours

1. **Hydrogen:** Introduction, resemblance with alkali metals and with halogens, various forms of hydrogen (nascent hydrogen, occluded hydrogen, atomic hydrogen, and ortho and para hydrogen molecules), isotopes of hydrogen, binary hydrides and their classification.
2. **The Alkali Metals:** Occurrence and extraction, comparative properties, hardness, ionization energies, cation sizes and polarization, flame coloration, solubility and hydration, hydration radii, reducing strength, anomalous behavior of Li, diagonal relationship of Li with Mg, compounds of Na.
3. **The Alkaline Earth Metals:** Occurrence and extraction, comparative properties, ionization energies, cation sizes and polarization, flame coloration, solubility and lattice energy, reducing character, anomalous behavior of Be, diagonal relationship between Be and Al, compounds of beryllium and calcium, hardness of water, biological role of magnesium and calcium ions.
4. **The Boron Family:** General properties, occurrence and abundance, extraction of aluminium, electron deficient compounds, chemistry of boron hydrides, borax and boric acid, borazine and its similarity and dissimilarity with benzene, Lewis acid character of BX_3 compounds.
5. **Carbon and Its Congeners:** Introduction, structure and allotropy of the elements, catenation, structure of graphite and diamond, inert pair effect, carbides, oxides of carbon and carbonic acid, physiological aspects of CO, multiple bonding in carbon and silicon, silicates, classification of silicates, structure of silicates, lead and its toxicity, carbon dating.
6. **The Nitrogen Family:** General properties, catenation, anomalous nature of nitrogen, nitrogen fixation, nitrogen hydrides, NH_3 as a nonaqueous solvent, hydroxylamine, azides, oxides and oxo-acids of nitrogen, allotropes of phosphorus, oxides and oxo-acids of phosphorus, phosphazenes and cyclophosphazenes, arsenic as a water pollutant.
7. **The Chalcogens:** General properties, anomalous nature of oxygen, allotropes of oxygen, uses of dioxygen, ozone - its production and importance in atmosphere, ionic and covalent oxides, peroxides and superoxides, occurrence and allotropes of sulfur, oxides and oxo-acids of sulfur, acid rain and SO_2 .
8. **The Halogens:** Occurrence, comparative properties, colors and physical states of dihalogens, trends in bond dissociation energies, electrolytic production of F_2 and Cl_2 and their uses, hydrogen halides, bridging halides, interhalogen compounds.
9. **The Inert Gases:** Occurrence, isolation, chemistry and uses, xenon compounds: fluorides, oxides and oxo - acids and their structures, complexes of xenon, clathrate compounds of noble gases.

Books Recommended:

1. Chemistry of the Elements, N. N. Greenwood and A. Earnshaw, Pergamon Press.
2. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, and P. L. Gaus, John Wiley & Sons.
3. Advanced Inorganic Chemistry, F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, John Wiley & Sons, Inc.
4. Modern Inorganic Chemistry, R. D. Madan, S. Chand & Co. Ltd.
5. Advanced Inorganic Chemistry, S. Prakash, G. D. Tuli, S. K. Basu, R. D. Madan, S. Chand & Co. Ltd.
6. Introduction to Modern Inorganic Chemistry, S. Z. Haider, Friends International.

Paper Code	222806	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Quantitative Inorganic Analysis (Practical)			Exam Duration: 4 Hours

- Data Collection and Processing:** Introduction to analytical balance, volumetric glasswares, reagents and standard solutions, calibration of weights and glasswares, uncertainty in measurements, accuracy and precision, standard deviation, systematic error, random error, rounding off, significant figures, primary and secondary standard substances.
- Volumetric Analysis:** The principle of volumetric analysis, preparation of standard solutions, classifications of methods of volumetric analysis,
 - Neutralization Method:* Standardization of sodium hydroxide solution using oxalic acid solution as a primary standard titrant, standardization of hydrochloric acid using standard sodium hydroxide solution, determination of acetic acid content in vinegar, determination of carbonate in washing soda.
 - Oxidation-Reduction Method:* Standardization potassium permanganate using standard oxalic acid solution, determination of Fe(II) using standard permanganate solution, determination of Fe(II) using potassium dichromate solution as primary standard titrant, determination of Fe(II) and Fe(III) in a Fe(II)-Fe(III) mixture.
 - Iodometric Method:* Standardization of sodium thiosulphate solution using dichromate solution, iodometric determination of copper(II), iodometric determination of Fe(III) using Cu^{2+} as catalyst, iodimetric determination of sulfite.
 - Precipitation Method:* Preparation of standard silver nitrate solution, standardization of ammonium or potassium thiocyanate solution, determination of chloride by Volhard's method.
 - Complexometric Method:* Preparation of standard EDTA solution, complexometric determination of copper using Fast sulphon Black as indicator, zinc using Eriochrome Black T as indicator, nickel using murexide as indicator, determination of hardness of water.
- Gravimetric Analysis:** Determination of calcium as oxalate, aluminium as 8-hydroxyquinolate, sulfate as barium sulfate.
- Analysis of Mixtures:** Separation and quantitative determination of copper (II) and nickel (II), copper (II) and zinc (II) from the respective binary admixtures using suitable methods.

Books Recommended:

- A Textbook of Quantitative Inorganic Analysis, A. I. Vogel, 3rd/4th edition, ELBS/Longman.
- Elementary Quantitative Analysis – Theory and Practice, W. J. Blaedel and V. W. Meloche, Harper & Row.
- Quantitative Chemical Analysis, R. B. Fischer and D. G. Peters, W. B. Saunders Co.
- Fundamentals of Analytical Chemistry, D. A. Skoog, D. M. West, F. J. Holler, and S. R. Crouch, Thomson Asia Pvt. Ltd.
- Analytical Chemistry, G. D. Christian, John Wiley & Sons, Inc.

Paper Code	222707	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Physics-III (Electricity and Modern Physics)			Exam Duration: 4 Hours

1. **Change and Matter:** Concept of charge, Conservation of charge. Coulomb's law.
2. **The Electrostatic Field:** The Electric field strength due to a point charge, a dipole, Group of charged and uniformly distributed charged bodies.
3. **The electrostatic potential:** Potential due to a point charge, a dipole, a group of charged and a continuous distribution of charged bodies. Notion of gradient: Relation between potential and electric field strength. Electric potential energy. Van de Graff generator.
4. **Flux of electrostatic field:** Gauss's law. Concept of solid angle. Flux due to a point charge, group of charge. Conservation of flux. Application of Gauss's law.
5. **Capacitor and Dielectrics:** Capacitance, Parallel plate and cylindrical capacitor. Dielectrics and Gauss's law. Energy storage in an electric field.
6. **Electric Current (D.C):** Electromotive force, Current and current density. Resistance, Resistivity and conductivity, Ohm's law, Atomic view of resistivity, Energy transfer in an electric circuit, Kirchhoff's laws and their applications. Potentiometer. Meter bridge and Post office box.
7. **The Magnetic field:** Magnetic Induction B. Motion of a charge field. Magnetic force on a current, Torque on a current loop, the Hall effect, Circulating charges. Dead beat and ballistic galvanometers, Thomson's experiment, Ampere's law, B near a long wire, Ampere's circuital law, B due to a solenoid, the Biot-Savart law and its applications.
8. **Electromagnetic induction:** Faraday's law of induction, Lenz's law, Self and mutual inductance. Time-varying magnetic fields, Energy density in a magnetic field.
9. **Magnetic Properties of matter:** Magnetic dipole, Gauss's Law for magnetism, Paramagnetism, Diamagnetism and ferromagnetism, Nuclear magnetism, Energy in a magnetic field, Hysteresis.
10. **Varying current:** Growth and decay of currents in LR, CR and LCR circuits.
11. **Alternating Currents:** AC generator, Concept of r.m.s and average values of current and voltage, Resistive circuit, CR, LR and LCR circuits in series and parallel, Resonance, Phase and Power transformer.
12. **Electronics:** Vacuum diodes and triodes, P-type, n-type semiconductors, p-n junctions, Transistors, Transistor biasing, Transistor amplifiers, Transmitters and Receivers.
13. **Special Theory of Relativity:** Inertial frame, Galilean transformation, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformation equations space contraction, Time dilation, Relativity of mass, Mass and energy.
14. **Light and Quantum Physics:** Planck's radiation formula, Photoelectric effect, Einstein's Photon theory, The Compton effect, The hydrogen atom and The correspondence principle.
15. **Waves and particles:** Matter waves, atomic structure and standing waves, Mechanics, Uncertainty principle.
16. **The atomic nucleus:** The nuclear constituents, The nuclear force, Nuclear radius, Stable nuclei, The binding energy of stable nuclei mass defect and Packing fraction.
17. **Radioactivity:** Meaning of radioactivity, Unstable nuclei, Exponential decay law, Half life, Mean life and units of radioactivity, Basic ideas of nuclear reactor, Nuclear fission and Nuclear fusion.

Books Recommended:

- | | |
|--|---|
| 1. Halliday, D, Resnick, R and Walker, J | : Fundamentals of Physics |
| 2. Halliday, D and Resnick, R. | : Physics |
| 3. Husain, A & Islam. S | : Parmanabik Bijnan |
| 4. Emran, M, Ishaque, M & Islam, A.M.Z. | : A Text Book of Magnetism, Electricity |

5. Besier, A. & Modern Physics.
: Concepts of Modern Physics
6. Semat, H. : Introduction to Atomic and Nuclear Physics.

Paper Code	222708	Marks: 50	Credits: 2	Class Hours: 30
Paper Title:	Physics-IV (Physics Practical)			Exam Duration: 6 Hours

To perform two experiments (one from each group) each of three hours duration.

i) Experiments (3 hours each)	2 x 20 =	40
ii) Laboratory note book		05
iii) Experimental Viva-voce		05

Total marks= 50 Marks for each experiment

shall be distributed as follows:

a) Theory	3
b) Data collection and Tabulation	8
c) Calculation, graphs and result	6
d) Discussion	3
Total marks	= 20

Group – A

1. Determination of 'g' by compound pendulum.
2. Determination of Young's and rigidity moduli by Searle's dynamic method.
3. Rigidity modulus by static method.
4. Surface tension of water by capillary tube method.
5. To determine the spring constant and effective mass of a given spiral spring and hence to calculate the rigidity modulus of the material of the spring.
6. To determine the Young's modulus by the flexure of a beam (bending method).
7. To determine the moment of inertia of a fly-wheel about its axis of rotation.
8. Determination of surface tension of mercury by Quincke's method.
9. To determine the specific heat of solid by method of mixture, with radiation correction.
10. To determine the specific heat of a liquid by the method of cooling.
11. To determine the thermal conductivity of a bad conductor by Lee's method.
12. To determine 'J' with radiation correction.
13. To verify the laws of transverse vibration of a stretched string with a sonometer (n-1, and n-T curves only)
14. To find the frequency of a tuning fork by Melde's experiment.

Group – B

1. Comparison of e.m.f.s of two cells by potentiometer.
2. Determination of galvanometer resistance by half deflection method.
3. Determination of low resistance by fall of potential method.
4. Determination of figure of merit of a galvanometer.
5. To determine ECE of copper/silver.
6. Determination of the refractive index of a glass prism by a spectrometer.
7. Determination of Cauchy's constant and the resolving power of a prism using a spectrometer.

8. Determination of wavelength of light by Newton's rings.
9. Determination of wavelength of light using a bi-prism.
10. Specific rotation of plane of Polarization in sugar solution by polarimeter.

Books Recommended:

- | | | |
|-------------------------------------|---|----------------------------|
| 1. Ahmed, G.U. and Uddin, M.S. | : | Practical Physics |
| 2. Chawdhury, S.A. and Bashak, A.K. | : | Practical Physics |
| 3. Din, K. and Matin, M.A. | : | Advanced Practical Physics |
| 4. Worsnop and Flint | : | Advanced Practical Physics |

Paper Code	223707	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Calculus- II			Exam Duration: 4 Hours

1. **Vector valued functions of a single variable:** Limits. Derivatives and integrals. Tangent lines to graphs of such functions. Arc length from vector viewpoint. Arc length parametrization .
2. **Curvature of space curves:** Definition. Curves of zero curvature. Curves of constant non-zero curvature. Cartesian equations and parametric equations. Radius of curvature. Centre of curvature.
3. **Functions of several variables:** Limits and continuity. Partial derivatives. Differentiability, linearization and differentials. The chain rule. Partial derivatives with constrained variables. Directional derivatives, gradient vectors and tangent planes. Extreme values and saddle points of functions of several variables. Lagrange multipliers. Taylor's formula.
4. **Multiple Integration:** Double integrals and iterated integrals. Double integrals over nonrectangular regions. Double integrals in polar coordinates. Area by double integrals. Triple integrals and iterated integrals. Volume as a triple integral. Triple integral in cylindrical and spherical coordinates. General multiple integrals. Jacobians.
5. **Topics in Vector Calculus:** Scalar and vector fields, Gradient, divergence and curl, and their properties. Line integrals, Independence of paths. Green's theorem. Surface integrals. Stokes' theorem. The divergence theorem.

Books Recommended :

1. Howard Anton-*Calculus 5/E (and forward edition)*

Paper Code	223708	Marks: 50	Credits: 2	Class Hours: 30
Paper Title:	Math. Lab.			Exam Duration: 6 Hours

Getting started. Problem solving using Mathematica /Maple (Problems will be selected from Papers studied in the first and second years of their studies).

Students are required to work on their assignments in MMT 201 in the lab sessions.

Paper Code	221109	Marks: 100	Non-Credit	Class Hours: 60
Paper Title:	English (Compulsory)			Exam Duration: 4 Hours

Aims and objectives of this Paper:

To develop students' English language skills, to enable them to benefit personally and professionally. The four skills ~ listening, speaking, reading and writing will be integrated to encourage better language use.

1. Reading and understanding

5×4=20

Students will be expected to read passages they might come across in their everyday life, such as newspapers, magazines, general books etc. Simple stories will also be included to give students a familiarity with different uses of the language.

[N.B. : 5 Questions are to be answered. Each question will carry 4 marks. There may be division in each question]

- Understanding different purposes and types of readings
- Guessing word-meaning in context.
- Understanding long sentences
- Recognizing main ideas and supporting ideas.
- Answering comprehension questions.
- Writing summaries.

2. Writing

40

- Writing correct sentences, completing sentences and combining sentences. 5
- Situational writing : Posters, notices, slogans, memos, advertisements etc. 4
- Paragraph writing : Structure of a paragraph; topic sentences; developing ideas; writing a conclusion; types of paragraphs (narrative, descriptive, expository, persuasive); techniques of paragraph development (such as listing, cause and effect, comparison and contrast). 8

Or,

- Newspaper writing : Reports, press releases dialogues etc.
- Writing resumes. **Or,**
- Writing letters : Formal and informal letters, letters to the editor, request letters, job applications, complaint letters etc.
- Essay : Generating ideas; outlining; writing a thesis sentence; writing the essay: writing introductions, developing ideas, writing conclusions; revising and editing. 15

8

3. Grammar

25

- Word order of sentences.
- Framing questions.
- Tenses, articles, subject-verb agreement, noun-pronoun agreement, verbs, phrasal verbs, conditionals, prepositions and prepositional phrases, infinitives, participles, gerunds. (Knowledge of grammar will be tested through contextualised passages).
- Punctuation.

4. Developing vocabulary : Using the dictionary, suffixes, prefixes, synonyms, antonyms, changing word forms (from verb to noun etc.) and using them in sentences. 10

5. Translation from Bengali to English :

1x 5=5

6. Speaking skills : Speaking skills should be integrated with writing and reading in classroom activities.

The English sound system; pronunciation skills; the IPA system; problem sounds, vowels, consonants and diphthongs; lexical and syntactic stress.

(Writing dialogue and practising it orally students can develop their speaking skill. Dialogue writing can be an item in writing test.)

NATIONAL UNIVERSITY



Syllabus

Department of Chemistry

**Four-Year B.Sc. (Honours) Course
Effective from the Session: 2009–2010**

National University

Syllabus for 4 years B. Sc. Honours Course
Subject : Chemistry

Third Year (Honours)

Subject Code	Subject Title	Marks	Credit
2872	Colloids, Phase Equilibria, Surface Chemistry and Solid State	100	4
2880	Physical Chemistry Practical	100	4
2873	Stereochemistry	100	4
2897	Organic Chemistry Practical (Detection & Preparation)	100	4
2874	Advanced Concepts of Atomic Structure and Chemical Bonding	50	2
2875	Coordination Chemistry and Organometallic Chemistry	100	4
2876	Fundamentals of Analytical and Environmental Chemistry	100	4
2877	Industrial Chemistry	100	4
2878	Chemical Spectroscopy	100	4
2879	Agricultural Chemistry	50	2
Total =		900	36

Course Code	2872	Marks: 100	Credits: 4	Class Hours: 60
Course Title	Colloids, Phase Equilibria, Surface Chemistry & Solid State			

- 1. Phase Equilibrium:** Phase, components and degrees of freedom; phase rule; application in one component system like water and sulfur, Completely and partially miscible liquid pairs; Duhem-Margules equation. Industrial application of distillation and fractional distillation; Two component system; solid-liquid system, solid-solid binary systems with reference to alloy, cooling curves, systems with and without compound formation, congruent and incongruent melting points; Efflorescence and deliquescence, vapour pressure of a saturated solution; Introductory idea about ternary systems and triangular phase diagram.
- 2. Colloidal State of matter:** Classification, preparation and physical properties, Electrokinetic phenomena; Colloidal electrolytes and their uses, Emulsion; preparation, properties, stability and use.
- 3. Surface Chemistry:** Solid surfaces and their characterization; Adsorption on solid surfaces: technique for measurement of adsorption from gas phase and solution; Langmuir, Freundlich and BET adsorption isotherm: Enthalpy of adsorption; Adsorption on liquid surface. Gibb's adsorption equation; Surface film; Electro-capillary phenomena.
- 4. Solid States:** Perfect crystal, point defect, Calculation of Schottky and Frenkel defects in ionic solids, Influence of defects on the physical properties of solids, colour centres, Band Theory: Semi conductors and their types, doping measurements of semi conductivity, Non-stoichiometric metal oxides, super conductors. Hall effects and its applications.

Books Recommended:

1. An Introduction to Chemisorption and Catalysis by Metals-R.P.A. Gasser.
2. Colloidal Science – A.E. Alexander and Johnson.
3. Colloidal Chemistry – B. Jigersons and M.E. Straumanis
4. Text of Colloidal Chemistry – A.B Weiser
5. Phase Rule-Findlay. Revised by Compbell.
6. Solid State Chemistry. N.B. Hannay
7. Solid State Chemistry. A.K. Galwey

Course Code	2880	Marks: 100	Credits: 4	Class Hours: 60
Course Title	Physical Chemistry Practical (6 Hours Duration)			

List of Experiments

1. A study of adsorption of acetic acid from solution on a sample of charcoal.
2. Determination of the surface area of a surface active molecule: n-butanol.
3. Determination of the rate constant for the alkaline hydrolysis of ethylacetate.
4. Determination of the association constant for the dimerization of benzoic acid in toluene by measuring distribution between water and toluene.
5. Determination of dissociation constant of acids by conductometric technique.
6. Conductometric titration (i) strong acid-strong base, (ii) weak acid-strong base and (iii) mixture of weak and strong acids-strong base.
7. Determination of dissociation constant of mono basic and dibasic acids by pH titration.
8. Study of electronic spectra of I_2 in CH_2Cl_2 and toluene, verification of the Beer-Lambert law using $KMnO_4$ solution.
9. Spectrophotometric determination of Iron: application of Beer-Lambert law.

Books Recommended:

1. Practical Physical Chemistry, A Faraday
2. Experimental Physical Chemistry, Deniel, Mathews and William
3. Findlay's Practical Physical Chemistry, Revised by BP Levitt
4. Experiments in Physical Chemistry, D.P Shomeker and C.W. Garland
5. Experiments of Physical Chemistry, F. Deniels, J.N. William, P.Bender, R.A. Alberty, C.D. Cornwell, and J.E. Harriman
6. Chemistry Experiments for Instrumental Methods. D.T. Sawyer, W.R. Heinman and J.M. Beebe.

Course Code	2873	Marks: 100	Credits: 4	Class Hours: 60
Course Title	Stereochemistry			

- 1. Fundamentals of Stereochemistry:** Stereochemistry and stereoisomerism.
- 2. Isomerism:** Cis-trans isomerism, interconversion of cis-trans isomers; Determination of configuration of geometrical isomers by chemical and physical methods, conformation of acyclic and cyclic molecules. Physical and spectral properties of diastereoisomers and conformers, conformation and reactivity.
- 3. Configuration:** D & L, threo erythro, R & S configurations. Absolute and relative configurations and their correlation. Relative and absolute configurations, determination of R-S configuration and their Chemical interconversion; Chiral, Prochiral and pseudochiral molecules. Chirality in molecules devoid of chiral centre; atropisomerism, biphenyl, allenes and spiranes; Conformational analysis of biopolymers; conformation of glycosides, starch, cellulose and their physical properties; Conformation of proteins, nucleic acids;
- 4. Optical Activity and Optical Isomerism:** Cause of optical activity. Chirality (Dissymmetry and asymmetry), prochirality, pseudo chirality. Symmetry elements. Optical isomers, diastereoisomers, enantiomers, epimers, anomers, meso and racemic compounds. Racemic modification and their resolution. Atropisomerism: biphenyls, allenes and spiranes.
- 5. Geometrical Isomerism:** Conditions, Configurations of geometrical isomers: cis-trans. *E/Z* system, Syn-anti. Physical properties and configurational assignment of geometrical isomers. Geometrical isomerism of polyenes, carbon-nitrogen, nitrogen-nitrogen double bonds and cyclic compounds (cis-trans isomerism in disubstituted cyclohexanes).
- 6. Stereochemistry of Fused Ring:** Stereochemistry of decalines, perhydroanthracene, perhydrophenanthrene, their optical activity and relative stability. Fused rings and bridged ring systems. Bredt's rule and its exceptions in flexible ring systems.
- 7. Conformation:** Conformation and conformers. Conformation of propane, butane, ethanediol, dihydroxystyrene, dichlorostyrene, their physical properties and stability. Stability of threo and erythro, meso and dl compounds, Conformation of cyclobutane, cyclopentane and cyclohexane and their stability. Conformation of mono and disubstituted cyclohexanes (1,3 – diaxial interactions, butane-gauche interactions etc)
- 8. Optical Rotation and Rotatory Power:** Factors leading to chirality. Molecular dissymmetry. Atomic dissymmetry and conformational asymmetry, Circular birefringence and circular dichroism (CD). Cotton effect, Dependence of optical rotation on wavelength – optical rotatory dispersion (ORD)

Books Recommended:

1. I.L. Eliel, Stereochemistry of Carbon Compounds, Tata Mc Graw-Hill, 1979
2. R.T. Morrison and R.N. Boyd, Organic Chemistry, Fifth edition, Prentice-Hall of India, New Delhi, 1989.
3. Handrickson and Pyne, Organic Chemistry, McGraw-Hill.
4. I.L. Finar, Organic Chemistry Vol. II, ELBS, Fifty edition, 1985

Course Code	2897	Marks: 100	Credits: 4	Class Hours: 60
Course Title	Organic Chemistry Practical (6 Hours Duration)			

1. **Systematic Identification of Organic Compounds:** Determination of melting temperature, T_m , boiling temperature, T_b ; detection of N, S and X in organic solids and liquids, determination of functional groups; naming of compounds.
2. **Organic Synthesis:** Preparation of acetanilide, 4-nitroacetanilide, 4- nitroaniline, 4-iodoaniline, benzoic acid, 4-bromoacetanilide and Methyl Orange.

Books Recommended:

1. Qualitative Organic Analysis – A.I Vogel
2. A Text Book of Practical Organic Chemistry – Clarke
3. Identification of Organic Compounds – Shiriner and Fuson.

Course Code	2874	Marks: 50	Credits: 2	Class Hours: 60
Course Title	Advanced Concepts of Atomic Structure And Chemical Bonding			

- 1. Atomic Structure:** Wave-Particle duality, de Broglie's hypothesis for matter waves and its consequences, standing waves and quantization, Heisenberg's uncertainty principle, significance of the uncertainty principle, Schrödinger's wave equation and its application to hydrogen atom, solutions of Schrödinger wave equation, quantum numbers and their properties, radial wave functions, angular wave functions and shapes of the orbitals, probability distribution, radial and angular nodes, many electron atoms, sequence of energy levels, electronic configuration of atoms.
- 2. Chemical Bonds:** Chemical bond, types of chemical bonds,
 - (i) Ionic Bond:** Ionic bond and its uniqueness, properties of ionic compounds, close packing, close-packed structures, interstitial sites, radius ratio, radius ratio rule, coordination number and radius ratio value, structure of NaCl, lattice energy of ionic crystals, theoretical calculation of lattice energy of NaCl crystal, Madelung constant, experimental determination of lattice energy of NaCl crystal, factors affecting the magnitude of lattice energy of ionic solids, applications of lattice energy calculation.
 - (ii) Covalent Bond:** Covalent bond, properties of covalent bond and covalent bonded compounds, overlap integral and bond strength, polarity of bonds, dipole moment and percentage ionic character, factors affecting the magnitude of dipole moment, valence bond theory, hybridization, mathematical formulation of sp and sp^2 hybrid orbitals, limitations of valence bond method, molecular orbital theory, the LCAO method, molecular orbital diagram, frontier orbitals - HOMO and LUMO, Mixing of MOs and the correlation diagrams, MO descriptions of heteronuclear diatoms, HF and CO, Walsh diagram, MO descriptions of polyatoms like H_2O , BeH_2 , and C_6H_6 involving π bonding electrons, comparison and contrast between VBT and MOT, applications of frontier orbital concept.
 - (iii) Bonding in Metals:** Metallic bond, factors favoring the formation of metallic bond, theories of metallic bond - electron sea theory, molecular orbital theory, characteristics of metals, conductors, semiconductors and insulators.
 - (iv) Hydrogen Bond:** Hydrogen bond, types of hydrogen bond, theories of formation of hydrogen bond – electrostatic approach, molecular orbital approach, properties of hydrogen bond and hydrogen bonded compounds, hydrogen bond in biological systems.

Books Recommended:

1. Chemical Structure and Bonding, R. L. DeKock and H. B. Gray, University Science Books.
2. Inorganic Chemistry, G. L. Miessler and D. A. Tarr, Prentice-Hall of India Private Limited.
3. Atomic Structure and the Chemical Bond, M. Chanda, Tata McGraw-Hill.
4. Physical Chemistry, G. M. Barrow, McGraw-Hill.
5. Inorganic Chemistry, D. F. Shriver, P. W. Atkins and C. H. Langford, Oxford University Press.
6. Valence and Molecular Structure, E. Cartmel and G. W. A. Fowles, Butterworths.

Course Code	2875	Marks: 100	Credits: 4	Class Hours: 60
Course Title	Coordination Chemistry And Organometallic Chemistry			

Transition and Inner Transition Elements: Transition elements, main and inner transition elements, their positions in the periodic table, main transition elements: general characteristics, melting and boiling points, variable oxidation states, color of complex ions, magnetism - origin of paramagnetism and diamagnetism, magnetic susceptibility, Curie's law, Curie-Weiss law, techniques of magnetic measurements, Gouy balance, ferromagnetism and antiferromagnetism, lanthanides and actinides: oxidation states, atomic and ionic radii of M^{3+} ions, magnetic properties of M^{3+} ions, lanthanide contraction, chemical reactivity of lanthanides, separation of lanthanide and actinide compounds, comparison between 3d and 4f block elements.

- 1. Concept of Coordination compounds:** Coordination compounds, double salts and coordination compounds, coordination sphere, coordination number, ligand types, properties of ligands, nomenclature of coordination compounds, isomerism in coordination compounds – structural isomerism and stereo isomerism, stability: thermodynamic and kinetic stability of coordination compounds, stepwise and overall stability constants, factors affecting the stability of metal complexes.
- 2. Bonding in Coordination Compounds:** Coordination bond, Werner's coordination postulate, limitations of Werner's postulate, Sidgwick's electronic concept, application of EAN rule, limitations of Sidgwick's concept, assumptions of valence bond theory (VBT), hybridization and geometry of complexes, inner orbital and outer orbital octahedral complexes, limitations of VBT, important features of crystal field theory (CFT), orbital splitting and electron spin, factors influencing the magnitude of $10Dq$, spectrochemical series, high and low spin complexes, crystal field stabilizing energies of d^n configuration ($n = 0$ to 10), four and six coordination preferences, magnetic moments, color of transition metal complexes, distortion of octahedral complexes and Jahn-Teller theorem, limitations of CFT, ligand field theory (LFT), molecular orbital theory (MOT), MOT as applied to octahedral complexes, comparison of different theories.
- 3. Reactions and Mechanisms in Coordination Chemistry:** Inert and labile ligands, substitution reactions, types of substitution reactions, nucleophilic substitution reactions, association, dissociation and interchange mechanisms, factors affecting the rate of substitution reactions, acid and base hydrolysis reactions, the conjugate base mechanism, stereochemistry of octahedral substitution, substitution in square planar complexes, trans effect – theories of trans effect, uses of trans effect, substitution in tetrahedral complexes, fluxionality in coordination compounds.
- 4. Metal Carbonyls and Nitrosyls:** π -acid ligands and π -acid complexes, metal carbonyl and metal nitrosyl complexes, preparation and properties of metal carbonyl and nitrosyl complexes, M-C-O and M-N-O bonding, bridging and terminal COs and NOs, infrared and ^{13}C NMR analysis of carbonyls and nitrosyls, biological role of nitrosyl compound.
- 5. Organometallics and Their Catalytic Aspects:** Introduction, general characteristics, ligands in organometallic chemistry, 18- and 16-electron rule, stability of organometallic compounds, classification of organometallic compounds, preparative routes for metal-carbon bond formation, bonding between metal atoms and organic π systems, structures of Zeise's salt and ferrocene,

organometallic reactions – ligand dissociation and substitution, oxidative addition, reductive elimination, carbonyl insertion, homogeneous catalysis, hydrogenation by Wilkinson's catalyst, hydroformylation, heterogeneous catalysis, Ziegler-Natta polymerizations, water gas reactions, Fisher-Tropsch reaction.

Books Recommended:

1. Inorganic Chemistry, J. E. Huheey, E. A. Keiter, and R. L. Keiter, Harper Collins College Publishers.
2. Advanced Inorganic Chemistry, F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, John Wiley & Sons, Inc.
3. Selected Topics on Advanced Inorganic Chemistry, S. Z. Haider, Students' Publications.
4. Inorganic Chemistry, D. F. Shriver, P. W. Atkins and C. H. Langford, Oxford University Press.
5. Kinetics and Mechanism, A. A. Frost and R. G. Pearson, John Wiley & Sons.
6. Inorganic Reaction Mechanisms, M. L. Tobe, Thomas Nelson and Sons Ltd.

Course Code	2876	Marks: 100	Credits: 4	Class Hours: 60
Course Title	Fundamentals of Analytical And Environmental Chemistry			

- 1. Basic Concepts in Analytical Chemistry and Statistical Treatment of Data:** Analytical detection and quantification, sensitivity, selectivity, specificity, concentration limit, dilution limit etc. of chemical reactions, sample containers, sample preservation, sampling, sample dissolution, wet ashing and dry ashing, reagents and reactions, population and sample mean, standard deviation, relative standard deviation, coefficient of variation, variance, confidence limit, Gaussian distribution, statistical tests – the F test, the T test, the Q test, regression lines, least square method, coefficient of correlation.
- 2. Volumetric Analysis:** Principle, apparatus, end point, indicator, general factors influencing volumetric method, advantages, acid-base titrations, redox titrations, complexometric titrations – complexing agents, influence of $[H^+]$ on complexation, metallochromic indicators, color transition with metallochromic indicators, masking and demasking, uses of EDTA titrations.
- 3. Gravimetric Analysis:** Introduction, general requirements of a gravimetric method, precipitation from homogeneous solution, practical gravimetric procedures, application of gravimetry.
- 4. Spectrophotometric Analysis:** Ultraviolet and visible radiation, absorbance, transmittance, absorptivity, the Beer-Lambert's law, limitations of Beer-Lambert's law, wavelength selection, basic components of a spectrophotometer, qualitative and quantitative analysis, stoichiometric determination of metal-ligand complexes, derivative spectrophotometry.
- 5. Thermal Analysis:** Thermogravimetry (TG), types of TG, instrumentation, application of TG, derivative thermogravimetry (DTG), simultaneous TG and DTG, differential thermal analysis (DTA): working principle, instrumentation, factors affecting DTA, applications, differential scanning calorimetry (DSC): working principle, instrumentation and applications.
- 6. Atomic Spectrometric Methods:** Atomic absorption and atomic emission, absorption line width, choice of absorption line, flame emission spectrometry: instrumentation, flame emission analysis, atomic absorption spectrophotometry: principles, instrumentation and interferences, electro-thermal atomizers, sample requirements and general preparation techniques, the effect of different solvents, sensitivity, qualitative and quantitative analysis, hydride vapour generation technique, cold vapour technique, advantages and disadvantages of AAS.
- 7. Voltammetric Analysis:** Diffusion current, half wave potential, oxygen interference, voltammetry – ASV, CSV and CV, multicomponent analysis, quantitative applications.
- 8. Basic Concept of Environmental Chemistry and its Scope:** Fundamental components and structure of the environment, lithosphere, hydrosphere, atmosphere and biosphere, their natural and chemical compositions, structure of the atmosphere.
- 9. Water Pollution:** General causes of water pollution, types of chemical pollutants in water, inorganics, organics, nutrients, pesticides, PCBs, PAHC, toxic heavy metals, radioactivity in water, detergents, etc., water treatment - coagulation, flocculation and filtration techniques, ion exchange purification of water, photo-oxidation, adsorption of chemical pollutants from dilute solution, electrochemical processes for water purification and reverse osmosis technology, sewerage and industrial waste water treatment.

- 10. Atmospheric Chemistry and Air Pollution:** Nature of chemical pollutants in the atmosphere and their sources, chemical and photochemical reactions and their consequent effects - ozone depletion, greenhouse effect and damage to physical structures, acid rain, photochemical smog, particulates, air pollution control.
- 11. Toxic Effect of Chemical Pollutants on Living Systems:** Introduction, biochemical effects and toxicity of metals: Hg, Cd, Pb, Cr, As, etc., pesticides, chlorinated hydrocarbons, polyaromatic hydrocarbons, gases: CO, H₂S, NO₂, HCN etc.
- 12. National Policy for the Protection of the Environment:** International laws of the seas, clean air and clean water acts, national environment quality standards (EQS), EEC and WHO guidelines for air and water quality.

Books Recommended:

1. Fundamentals of Analytical Chemistry, D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Saunders College Publishing.
2. Analytical Chemistry, G. D. Christian, John Wiley & Sons.
3. Modern Analytical Chemistry, D. Harvey, McGraw-Hill Higher Education.
4. A Text Book of Quantitative Analysis, A. I. Vogel, Longman, Green and Co. Ltd.
5. Environmental Chemistry, S. E. Manahan, 8th edition, CRC Press.
6. Fundamental Concepts of Environmental Chemistry, G. S. Sodhi, Narosa Publishing House.
7. Environmental Chemistry, A.K. De, New Age International Publishers.
8. Air Quality, T. Godish, Lewis Publishers.
9. Environmental Toxicology, M. Satake, Y Mido, M. S. Sethi, S. A. Iqbal, H. Yasuhisa and S. Taguchi, Discovery Publishing House.

Course Code	2877	Marks: 100	Credits: 4	Class Hours: 60
Course Title	Industrial Chemistry			

- 1. Fundamentals in the Development of Chemical Industries:** General ideas about unit processes and unit operations, raw materials, process design, commercial energy sources, catalysts, heat transfer, mass transfer, separation processes, concepts of consumption, production, and market evaluation, safety, environmental considerations, site and technology selection criteria, cost-benefit analysis.
- 2. Chlor-alkali Industries:** Raw materials, manufacture of caustic soda, soda ash, sodium bicarbonate, chlorine, bleaching powder, environmental hazards of these chemicals.
- 3. Fertilizer Industries:** Plant nutrients, classification of fertilizers, natural inorganic fertilizers, nitrogen fixation, artificial fertilizers, manufacture of ammonia and urea, action of urea as fertilizer, potassium fertilizer, calcium phosphate and other phosphatic fertilizers, NPK fertilizer.
- 4. Cement Industries:** Portland cement, raw materials, important process parameters for manufacturing a good cement clinker, methods of manufacturing Portland cement, sequence of operations, additives for cement, properties of cement, testing of cement, setting of cement, other types of cement, manufacture of gypsum, Plaster of Paris.
- 5. Glass Industries:** Properties of glass, raw materials and fundamentals of glass industries, methods of manufacture, choice of the furnace, chemical reactions in the furnace, annealing, special glasses.
- 6. Ceramic Industries:** Ceramics, properties of ceramics, basic raw materials, manufactures of ceramics, refractories, requisites of a good refractory, classification of refractories, properties of refractories, manufacture of refractories, types of refractory products.
- 7. Acids:** Raw materials, manufacture of hydrochloric, phosphoric, sulfuric acids, concentration and purification of acids, industrial uses of mineral acids, safety and hazards.
- 8. Iron and Steel Industry:** Fundamentals of metallurgy, ores of iron, three commercial forms of iron, construction and operation of blast furnace, reactions in blast furnace, byproduct in blast furnace, classification of steel, steel manufacturing processes, effects of impurities on steel, phases in Fe-C system.
- 9. Sugar and Starch Industries:** Steps in the industrial extraction of cane sugar, and inversion of sugar, refining of sugar, production of sugar from sugar beet, byproducts of sugar industries, management of industrial waste of sugar industries, production of starch from corn, production of glucose and dextrin from starch.

- 10. Cellulose and Allied Industries:** Natural sources of cellulose, its constituents and their estimation, different processes for the manufacturer of paper from pulp, production of paper board, viscose rayon and other modified cellulosic fiber, wood chemistry and wood chemicals.
- 11. Fuels:** Solid, liquid and gaseous fuels, coal and its constituents, different stages of coal formation, analysis and calorific value of coal and other fuels, manufacture of producer gas and water gas, refining and distillation of crude oil, thermal and catalytic cracking, hydrocarbons and petroleum, petroleum refining, petrochemicals from liquid and gaseous hydrocarbons, natural gas and its utilization.
- 12. Natural Oils, Fats and Waxes:** Extraction and refining of vegetable oils, analysis of fats and oils and their uses, hydrogenation of oils - soybean and sunflower oils and their uses.
- 13. Paints and Varnishes:** Constituents of paints, varnishes, lacquers, enamels and printing inks and their functions, paints and pigments and their manufacturer, differentiation between paints and varnishes.
- 14. Soaps and Detergents:** Methods of fat splitting, manufacturer of laundry and toilet soaps, recovery and refining of glycerin, detergents: definition, classification and their manufacture, comparison between soaps and detergent.
- 15. Fermentation Industries:** Enzymes and their application, manufacture of industrial alcohol and absolute alcohol, principal and production of acetone and acetic and citric acid, antibiotics.
- 16. Explosives:** Definition and classification, toxic chemical agents and propellants, industrial explosives - nitroglycerine, dynamite, etc., military explosives - TNT, picric acid, nitrocellulose, etc.

Books recommended:

1. Chemical Process Industries, R. N. Shreve and J. A. Brink, Jr., McGraw-Hill Inc.
2. Industrial Chemistry, B. K. Sharma, Geol Publishing House.
3. Reagel's Hand Book of Industrial Chemistry, J. A. Kent edited, Van Nostrand.
4. Chemical Process Industries, G. T. Austin edited, McGraw-Hill.
5. Materials Science and Engineering – An Introduction, W. D. Callister, Jr., John Wiley & Sons, Inc.
6. Inorganic Medicinal and Pharmaceutical Chemistry, J. H. Block and E. B. Roche, Lea and Febiger Pub.
7. Environmental Chemistry Vol. I - III, H. J. M. Bowen, The Royal Society of Chemistry.

Course Code	2878	Marks: 100	Credits: 4	Class Hours: 60
Course Title	Chemical Spectroscopy			

1. **Electromagnetic Radiation:** The nature of electromagnetic radiation; Emission and absorption spectra; Spectrometers; Basic components of dispersive spectrometers, modulation technique; Transmittance and absorbance; Representation of spectra; Spectral peaks, Intensities, Width and resolution, Signal to noise ratio and signal averaging; Fourier transform technique and its advantages.
2. **Atomic spectroscopy:** Atomic spectra; Spectra of hydrogen and hydrogen-like elements; Energy level diagrams; Angular momentum of atoms; Coupling of orbital and spin angular momenta; Term symbols; Fine structure of atomic spectra; Methods of exciting atomic spectra; Atomic absorption spectroscopy; Applications.
3. **Rotational spectroscopy:** Rotation of molecules and the classification of rotating molecules with radiation; Microwave spectrometer; Rotational energies of linear rotators; Distribution of molecules and rotational spectra centrifugal distortion; Symmetric top molecules and their rotational spectra; Effect of isotopic substitution; Stark effect and its use in microwave spectrometers; Determination of molecular geometry from microwave spectra.
4. **Infrared spectroscopy:** Vibration in molecules; Normal modes, Harmonic and anharmonic; Potential energy diagrams; Morse equation; Vibrational energy; Dissociation energy of diatomic molecules; Population of vibration levels; Transition probabilities; Fundamental, overtone and hot band transitions; Combination and difference bands; Fermi resonance; Vibration – rotation spectra of gaseous molecules; P, Q and R branches: parallel and perpendicular vibrations; Infrared spectra of polyatomic molecules; Characteristic group vibrations and skeletal vibrations; Shifts in group frequencies Techniques; Radiation sources; Optics; Monochromators; Sample holders; Detectors for infrared spectrometers; Handling of samples; Gaseous; Liquid and solid samples; FTIR spectrometers.
5. **Ultraviolet-visible spectroscopy:** Electronic states of molecules; Spectra of simple gaseous diatomic species and their vibrational course structure; Frank-Condon principle and intensities of spectral lines; Dissociation energy; Pre-dissociation; Spectra of species in condensed phase; Various electronic transitions in organic and inorganic species; Width of electronic bands; Effect of solvent on band width and band position; Chromophores, Bathochromic and Hypsochromic shifts, Auxochromes.
6. **Raman spectroscopy:** Raman effect; Classical and quantum concept of Raman scattering; Criterion of Raman activity; Raman spectrometers; Use of laser in Raman spectroscopy; Energy expression for Vibrational and rotational Raman spectra; Use of polarized light; Applications of Raman spectroscopy.
7. **Principles of Resonance spectroscopy:** Electron spin and nuclear spin; Effect of magnetic field on the energies of spinning electrons and nuclei; The Larmor precession; Resonance absorption of radiation through spin flipping; Relaxation times; The NMR spectrometers; The ESR spectrometer; NMR spectroscopy: Electron density at the nucleus, the chemical shift, and scales of chemical shift; the coupling of nuclear spins, the coupling constant; Exchange phenomenon in chemical analysis by NMR techniques. ESR spectroscopy: The g-factor, Hyperfine splitting. Determination of electron density from ESR spectroscopic studies.
8. **Mass spectrometry:** Theory, spectrometer, Electron impact (EI), Chemical ionization (CI), Desorption ionization (DI), Fast atom Bombardment, Tandem mass spectroscopy, Fragmentation

process, Molecular ion identification, Interpretation of Mass spectra. Instrumentation of mass spectrophotometer.

Books Recommended:

1. The structure of Molecules; G.M. Barrow
2. Introduction of Molecular Spectroscopy; G.M. Barrow
3. Fundamental of Molecular Spectroscopy; C.N. Banwell
4. The Infrared Spectra of Complex Molecule; L.J. Bellamy
5. Ultraviolet and Visible Spectroscopy; Rao
6. Molecular Spectroscopy; Raymond Chang
7. Spectra of Diatomic Molecule; Hertzberg
8. Physical Chemistry; P.W. Atkins

Course Code	2879	Marks: 50	Credits: 2	Class Hours: 60
Course Title	Agricultural Chemistry			

1. **Pesticides:** Its importance, Classification with examples
2. Important Insecticides, Acaricides nematocides, Moluscicides, Rodenticides, Herbicides, Fungicides etc.
3. **Toxicity of Pesticides:** Lethaldose, Toxicsurblethaldose, LD₅₀, ED₅₀, EC₅₀ etc.
4. **Formulation Pesticides:** Grannular, Wettable powder, Emulsion etc.
5. Metabolism of pesticides in biological system, detoxification of pesticides and their metabolites in the environment
6. A brief introduction of organochlorine compounds as pesticides with reference to lindane, heptachlor., DDT, endosulphane etc. The mechanism of action of organochlorine compounds in the biological system, detoxification of the organochlorine and the residual effects in the environment.
7. A brief introduction of organophosphorous compounds and carbamates and their mechanism of actions in the biological system, their metabolism and cause of resistance in the insect system.
8. **Studies of a few pesticides:** Metaphos, Bromophos, Metathion, Diazinon, Melathion, Carbaryl, Pirimicarb etc.
9. Insect attractant, repellent, chemosterile retardants etc.
10. **Natural Pesticides:** Pest control by compounds from natural products. Pyrethrines, rotenone, glucosinolates, azadirachtin etc.
11. Pest control by pheromones. Advantage of using pheromones over synthetic pesticides.

Books Recommended:

1. G.S. Gruzdyev VA. Zinchenko, V.A. Kalinin, R.I. Slovisov, The Chemical Protection of Plants. Mir Publishers Moscow.

NATIONAL UNIVERSITY



Fourth Year Syllabus Department of Chemistry

Four Year B.Sc. Honours (Integrated) Course
Effective from the Session : 2013–2014

National University

Subject: Chemistry

Syllabus for Four Year B.Sc. Honours Course

Effective from the Session: 2013-2014

Year wise Paper, Marks and Credit distribution

FOURTH YEAR

Paper Code	Paper Title	Marks	Credits
242801	Physical Chemistry-IV	100	4
242803	Selected Topics in Organic Chemistry	100	4
242805	Selected Topics in Inorganic Chemistry	100	4
242807	Nuclear Chemistry	100	4
242809	Organic Polymers	100	4
242811	Reaction Mechanism	100	4
242813	Separation Techniques	100	4
242815	Chemical Spectroscopy	100	4
242816	Practical Chemistry (Organic)	50	2
242818	Practical Chemistry (Industrial)	50	2
242820	Viva-voce	100	4
	Total =	1000	40

Detailed Syllabus

Paper Code	242801	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Physical Chemistry-IV			

- 1. Quantum Chemistry:** Failure of classical mechanics, black body radiation, Planck's quantum theory, photoelectric effect, Einstein's explanation of the photoelectric effect, Compton effect, heat capacities of solids, atomic spectra, de-Broglie's hypothesis, diffraction of electrons, consequences of de Broglie's concepts, Heisenberg's uncertainty principle, consequences of the uncertainty relation.
- 2. Schrodinger wave equation and it's solution:** The time-independent Schrodinger wave equation, operators in quantum mechanics, eigenfunctions and eigenvalues, well behaved wave functions, significance of wave functions, postulates of quantum mechanics, applications of quantum mechanics, particle in a one-dimensional box, degeneracy, Schrodinger wave equation for the hydrogen atom, separation of variables, Φ , Θ and R equations, solutions of the Φ and Θ equations, the perturbation theory, perturbation treatment of the helium atom ground state, the variation theorem, variation treatment of the ground state of helium.
- 3. Statistical Mechanics:** Macroscopic system, configuration, population, weight, Boltzmann distribution, molecular partition function: translational, rotation and vibrational partition functions of molecules, internal energy of a system, Fermi-Dirac and Bose Einstein statistics, evaluation of partition function, calculation of thermodynamic function, Einstein and Debye equation, chemical equilibrium, statistical treatment, evaluation of equilibrium constant.

Books Recommended:

1. Quantum Chemistry, I. N. Levine, Prentice Hall of India Pvt. Ltd.
2. Quantum Chemistry, Donald A McQuarri.
3. Quantum Chemistry, R K. Prasad Second Edition.
4. Quanta, P.W. Atkins.
5. Quantum Mechanics in Chemistry, M. W. Hanna.
6. Elements of Quantum Mechanics, K. Singh and S. P. Singh, S. Chand & Company Ltd.
7. Physical Chemistry, P.W. Atkins, Oxford.
8. Statistical Thermodynamics by Davidson, McGraw-Hill, New York

Paper Code	242803	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Selected Topics in Organic Chemistry			

1. Natural Products

- 1.1. Carbohydrates:** Sources and importance, Classification, structure and configuration of aldoses and ketoses projection formula and conformation, reaction of monosacharides. Structure and conformation of aldo-hexoses structure of sucrose, maltose and lactose, mutarotation, anomerization, epimerization, determination of ring size, conformation of aldo-hexoses.

- 1.2. Alkaloids:** Occurrence and importance Classification, Tests of alkaloids, extraction and purification of alkaloids; general methods of determining the structure, Chemistry of ephedrine, nicotine, papaverine and atropine.
- 1.3. Terpenes:** The essential oils; Classification of terpenes; Isoprene and special isoprene rule, isolation, purification and general methods of determining structures of terpenes; Detailed studies of some mono terpenes; i. acyclic-citral, ii. Monocyclic.
- 1.4. Amino-acids and Proteins:** Structure, Classification, synthesis, physical and chemical behaviour of amino-acids; Isoelectric point of amino-acids, analysis of amino-acids; structure and synthesis of peptides, general nature and assay of polypeptides and proteins.
- 1.5. Urides and Purines:** Isolation and purification of purine bases; Structure and synthesis of uric acids, structures of important derivatives of purines; Adenine, Xanthine, Guanine, Nucleotides; Nucleosides and Nucleic acids.
- 1.6. Colouring Matters:** Isolation, purification and structure of anthocyanines, Flavonoids and Carotenoids.
- 1.7. Steroids:** Occurrence classification and detection of steroids, Structure elucidation of steroids with reference to β -sitosterol, cholesterol

2. Medicinal Chemistry

1. Synthesis of Some Important Organic Drugs:

- 1.1. Sulpha Drugs:** Sulphanilamide, Sulphapyridine, Sulphathiazole.
- 1.2. Antimalarials:** Plasmaquine, Mepacrine, Chloroquine & Paludrine.
- 1.3. Fever Sinking Drugs:** Paracetamol, Aspirin, Phenacetin.
- 2. Antibiotics:** Penicilin. Steptomycin, Chloromycetin.

Books Recommended:

1. An Introduction to the Chemistry of Carbohydrates, R.D. Guthrie and John Honeyman
2. Carbohydrate Chemistry, Davison.
3. Chromatographic Methods. Stock and Rice
4. Steroids, Fieser and Fieser.
5. Chemistry of Alkaloids Pelletier. Van Nostrand
6. Organic Chemistry, Chemistry of Organic Natural Products. O.P. Agarwal. Vol-I & II, GOEL. Publishing House, Meerut. India.

Paper Code	242805	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Selected Topics In Inorganic Chemistry			

- 1. Molecular Symmetry and Group Theory:** Symmetry elements and operations, point groups of molecules, groups of very high and low symmetry, use of flow chart to identify a point group, optical activity and dipole moments on the basis of point group symmetry.

- Bioinorganic Chemistry:** Essential and non-essential elements, availability of bioelements, deficiency and specificity of bioactive elements, roles of Na^+ and K^+ , ion pump, role of calcium in muscle contraction, role of magnesium in photosynthesis, biochemistry of iron, hemoglobin and myoglobin, oxygen transport and storage, oxygen carriers, cytochromes, metalloenzymes, iron-sulfur proteins, nitrogen fixation, vitamin B_{12} .
- Non-aqueous Solvents:** Classification of solvents, general properties of ionizing solvents, leveling and differentiating solvents, types of chemical reactions in solvents, measurement of solvent strength, liquid ammonia, ethanol, anhydrous sulfuric acid, liquid SO_2 , molten salts as solvents.
- Inorganic Polymers:** Concept of inorganic polymers as distinct to organic polymers, classification of inorganic polymers, properties of inorganic polymers, studies of some typical inorganic polymers: (i) phosphazines, (ii) silicones, and (iii) S-N polymers.
- Nanochemistry:** Overview of different nanomaterials available, classification, Methods for the synthesis and characterization of nanomaterials, fullerenes and carbon nanotube, applications of nanomaterials.
- Metal Clusters:** Introduction, synthesis, structures of metal clusters with pi-acid ligands - polyhedral skeletal electron-pair theory, the capping principle, reactions of metal clusters, applications.

Books Recommended:

- Chemical Applications of Group Theory, F. A. Cotton, John Wiley & Sons, Inc.
- Concepts and Models of Inorganic Chemistry, B. E. Douglas, D. H. McDaniel, and J. J. Alexander, John Wiley & Sons, Inc.
- Non-aqueous Solvents, H. Sisler.
- Non-aqueous Solvents, J. R. Chipperfield.
- Inorganic Polymers, F. G. A. Stone, and W. A. G. Graham.

Paper Code	242807	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Nuclear Chemistry			

- The Atomic Nucleus and Its Properties:** Atomic nucleus and its constituents, nuclear radius and nuclear density, nuclear force, mass defect, packing fraction, binding energy, nuclear spin and moments, nuclear potential, concepts of nuclear structure - shell model, nuclear statistics, nuclear stability, nuclidic mass and atomic mass, nuclear mass and energy correlation, classification of nuclides.
- Radioactivity and Radioactive Decay Laws:** Radioactivity, units of radioactivity, natural and artificial radioactivity, radioactive decay, kinetics of radioactive decay, half-life and average life, radioactive decay series, radioactive equilibria, comparison between radioactive equilibrium and chemical equilibrium.
- Nuclear Reactions:** Nuclear reactions and their comparison with chemical reactions, types of nuclear reactions, conservation laws, energetics of nuclear reactions, nuclear reaction cross-section, excitation function, nuclear reactions mechanisms, nuclear fission and liquid drop model,

fissionability parameters, the mass, charge and kinetic energy distributions in thermal neutron induced fission of ^{235}U , practical application of nuclear fission, nuclear fusion, controlled nuclear fusion, importance of nuclear fusion.

4. **Interaction of Radiation with Matter and Detection of Nuclear Radiation:** Modes of interactions, interactions of gamma radiations and charged particles with matters, Bremsstrahlung radiation, Čerenkov radiation, beta backscatter, the Auger process, radiation detection, measurements of radiations with ionization chambers, proportional counter, Geiger Müller counter, NaI(Tl) scintillation detectors.
5. **Nuclear Reactors:** The fission energy, fission cross-sections and threshold, fission neutrons, the reproduction factor, Fermi's four factor formula, major components of a reactor, the classification of reactors, reactor power, critical size of a thermal reactor, excess reactivity and control, breeder reactors, application of reactors.
6. **Accelerators:** Working principles, basic components and utilization of Van de graaff, tandem Van de graaff, cyclotron and synchrotrons accelerators.
7. **Production and Uses of Radioisotopes:** General principles of production of radioisotopes, radiochemical separation and purification of isotopes, uses of radioisotopes.
8. **Nuclear and Radiochemical Methods of Analysis and their Applications:** Radiotracer, geochronology and radioactive dating, isotope dilution method in chemical analysis, neutron activation analysis of trace elements.
9. **Safety:** Radiation exposure, radiation dose, dose equivalent, quality factor, simple calculation of radiation exposure and radiation dose for γ - and β -rays, radiation hazards, radiation protection and control, radioactive wastes and their management.

Books Recommended:

1. Radiochemistry and Nuclear Methods of Analysis, W. D. Ehmann and D. E. Vance, John Wiley & Sons, Inc.
2. Nuclear and Radiochemistry, G. Friedlander, J. W. Kennedy, E. S. Macias and J. M. Miller, John Wiley & Sons.
3. Introduction to Nuclear Physics and Chemistry, B. G. Harvey, Prentice-Hall Inc.
4. Essentials of Nuclear Chemistry, H. J. Arnikar, Wiley Eastern Ltd.
5. Nuclear Chemistry and its Applications, G. R. Choppin and J. Rydberg, Oxford: Pergamon.

Paper Code	242809	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Organic Polymers			

1. **Classification of Polymers & Polymerization Process:** Addition (Chain reaction) and Condensation (Step reaction) Polymerizations
2. **Fundamental Concept of the Following Polymer:** Homopolymers and heteropolymers. Low density and high density polymers and their properties. Copolymers; alternating, random, block and graft copolymers. Elastomer, thermoplastic and thermosetting polymers and their properties. Fiber and elastomer.

3. **Mechanism of polymerization:** Redical, cationic and anionic polymerization, and their kinetics, Chain termination, Chain transfer, Chain retardation and chain inhibition.
4. **Co-ordination polymerization:** Fluid-bed process, Ziegler-Natta Catalysis, mechanism of co-ordination polymerization and its kinetics, Metal oxide catalyzed and Olefin polymerizations. Ring opening polymerization.
5. **Configuration of polymers:** Syndiotactic, isotactic, atactic polymers.
6. **Some important polymers:** Production of monomer unit, physical properties and important uses of polythene, polyvinylchloride (PVC), polystyrene, polybutylene, polybutadiene-styrene, neoprene, polymethylmethacrylate, polyacrylonitrile, polyvinylacetate, polyamides: Nylon 6, nylon 66, nylon 11 and nylon 12, silk and wool.
7. **Thermosetting resins:** Phenol-formaldehyde, phenol-urea, melamine-formaldehyde polymers, their preparation and uses. Epoxy resins and polyurathanes.

Books Recommended:

1. Organic Chemistry, R.T. Morrison and R.N. Boyd Fifth edition.
2. Text book of polymer science, F.W. Billmeyer, JR

Paper Code	242811	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Reaction Mechanism			

1. Broad concept of the mechanism of the following classes of organic reaction:

- 1.1 **Nucleophilic Substitution at Saturated Carbon:** Mechanism of S_N1 and S_N2 ; stereochemistry and kinetics of S_N1 and S_N2 reactions; broad concept of effect of solvent, effect of structure, effect of attacking reagents and leaving groups, neighbouring group participation, Steric effect. nucleophilic substitution at unsaturated carbon with special reference of Claisen condensation reaction; Aromatic nucleophilic substitution reactions.
- 1.2 **Electrophilic substitution Reactions:** Electrophilic substitution reactions at unsaturated carbon including aromatic compounds; nitration, halogenation, sulphonation alkylation and acylation.
- 1.3 **Electrophilic addition reactions:** Electrophilic addition to $C=C$ and $C\equiv C$ bonds; halogenation, hydrogenation, hydration, hydroxylations, hydorboration, ozonolysis, Diels-Alder reaction, Michael addition.

- 1.4 **Oxidation-Reduction Reactions:** Wolff-Kishner reduction, Clemmensen reduction, Oppenauer oxidation; reduction with metal hydrides; Rosenmund reduction, Wittig reaction Meerwein-Ponndorf-Verley reduction.
2. **Addition:** Mechanism & stereo chemistry of nucleophilic addition to C=O bond with special reference to Cannizzaro reaction, Aldol condensation, Perkin reaction, Reformatsky reaction, Benzoin condensation, Mannich reaction, Grignard reaction Knoevenagel reaction. 1,3-Dipolar addition and 1,4-addition reactions.
3. **Elimination:** E₁ & E₂ mechanism; stereochemistry and orientation of elimination reactions; competition between elimination and substitution; intramolecular elimination. Ionic elimination, thermal and syn-elimination (Chugaev and related reactions). detailed treatment of Saytzeff and Hofmann rule of elimination reaction leading to product formations.
4. **Molecular Rearrangements:** Base-catalysed rearrangements, rearrangements involving migration to electron deficient nitrogen and oxygen atoms; aromatic rearrangement passing through "No mechanism pathways" Claisen, Cope and related rearrangements.
5. **Conformational Analysis and its Effect on Reactivity:** Conformational effects on stability and reactivity Curtius-Hammet principle. transannular effects. the concept of 1-strain.
6. **Molecular Orbital Theory:** Phase of an orbital and its role in bonding and antibonding. Huckel molecular orbital theory. LCAO's theory and M.O's theory – their shapes and energy states. illustration with 1,3-butadiene allyl system and 1,3,5-hexatriene.
7. **Orbital Symmetry and Chemical Reactions:** Woodward and Hofmann rules and their applications in thermal and photochemical reactions. electrocyclic reactions, cycloaddition reaction and sigmatropic rearrangements.

Books Recommended:

1. A guide book to Mechanism in Organic Chemistry – Peter Sykes, Longman.
2. Mechanism and Structure in Organic Chemistry – E.S. Gould, Holt Dryden
3. Advanced Organic Chemistry – Jerry, March, 3rd Edition, Wiley Eastern Limited
4. Physical Organic Chemistry, Lowry and Richardson.
5. Physical Organic Chemistry, Batlar.
6. Physical organic Chemistry, Jack and Hine.
7. Organic Chemistry, Pine and Statnely.
8. Symmetry in organic Molecules, Gilchrist and Storr.
9. Frontier Orbital Theory, I Fleming
10. Organic Reaction Mechanism, E.S. Gould

Paper Code	242813	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Separation Techniques			

- 1. Solvent Extraction:** Introduction, completeness of extraction, selectivity of extraction, factors favoring solvent extraction, solvent extraction equilibria, batch and continuous extractions, analytical applications.
- 2. Chromatographic Methods in General:** Introduction, retention behavior, efficiency, selectivity, resolution, chromatographic theory, measured chromatographic parameters, evaluation methods, classification of chromatography.
- 3. Liquid Chromatography:** Introduction, technique of liquid chromatography, various forms of liquid chromatography, ion pair chromatography, principles of ion pair extraction, retention, selectivity, application.
- 4. Paper Chromatography:** Principle, types of paper, choice of solvents, sample application, apparatus, location of spots and measurements of R_F value, separation of amino acids by paper chromatography.
- 5. Thin Layer Chromatography:** Theories and mechanism of TLC, choice of adsorbents, choice of solvents, detecting reagents, developing chamber, development and detection, superiority of TLC, analytical applications.
- 6. Column Chromatography:** Introduction, the column, packing the column, adsorbent, solvents used with columns, separation techniques, identification of compounds, applications.
- 7. Ion-Exchange Chromatography:** Ion-exchange resin, types of resins, their structure and properties, factors affecting the ion-exchange-equilibria, eluting solvents, analysis of the elute, application of ion-exchange chromatography.
- 8. Gel Chromatography:** Theory of gel chromatography, column, gel preparation, packing of column, advantages of gel chromatography, applications of gel chromatography.
- 9. High-Performance Liquid Chromatography:** The HPLC system, particle size and support material, filtration and degassing, HPLC columns, solvent requirements, solvent pumping systems, injection systems, HPLC detectors, advantages of HPLC, effect of temperature in HPLC, applications.
- 10. Electrophoresis:** Definition, Types of electrophoretic methods, paper electrophoresis, paper used, electrodes, source of current, location of components, requirements of electrophoretic chambers, sample introduction and detection, applications.
- 11. Gas Chromatography:** Principle, GC columns, selection of materials and column design, stationary phases, carrier gas, sample injection system, general properties of detectors, detector types, theory and principle of gas liquid chromatography, factors affecting separation, applications of gas liquid chromatography.

Books Recommended:

1. Fundamentals of Analytical Chemistry, D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Saunders College Publishing.
2. Analytical Chemistry, G. D. Christian, John Wiley & Sons.
3. Modern Analytical Chemistry, D. Harvey, McGraw-Hill Higher Education.
4. Analytical Chemistry Principles, J. H. Kennedy, Saunders College Publishing.
5. A Text Book of Quantitative Analysis, A. I. Vogel, Longman, Green and Co. Ltd.
6. Chromatography, B. K. Sharma, Goel Publishing House.
7. Chemical Analysis, A. K. Srivastava and P. C. Jain, S. Chand & Company Ltd.

Paper Code	242815	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title	Chemical Spectroscopy			

1. **Electromagnetic Radiation:** The nature of electromagnetic radiation; emission and absorption spectra; spectrometers; basic components of dispersive spectrometers, modulation technique; transmittance and absorbance; representation of spectra; spectral peaks, intensities, width and resolution, signal to noise ratio and signal averaging; Fourier transform technique and its advantages.
2. **Rotational spectroscopy:** Rotation of molecules and the classification of rotating molecules with radiation; microwave spectrometer; rotational energies of linear rotators; distribution of molecules and rotational spectra; centrifugal distortion; symmetric top molecules and their rotational spectra; effect of isotopic substitution; Stark effect and its use in microwave spectrometers; determination of molecular geometry from microwave spectra.
3. **Infrared spectroscopy:** Vibration in molecules; normal modes, harmonic and anharmonic; potential energy diagrams; Morse equation; vibrational energy; dissociation energy of diatomic molecules; population of vibration levels; transition probabilities; fundamental, overtone and hot band transitions; combination and difference bands; Fermi resonance; vibration – rotation spectra of gaseous molecules; P, Q and R branches: parallel and perpendicular vibrations; infrared spectra of polyatomic molecules; characteristic group vibrations and skeletal vibrations; shifts in group frequencies.
4. **Ultraviolet-visible spectroscopy:** Electronic states of molecules; spectra of simple gaseous diatomic species and their vibrational structure; Frank-Condon principle and intensities of spectral lines; dissociation energy; pre-dissociation; spectra of species in condensed phase; various electronic transitions in organic and inorganic species; width of electronic bands; effect of solvent on band width and band position; chromophores, bathochromic and hypsochromic shifts, auxochromes.
5. **Raman spectroscopy:** Raman effect; classical and quantum concept of Raman scattering; criterion of Raman activity; Raman spectrometers. Applications of Raman spectroscopy.
6. **Principles of Resonance spectroscopy:** Electron spin and nuclear spin; effect of magnetic field on the energies of spinning electrons and nuclei; the Larmor precession; Resonance absorption of radiation through spin flipping; relaxation times; NMR spectroscopy: electron density at the nucleus, the chemical shift, and scales of chemical shift; the coupling of nuclear spins, the coupling constant; Exchange phenomenon in chemical analysis by NMR techniques. ESR spectroscopy: The g-factor, hyperfine splitting. Determination of electron density from ESR spectroscopic studies.

7. **Mass spectroscopy:** Basic Principles, ionization techniques, Electron impact (EI), Chemical ionization (CI), desorption ionization (DI), Fast Atom Bombardment (FAB), molecular ion peak, meta-stable ions, fragmentation process, McLafferty rearrangement, molecular ion identification, interpretation of mass spectra. instrumentation of mass spectrophotometer.

Books Recommended:

1. The structure of Molecules; G.M. Barrow
2. Introduction of Molecular Spectroscopy; G.M. Barrow
3. Fundamental of Molecular Spectroscopy; C.N. Banwell
4. The Infrared Spectra of Complex Molecule; L.J. Bellamy
5. Ultraviolet and Visible Spectroscopy; Rao
6. Molecular Spectroscopy; Raymond Chang
7. Spectra of Diatomic Molecule; Hertzberg
8. Physical Chemistry; P.W. Atkins

Paper Code	242816	Marks: 50	Credits: 2	Class Hours: 30 hrs.
Paper Title:	Practical Chemistry (Organic)			

1. **Multistep organic synthesis:** Paracetamol, Diels-Alder adduct etc.
2. Separation and Identification of mixture of organic compounds by chemical and chromatographic method (using TLC/Column chromatography/paper chromatography)

Books Recommended:

1. Qualitative Organic Analysis, A.I. Vogel
2. Quantitative Organic Analysis, A.I. Vogel
3. A Text book of Practical of Organic Chemistry, Clarke
4. Identification of Organic Compounds, Shriner and Fuson
5. Chromatographic Methods, Stock and Rice

Paper Code	242818	Marks: 50	Credits: 2	Class Hours: 30 hrs.
Paper Title:	Practical Chemistry (Industrial)			

To Perform two Experiments (one from each group) each of 3 hours duration.

A. Inorganic Industrial Chemistry experiments

1. Determination of water hardness: temporary and permanent hardness.
2. Determination of chloride content in water by Hg (II) nitrate method.
3. Determination of dissolved O₂ in water by NaOH-MnSO₄ method
4. Measurement of pH and conductivity of water
5. Determination of Fe content in an iron tablet.

6. Determination of nitrogen by Kjeldahl's method
7. Determination of total arsenic, As(III) + As(V), in a groundwater sample
8. Determination of calcium in egg shell.
9. Determination of nicotine in tobacco.
10. Determination of ascorbic in Vitamin-C tablet
11. Determination of iodine in a salt sample.

B. Organo Industrial Chemistry experiments

1. Determination of iodine value of supplied oil sample.
2. Saponification value of oils and fats.
3. Determination of total acid and alkali in a soap sample
4. Determination of free acid and free alkali in soap sample
5. Determination of acid value of fats and oils.
6. Determination of the amount of glucose with the help of Fehling's solution.
7. Determination of the purity of sugar with the help of Fehling's solution.
8. Quantitative analysis of Aspirin.

Books Recommended:

1. Qualitative Organic Analysis, A.I. Vogel
2. Quantitative Organic Analysis, A.I. Vogel
3. Chromatographic Methods, Stock and Rice.

Paper Code	242820	Marks: 100	Credits:4	
Paper Title:	Viva voce			