THE UNIVERSITY OF BURDWAN

Syllabus of 3-Year Degree/4-Year Honours

in

Chemistry

Under Curriculum and Credit Framework for Undergraduate Programme (CCFUP) as per National Education Policy 2020

with effect from 2023-24

Semester-wise and Course-wise Distribution of Credit & Marks under CCFUP of NEP, 2020

Sem	Course type	Paper code	Course name	Credit				Marks			
				T	Lec	Prac	Tut	Th	Prac	IA	T
I	Major	CHEM1011	Basic Chemistry-I	4	3	1	0	40	20	15	75
	Minor	CHEM1021	General Chemistry-I	4	3	1	0	40	20	15	75
	Multi/ Interdisciplinary	CHEM1031	Chemistry for household importance	3	3	0	0	40	00	10	50
	Ability Enhancement Course (AEC) MIL (L_1)	……..1041	Arabic/ Bengali/ Hindi/ Sanskrit/ Santali/ Urdu Or Equivalent Course from SWAYAM or other UGC recognized Platform.	2	2	0	0	40	00	10	50
	Skill Enhancement Course (SEC)	CHEM1051	Drugs and pharmaceuticals	3	3	0	0	40	00	10	50
	Common Value Added (CVA) Course	CVA 1061	Environmental Science/Education	4	3	1	0	60	20	20	100
II	Major	CHEM2011	Basic Chemistry-II	4	3	1	0	40	20	15	75
	Minor	CHEM2021	General Chemistry-II	4	3	1	0	40	20	15	75
	Multi/ Interdisciplinary	CHEM2031	Chemistry of Dyes, pigments, cosmetics and perfumes	3	3	0	0	40	00	10	50
	Ability Enhancement Course (AEC) English (L_2)	ENGL2041	Functional English Or Equivalent Course from SWAYAM or other UGC recognized Platform.								
	Skill Enhancement Course (SEC)	CHEM2051	Basic Analytical Chemistry	3	3	0	0	40	00	10	50
	Common Value Add-ed (CVA) Course	CVA 2061	Understanding India/Digital and Technological solutions, Health & wellness, Yoga education, Sports & fitness	4	3	1/0	0/1	80/ 60	0/20	20	100
III	Major	CHEM3011	Inorganic Chemistry (Th)	5	5	0	0	60	00	15	75
		CHEM3012	Inorganic Chemistry (Prac)	5	0	5	0	00	60	15	75
	Minor	……3021	Vocational Education & Training	4						15	75
	Multi/ Inter disciplinary	CHEM3031	Chemistry of Soil and Fertilizer	3	2	0	1	40	00	10	50
	Ability Enhancement Course (AEC) MIL (L_1-2)	……..3041	Arabic/Bengali/Hindi/Sanskrit/Santali/Urdu or equivalent course form SWAYAM or any other UGC recognized platform	2				40		10	50
	Skill Enhancement Course (SEC)	CHEM3051	IT skill in Chemistry	3	2	0	1	40	00	10	50
IV	Major	CHEM4011	Organic Chemistry (Th)	5	5	0	0	60	00	15	75
		CHEM4012	Physical Chemistry (Th)	5	5	0	0	60	00	15	75
		CHEM4013	Organic Chemistry (Prac)	5	0	5	0	00	60	15	75
	Minor	CHEM4021	General Chemistry-III	4	3	1	0	40	20	15	75

	Minor (other than Chemistry)	…….4021		4						15	75
	Ability Enhancement Course (AEC) (English, L_2-2)	ENGL4041	Language and Creativity Or Equivalent Course from SWAYAM or other UGC recognized Platform.	2				40	00	10	50

Semester-I

Chemistry MAJOR

Paper code: CHEM1011
Paper title: Basic Chemistry-I
Credits 3 + 1

Course objective

- Several fundamental aspects of inorganic, organic and physical chemistry is discussed for the basic understanding of the students
- The topics covered will help the students for studying higher in chemical sciences
- Easy organic chemistry practical using several chemical and physical methods will enhance the basic knowledge of students' hands-on training

Course outcome

Students will be introduced with several basic aspects of theory and practical of chemical sciences. This will grow the foundation of the subject for studying various advanced topics in future semesters.

Theory Credit 3

1. Atomic structure

Bohr's theory- its limitations and atomic spectra of hydrogen atom, Sommerfeld's theory, wave mechanics- de Broglie equation, Heisenberg's uncertainty principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2, quantum numbers and their significance, Radial and angular wave functions for hydrogen atom, radial and angular distribution curves, shapes of s, p, d and f orbitals, Pauli's exclusion principle, Hund's rules and multiplicity, exchange energy, Aufbau principle and its limitations, Ground state Term symbols of atoms and ions for atomic number upto 30

6 Hours

2. Periodic properties

Modern IUPAC periodic table, effective nuclear charge, screening effects and penetration, Slater's rules, atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction; ionization potential, electron affinity and electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities, group trends and periodic trends in these properties in respect of s-, p- and d-block elements, secondary periodicity, relativistic Effect, inert pair effect

6 Hours

3. Acids and bases

Acid-Base concept- Arrhenius concept, theory of solvent system (in H_2O, NH_3, SO_2 and HF); Bronsted-Lowry's concept, relative strength of acids, Pauling's rules, Lux-Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects, thermodynamic acidity parameters, Drago-Wayland equation, superacids, gas phase acidity and proton affinity, HSAB principle, acid-base equilibria in aqueous solution (proton transfer equilibria in water), pH, buffer, acid-base neutralisation curves, indicator, choice of indicators, concept of organic acids and bases, effect of structure, substituent and solvent on acidity and basicity, proton sponge, gas-phase acidity and basicity *6 Hours*

4. Fundamentals in Organic chemistry

Electron displacement phenomena and physical properties: inductive effect, field effect, hyperconjugation, mesomeric effect, resonance energy, bond polarization and bond polarizability, electromeric effect, steric effect, steric inhibition of resonance, influence of hybridization on bond properties, bond dissociation energy (BDE) and bond energy, bond distances, bond angles, concept of bond angle strain (Baeyer's strain theory), melting point/boiling point and solubility of common organic compounds in terms of covalent & non-covalent intermolecular forces, polarity of molecules and dipole moments, relative stabilities of isomeric hydrocarbons in terms of heat of hydrogenation, heat of combustion and heat of formation, calculation of formal charges and double bond equivalent (DBE)

Reactive intermediates: carbocations (carbenium and carbonium ions), carbanions, carbon radicals, carbenes, benzynes and nitrenes, generation and stability, structure using orbital picture and electrophilic/nucleophilic behaviour of the reactive intermediates (elementary idea)

Concept of aromaticity: Hückel's rules for aromaticity up to [10]-annulene (including mononuclear heterocyclic compounds up to 6-membered ring), concept of antiaromaticity and homoaromaticity, non-aromatic molecules, Frost diagram, elementary idea about α and β, measurement of delocalization energies in terms of β for buta-1,3-diene, cyclobutadiene, hexa-1,3,5-triene and benzene

12 Hours

5. Properties of Gases

Ideal and real gases: Deviation of gases from ideal behaviour, compressibility factor, Boyle temperature, Andrew's and Amagat's plots, van der Waals equation and its features, its derivation and application in explaining real gas behaviour, Dieterici equation of state, existence of critical state, critical constants in terms of van der Waals constants, law of corresponding states, virial equation of state, van der Waals equation expressed in virial form and significance of second virial coefficient, intermolecular forces (Debye, Keesom and London interactions, Lennard-Jones potential - elementary idea)

4 Hours

6. Chemical Kinetics-I

Rate law, order and molecularity: Introduction of rate law, extent of reaction, rate constants, order, forms of rate equations of first-, second- and n-th order reactions, pseudo first-order reactions (example using acid catalyzed hydrolysis of methyl acetate), determination of order of a reaction by half-life and differential method, opposing reactions, consecutive reactions and parallel reactions (with explanation of kinetic and thermodynamic control of products with all steps of first order)

Temperature and theories of reaction rate: Temperature dependence of rate constant; Arrhenius equation, energy of activation, rate-determining step and steady-state approximation – explanation with suitable examples.

5 Hours

7. Thermodynamics-I

Zeroth and 1st law of Thermodynamics: intensive and extensive variables, state and path functions, isolated, closed and open systems, zeroth law of thermodynamics, concept of heat q, work wand internal energy U, statement of first law, enthalpy H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion

of gases (ideal and van der Waals) under isothermal and adiabatic conditions, Joule's experiment and its consequence

Thermochemistry: standard states, heats of reaction, enthalpy of formation of molecules and ions and enthalpy of combustion and its applications, laws of thermochemistry, bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions, adiabatic flame temperature, explosion temperature *6 Hours*

Reference Books

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.

2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.

4. Atkins, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India.

6. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.

7. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.

8. Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998).

9. Winter, M. J., The Orbitron, http://winter.group.shef.ac.uk/orbitron/ (2002). An illustrated gallery of atomic and molecular orbitals.

10. Burgess, J., Ions in solution: basic principles of chemical interactions. Ellis Horwood (1999).

11. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.

12. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.

13. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

14. Pathak & Saha, Organic Chemistry (Volume-1), Books and Allied (P) Ltd.

15. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).

16. Morrison, R. T. Study guide to organic Chemistry, Pearson.

17. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press.

18. Castellan, G. W., Physical Chemistry, Narosa Publishing House.

19. McQuarrie, D. A. & Simons, J. D. Physical Chemistry: A Molecular Approach, Viva Press.

20. Engel, T. & Reid, P. Physical Chemistry, Pearson.

21. Maron, S. &Prutton, Principles of Physical Chemistry, Collier Macmillan Ltd.

22. Mortimer, R. G. Physical Chemistry, Elsevier.

23. Ball, D. W., Physical Chemistry, Thomson Press.

24. Glasstone, S. & Lewis, G.N. Elements of Physical Chemistry.

25. Rakshit, P.C., Physical Chemistry, Sarat Book House.
26. Zemansky, M. W. &Dittman, R.H. Heat and Thermodynamics, Tata-McGraw-Hill.
27. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas Publishing House.
28. Clauze& Rosenberg, Chemical Thermodynamics: Basic concepts & Methods, John Wiley & Sons, 2008.
29. Sharma, K. K. & Sharma, L. K., A Textbook of Physical Chemistry, Vikas Publishing House.
30. Rajaram, J. Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson.
30. Chatterjee Hrishikesh, Physical Chemistry (Volume-1), Platinum Publisher
31. Kapoor, K.L., Textbook of Physical Chemistry (Volume 1 and Volume-2), McGraw Hill Education
32. Ghoshal, A. Numerical problems & short questions on Physical Chemistry, Books and Allied (P) Ltd.
33. Bajpai, D. N., Advanced Physical Chemistry, S. Chand Publication.
34. Levine, I. N. Physical Chemistry, Tata McGraw-Hill.

Practical Credit 1

(i) Separation, purification and melting point determination

Separation of components of a binary solid mixture based on solubility by using common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. $NaHCO_3$, etc., purification of any one of the separated components by crystallization and determination of its melting point. The composition of the mixture may be of the following types: Benzoic acid/*p*-toluidine, *p*-nitrotolune/*p*-anisidine, benzoic acid/benzophenone, urea/benzophenone, salicylic acid/*p*-nitrotoluene, etc. *6 Hours*

(ii) Determination of boiling point

Boiling points of common organic liquid compounds e.g., ethanol, cyclohexane, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide, etc.

6 Hours

[Boiling points of the chosen organic compounds should preferably be less than 160°C]

(iii) Identification of a pure organic compound by chemical test(s)

Solid compounds: oxalic acid, succinic acid, resorcinol, urea, glucose and salicylic acid.

Liquid Compounds: acetic acid, ethyl alcohol, acetone, aniline and nitrobenzene

3 Hours

Reference Books

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.

2. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic Analysis, CBS Publishers and Distributors.

3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

4. A.K. Manna, Practical Organic Chemistry, Books & Allied (P) Ltd.

Ghosh, Das Sharma, Majumdar, Manna, Chemistry in Laboratory, Santra Publication (P) Ltd.

Chemistry MINOR

Paper code: CHEM1021

Paper title: General Chemistry-I Credit 3 + 1

Theory Credit 3

Course objective

- Several fundamental aspects of the subject are discussed so that the principles can be useful for studying other branches of science (physical and/or biological sciences)
- Practical experiments are designed in such a way that the students of other disciplines can have an experience of hands-on training in chemistry at the primary level

Course outcome

On studying the course, the students will have an idea of chemical sciences, which may be applied for in-depth study of other science streams.

1. **Atomic structure**

   Bohr's theory for hydrogen atom (simple mathematical treatment), atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, Aufbau principle and its limitations

   6 Hours

2. **Periodic properties**

   Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements, positions of hydrogen and noble gases, atomic and ionic radii, ionization potential, electron affinity and electronegativity,periodic and group-wise variation of above properties in respect of s- and p- block elements

   6 Hours

3. Acids and bases

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents,Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept, hard and soft acids and bases (HSAB concept), applications of HSAB process, acidity and basicity of common organic compounds

7 Hours

4. Aliphatic hydrocarbons

Functional group approach for the following compounds to be studied in context of their preparations, properties, structures and reactions

Alkanes (up to 5 carbons): preparation- catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis using Grignard reagent; Reaction mechanism for free radical substitution, halogenation

Alkenes (up to 5 carbons): preparation- elimination reactions, dehydration of alcohols and dehydrohalogenation of alkyl halides, *cis* alkenes (partial catalytic hydrogenation) and trans alkenes (Birch reduction), reactions- *cis*-addition (alkaline KMnO4) and trans-addition (bromine) with mechanism, addition of HX [Markownikoff's (with mechanism) and anti-Markownikoff's addition], hydration, ozonolysis, oxymercuration-demercuration and hydroboration-oxidation reaction

Alkynes (up to 5 carbons):preparation- acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides, formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alkaline $KMnO_4$

10 Hours

5. Ideal and real gases

Concept of pressure and temperature, Deviation of gases from ideal behaviour, compressibility factor, Boyle temperature, Andrew's and Amagat's plots, van der Waals equation and its features, derivation and application in explaining real gas behaviour, existence of critical state, critical constants in terms of van der Waals constants, law of corresponding states

Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only)

5 Hours

6. Thermodynamics-I

Intensive and extensive properties state and path functions, isolated, closed and open systems, zeroth law of thermodynamics,concept of heat, work, internal energy and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases

Standard states, heat of reaction, enthalpy of formation of molecules and ions, enthalpy of combustion and its applications, laws of thermochemistry, bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchoff's equation and effect of pressure on enthalpy, adiabatic flame temperature, explosion temperature

7 Hours

7. Chemical Kinetics-I

Introduction of rate law, order and molecularity, extent of reaction, rate constants, rates of first-, second- and n-th order reactions and their integrated forms (with derivation), pseudo first order reactions, determination of order of a reaction-half-life and differential method, opposing reactions, consecutive reactions and parallel reactions (elementary idea)

Theories of reaction rate: Temperature dependence on reaction rate, Arrhenius equation, energy of activation

4 Hours

Reference Books

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.

2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.

4. Atkins, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India.

6. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.

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13. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).
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15. Pathak & Saha, Organic Chemistry (Volume-1), Books and Allied (P) Ltd.
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17. Castellan, G. W., Physical Chemistry, Narosa Publishing House.
18. McQuarrie, D. A. & Simons, J. D. Physical Chemistry: A Molecular Approach, Viva Press.
19. Engel, T. & Reid, P. Physical Chemistry, Pearson.
20. Mortimer, R. G. Physical Chemistry, Elsevier.
21. Ball, D. W. Physical Chemistry, Thomson Press.
22. Glasstone, S. & Lewis, G.N. Elements of Physical Chemistry.
23. Rakshit, P.C., Physical Chemistry, Sarat Book House.
24. Zemansky, M. W. &Dittman, R.H. Heat and Thermodynamics, Tata-McGraw-Hill.
25. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas Publishing House.
26. Clauze& Rosenberg, Chemical Thermodynamics: Basic concepts & Methods, John Wiley & Sons, 2008.
27. Sharma, K. K. & Sharma, L. K., A Textbook of Physical Chemistry, Vikas Publishing House.
28. Bajpai, D. N., Advanced Physical Chemistry, S. Chand Publication.
29. Rajaram, J. Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson.
30. Chatterjee Hrishikesh, Physical Chemistry (Volume-1), Platinum Publisher
31. Kapoor, K.L., Textbook of Physical Chemistry (Volume 1 and Volume-2), McGraw Hill Education
32. Ghoshal, A. Numerical problems & short questions on Physical Chemistry, Books and Allied (P) Ltd.
33. Maron, S. &Prutton, Principles of Physical Chemistry, Collier Macmillan Ltd.
34. Levine, I. N. Physical Chemistry, Tata McGraw-Hill.

Practical Credit 1

***(i) Determination of boiling point*s**

Boiling points of common organic liquid compounds e.g., ethanol, cyclohexane, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide,etc.

8 Hours

(ii) Identification of a pure organic compound

Solid compounds: oxalic acid, succinic acid, resorcinol, urea, glucose, benzoic acid and salicylic acid.

Liquid Compounds: acetone, aniline and nitrobenzene

7 Hours

Reference Books

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.

2. Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic Analysis, CBS Publishers and Distributors.

3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

4. A.K. Manna, Practical Organic Chemistry, Books & Allied (P) Ltd.

Ghosh, Das Sharma, Majumdar, Manna, Chemistry in Laboratory, Santra Publication (P) Ltd.

MULTIDISCIPLINARY

Paper code: CHEM1031

Paper title: Chemistry for Household Importance Credit 3

Course objective

Several topics related to everyday life have been included to grow interest among students for the subject

Course outcome

After studying the topics these may help the students to get employment.

Theory

1. Food chemistry: Food additive, food flavor, adulterant, preservative, artificial sweeteners *8 Hours*
2. Drugs and pharmaceuticals: Structure and function, antipyretic and analgesic drugs – aspirin, paracetamol, ibuprofen *8 Hours*
3. Vitamins: Vitamin C and B_{12} *2 Hours*
4. Antibiotics: Penicillin, sulphaguanidine, chloramphenicol *4 Hours*
5. Glass and ceramics: Definition and manufacture of glasses, optical and colour glasses *6 Hours*
6. Surface chemistry: Soaps and detergents *2 Hours*

7. Chemistry of fuels: Conventional and non-conventional energy sources, classification of fuels, calorific values of fuels like kerosene, coal, coal gas, petrol, liquefied petroleum gas, octane number, biogas *15 Hours*

Reference Books

1) Thapar, Food Chemistry, Pacific Book International
2) Gayatri Baidya, Textbook of Food Chemistry, Book Rivers
3) Mandal, S.K., Pharmaceutical Chemistry and Production: An Introductory Textbook Rebeca Ghanta; Bentham Science Publishers 2022, ISBN: 978-1-68108-890-7
4) Sengupta,S.,Application Oriented Chemistry Books Syndicate Pvt. Ltd., 2000

SKILL ENHANCEMENT COURSE

Paper code: CHEM1051

Paper title: Drugs and pharmaceuticals

Theory Credit 3

Course objective

- Design and development of several organic drugs
- The very detail discussion for growing of very clear idea about the drugs, their synthesis and physiological action

Course outcome

The clear idea about the drugs may not only grow the general sense about the synthesis and mode of action of the drugs but also help them to have employment in pharmaceutical industry.

Drug discovery, design and development, synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (aspirin, paracetamol, ilbuprofen), antibiotics (penicillin, chloramphenicol), antibacterial and antifungal agents (sulphonamides, sulphanethoxazol, sulphacetamide, trimethoprim); antiviral agents (acyclovir), central nervous system agents (phenobarbital, diazepam), cardiovascular (glyceryl trinitrate), antilaprosy (dapsone), HIV-AIDS related drugs (AZT-Zidovudine)

45 Hours

Reference Books

1. Patrick, G. L. Introduction to Medicinal Chemistry, Oxford University Press, UK, 2013.

2. Singh, H. & Kapoor, V.K. Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi, 2012.

3. Foye, W.O., Lemke, T.L. & William, D.A.: Principles of Medicinal Chemistry, 4th ed., B.I. Waverly Pvt. Ltd. New Delhi.

4. El-Mansi, E.M.T., Bryce, C.F.A., Ddemain, A.L., Allman, A.R., Fermentatias Microbiology and Biotechnology, 2nd Ed. Taylor & Francis.

5. Prescott & Dunn's Industrial Microbiology, 2004, CBS Publisher.

Semester-II

Chemistry MAJOR

Paper code: CHEM2011

Paper title: Basic Chemistry-II Credit 3 + 1

Theory Credit 3

Course objective

- Several basic topics from inorganic, organic and physical chemistry have been chosen for the development of the general chemistry knowledge of the students.
- This will help to grow the foundation for studying the several aspects of applied chemistry in future.

Course outcome

The topics will grow the foundation of the students for the subject chemistry for learning any further advanced topics.

1. **Chemical bonding-I**

   Ionic bond: general characteristics, types of ions, size effects, radius ratio rule and its application and limitations, packing of ions in crystals Born-Landé equation with derivation and importance, Kapustinskii expression for lattice energy, Madelung constant, Born-Haber cycle and its application, solvation energy, solubility energetics of dissolution process.

   Covalent bond: polarizing power and polarizability, ionic potential, Fazan's rules,Lewis structures, formal charge, Valence Bond Theory- hydrogen molecule (Heitler-London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rule, dipole moments, VSEPR

theory, shapes of molecules and ions containing lone pairs and bond pairs (examples from main groups chemistry) and multiple bonding (σ and π bond approach)

6 Hours

2. Redox Reactions and Precipitation Reactions

Balancing of redox reactions: ion-electron method, elementary idea on standard redox potentials- Nernst equation (without derivation), influence of complex formation, precipitation and pH, formal potential

Redox titrations: feasibility, redox potential at the equivalence point, redox indicators, redox potential diagram (Latimer and Frost diagrams) of common elements and their applications Disproportionation and comproportionation reactions (typical examples), solubility product principle, common ion effect and their applications to the precipitation and separation of common metallic ions as hydroxides, sulfides, phosphates, carbonates, sulfates and halides

4 Hours

3. Stereochemistry-I

Bonding geometries and representation of carbon compounds: tetrahedral nature of carbon and concept of asymmetry: Fischer, sawhorse, flying-wedge and Newman projection formulae and their inter translations

Chirality and symmetry: symmetry elements and point groups (C_v, C_{nv}, C_{nh}, C_n, D_h, D_{nh}, D_{nd}, D_n, S_n (C_s, C_i), molecular chirality and centre of chirality, asymmetric and dissymmetric molecules, enantiomers and diastereomers, epimers, stereogenicity, chirotopicity and pseudoasymmetry, chiral centres and number of stereoisomerism, systems involving 1/2/3-chiral centre(s)- AA, AB, ABA and ABC types

Relative and absolute configuration: D/L and R/S descriptors, erythro/threo and meso nomenclature of compounds, syn/anti nomenclatures for aldols, E/Z descriptors- C=C, conjugated diene, triene, C=N and N=N systems, combination of R/S- and E/Z-isomerisms

Optical activity compounds: optical rotation, specific rotation and molar rotation, racemic compounds, racemisation (through cationic, anionic, radical intermediates and through reversible formation of stable achiral intermediates), resolution of acids, bases and alcohols via diastereomeric salt formation, optical purity and enantiomeric excess. *6 Hours*

4. General Treatment of Reaction Mechanism

Free energy profiles: one-, two- and three-step reactions, catalyzed reactions- electrophilic and nucleophilic catalysis, kinetic control and thermodynamic control of reactions, isotope effect- primary and secondary kinetic isotopic effect (k_H /k_D), principle of microscopic reversibility

Tautomerism: prototropy (keto-enol, amido-imidol, nitroso-oximino, diazo-amino and enamine-imine systems) and ring-chain tautomerism, composition of the equilibrium in different systems (simple carbonyl; 1,2- and 1,3-dicarbonyl systems, phenols and related systems), factors affecting keto-enol tautomerism, application of thermodynamic principles in tautomeric equilibria

6 Hours

5. Substitution and Elimination Reactions

Nucleophilic substitution reactions: substitution at sp3 centre- mechanisms (with evidence), relative rates, stereochemical features, S_N1, S_N2, S_N2', S_N1' (allylic rearrangement) and S_Ni, effects of solvent, substrate structure, leaving group and nucleophiles (including ambident nucleophiles, cyanide & nitrite), electrofuges and nucleofuges, substitutions involving NGP, role of crown ethers and phase transfer catalysts [systems: alkyl halides, allyl halides, benzyl halides, alcohols, ethers, epoxides]

Elimination reactions: E_1, E_2, E_1cB and Ei (pyrolytic syn eliminations), formation of alkenes and alkynes, mechanisms (with evidence), reactivity, regioselectivity (Saytzeff/Hofmann) and stereoselectivity, comparison between substitution and elimination

6 Hours

6. Kinetic Theory of gases:

Concept of pressure and temperature; collision of gas molecules, collision diameter, collision number and mean free path, frequency of binary collisions (similar and different molecules), wall collision and rate of effusion

Maxwell's distribution of speed and energy: Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions, kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case, calculation of number of molecules having energy $\geq \varepsilon$, equipartition principle and its application to calculate

the classical limit of molar heat capacity of gases.

5 Hours

7. Liquid state

Viscosity: General features of fluid flow (streamline and turbulent flow); Newton's equation, viscosity coefficient; Poiseuille's equation; principle of determination of viscosity coefficient of liquids by falling sphere method; temperature variation of viscosity of liquids and comparison with that of gases

Surface tension and energy: Surface tension, surface energy, excess pressure, capillary rise and surface tension; work f cohesion and adhesion, spreading of liquids over other surfaces; vapour pressure over curved surface; temperature dependence of surface tension, principle of surface tension measurement

6 Hours

8. Thermodynamics-II

Second Law: its need and statement, concept of heat reservoirs and heat engines, Carnot cycle, physical concept of entropy, Carnot engine and refrigerator, Kelvin – Planck and Clausius statements and their equivalence in entropic formulation, Carnot's theorem,values of §dQ/T and Clausius inequality, entropy change of systems and surroundings for various processes and transformations, entropy and unavailable work, auxiliary state functions (G and A) and their variations (with T, P and V), criteria of spontaneity and equilibrium

Thermodynamic relations: Maxwell's relations, Gibbs- Helmholtz equation, Joule-Thomson experiment and its consequences, inversion temperature, Joule-Thomson coefficient for a van der Waals gas, general heat capacity relations.

6 Hours

Reference Books

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.

2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.

4. Atkins, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India.

6. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.

7. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.

8. Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998).

9. Winter, M. J., The Orbitron, http://winter.group.shef.ac.uk/orbitron/ (2002). An illustrated gallery of atomic and molecular orbitals.
10. Burgess, J., Ions in solution: basic principles of chemical interactions. Ellis Horwood (1999).
11. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.
12. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
13. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
14. Pathak & Saha, Organic Chemistry (Volume-1), Books and Allied (P) Ltd.
15. Rajaram, J. Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson.
16. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).
17. Morrison, R. T. Study guide to organic Chemistry, Pearson.
18. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press.
19. Castellan, G. W. Physical Chemistry, Narosa Publishing House.
20. Maron, S. &Prutton, Principles of Physical Chemistry, Collier Macmillan Ltd.
21. Laidler, K. J. Chemical Kinetics, Pearson.
22. Glasstone, S. & Lewis, G.N. Elements of Physical Chemistry.
23. Rakshit, P.C., Physical Chemistry, Sarat Book House.
24. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas.
25. Sharma, K. K. & Sharma, L. K., A Textbook of Physical Chemistry, Vikas Publishing House.
26. Nasipuri, D. Stereochemistry of Organic Compounds, New Age International (P) Ltd.
27. Sengupta,S. Basic Stereochemistry of Organic Molecules, Oxford University Press
28. Manna, A.K. Organic Molecular Spectroscopy, Books and Allied (P) Ltd.
29. Bajpai, D. N., Advanced Physical Chemistry, S. Chand Publication.
30. Engel, T. & Reid, P. Physical Chemistry, Pearson.
31 Levine, I. N. Physical Chemistry, Tata McGraw-Hill.
32. Ball, D. W. Physical Chemistry, Thomson Press.
33. Chatterjee Hrishikesh, Physical Chemistry (Volume-1), Platinum Publisher
34. Kapoor, K.L., Textbook of Physical Chemistry (Volume 1 and Volume-2), McGraw Hill Education
35. Ghoshal, A. Numerical problems & short questions on Physical Chemistry, Books and Allied (P) Ltd.

Practical Credit 1

1. Study of kinetics of acid-catalyzed hydrolysis of methyl acetate
2. Study of kinetics of decomposition of H_2O_2 by KI

3. Determination of pH of unknown strong alkali and acid solution by colour matching method

4. Determination of pH of unknown buffer solution by colour matching method

5. Study of viscosity of unknown liquid (glycerol, sugar) with respect to water

6. Determination of surface tension of a liquid using Stalagmometer

15 Hours

Reference Books

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.

2. Nad, Mahapatra, Ghosal, An Advance course in Practical Chemistry, New Central Book Agency (P) Ltd.

3. K. S. Mukherjee, Textbook on Practical Chemistry, New Central Book Agency (P) Ltd.

4. Ghosh, Das Sharma, Majumdar, Manna, Chemistry in Laboratory, santra Publication (P) Ltd.

5. Poddar and Ghosh, Degree Practical Chemistry, Book Syndicate (P) Ltd.

Chemistry MINOR

Paper code: CHEM2021

Paper title: General Chemistry-II Credit 3 + 1

Theory Credit 3

Course objective

- Several basic aspects from inorganic, organic and physical chemistry have been discussed
- Generation of idea for studying physical and biological sciences in future

Course outcome

The idea created from this course may help to understand students for further studying physical, biological and material sciences.

1. **Thermodynamics-II**

   Statement of the second law of thermodynamics, concept of heat reservoirs and heat engines, Carnot cycle, physical concept of entropy, Carnot engine, refrigerator and efficiency, entropy change of systems and surroundings for various processes and transformations, auxiliary state functions (G and A) and criteria for spontaneity and equilibrium

   5 Hours

2. Ideal gas

Collision of gas molecules, collision diameter, collision number and mean free path, frequency of binary collisions (similar and different molecules), rate of effusion

Nature of distribution of velocities, Maxwell's distribution of speed and kinetic energy, average velocity, root mean square velocity and most probable velocity, equipartition principle and its application to calculate the classical limit of molar heat capacity of gases.

5 Hours

3. Chemical Kinetics-II

Collision theory, Lindemann theory of unimolecular reaction, outline of Transition State theory (classical treatment)

5 Hours

4. Fundamentals of Organic Chemistry

Electronic displacement phenomena- inductive effect, resonance and hyperconjugation, cleavage of bonds- homolytic and heterolytic, structures of organic molecules on the basis of VBT, nucleophiles, electrophiles, reactive intermediates- carbocations, carbanions and free radicals.

6 Hours

5. Stereochemistry

Isomerism- geometrical and optical isomerism, concept of chirality and optical activity (up to two carbon atoms), asymmetric carbon atom, elements of symmetry (plane and centre), interconversion of Fischer and Newman representations, enantiomerism and diastereomerism, meso compounds, threo and erythro, D and L, cis- and trans- nomenclatures, CIP rules: R/S (upto 2 chiral carbon atoms) and E/Z nomenclatures.

6 Hours

6. Nucleophilic Substitution and Elimination Reactions

Nucleophilic substitutions- S_N1, S_N2 and S_Ni reactions, eliminations- E_1 and E_2 reactions (elementary mechanistic aspects), Saytzeff and Hofmann eliminations, elimination vs. substitution

6 Hours

7. Chemical Bonding and Molecular Structure

Ionic Bonding: general characteristics, energy considerations, lattice energy and solvation energy and their importance for stability and solubility of ionic

compounds, statement of Born-Landé equation for lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability, Fajans' rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character

Covalent bonding: Valence Bond (VB) theory approach, shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements

Concept of resonance and resonating structures in various inorganic and organic compounds

Molecular orbital (MO) theory approach -the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods. (including the idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+, comparison of VB and MO approaches *12 Hours*

Reference Books

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.

2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.

4. Atkins, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India.

6. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.

7. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.

8. Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998).

9. Burgess, J., Ions in solution: basic principles of chemical interactions. Ellis Horwood (1999).

10. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.

11. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.

12. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

13. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).

14. Morrison, R. T. Study guide to organic Chemistry, Pearson.

15. Pathak & Saha, Organic Chemistry (Volume-1), Books and Allied (P) Ltd.

16. Castellan, G. W. Physical Chemistry, Narosa Publishing House.

17. Engel, T. & Reid, P. Physical Chemistry, Pearson.

18. Maron, S. &Prutton, Principles of Physical Chemistry, Collier Macmillan Ltd.

19. Laidler, K. J. Chemical Kinetics, Pearson.

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21. Rakshit, P.C., Physical Chemistry, Sarat Book House.

22. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas Publishing House.

23. Sharma, K. K. & Sharma, L. K., A Textbook of Physical Chemistry, Vikas Publishing House.

24. Bajpai, D. N., Advanced Physical Chemistry, S. Chand Publication.

25. Rajaram, J. Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson.

26. Nasipuri, D. Stereochemistry of Organic Compounds, New Age International (P) Ltd.

27. Sengupta,S.Basic Stereochemistry of Organic Molecules, Oxford University Press

28. Chatterjee Hrishikesh, Physical Chemistry (Volume-1), Platinum Publisher

29. Kapoor, K.L., Textbook of Physical Chemistry (Volume 1 and Volume-2), McGraw Hill Education

30. Ghoshal, A. Numerical problems & short questions on Physical Chemistry, Books and Allied (P) Ltd.

31. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press.

Practical Credit 1

1. Determination of pH of unknown strong alkali and acid by colour matching method
2. Study of kinetics of acid-catalyzed hydrolysis of methyl acetate
3. Estimation of Mohr's salt by titrating with $KMnO_4$/ $K_2Cr_2O_7$
4. Estimation of sodium carbonate and sodium hydrogen carbonate in a mixture *15 Hours*

Reference Books

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.

2. Nad, Mahapatra, Ghosal, An Advance course in Practical Chemistry, New Central Book Agency (P) Ltd.

3. K. S. Mukherjee, Textbook on Practical Chemistry, New Central Book Agency (P) Ltd.

4. Ghosh, Das Sharma, Majumdar, Manna, Chemistry in Laboratory, santra Publication (P) Ltd.

5. Poddar and Ghosh, Degree Practical Chemistry, Book Syndicate (P) Ltd.

MULTIDISCIPLINARY

Paper code: CHEM2031

Paper title: Chemistry of Dyes, Pigments, Cosmetics and Perfumes Credit 3

Course objective

Introduction of idea of every day products of chemical industries

Course outcome

Development of idea of several molecules and materials related to dye and cosmetics industry

Theory

Definition and classification, structures and theories of coloration, preparation, properties and uses of dyes like phenolphthalein, methyl orange, malachite green, alizarin, indigo, different types of pigments like chlorophyll, carotenoids, anthocyanins, flavonoids (elemental idea)

Preparation and uses of the following: hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours

Essential oils and their importance in cosmetic industries with reference to eugenol, geraniol, sandalwood oil, eucalyptus, rose-oil, 2-phenyl ethyl alcohol, jasmone, civetone, muscone

45 Hours

Reference Books

1. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).
2. Bahl and Bahl, A Text book of Organic Chemistry, S. Chand publication
3. StocchiE.: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
4. Jain, P.C.&Jain,M:.Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
5. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

SKILL ENHANCEMENT COURSE

Paper title: CHEM2051

Paper code: Basic Analytical Chemistry Credit 3

Course objective

- Development of skill for analyzing several natural and synthetic samples to find out their purity, composition, etc
- Development of skill for advanced separation techniques for natural and synthetic samples

Course outcome

This course will develop the analysis as well as separation skills of the students which may help them to motivate for joining research and/or have employment.

Theory Credit 3

1. **General principle**

Introduction to analytical chemistry and its interdisciplinary nature, concept of sampling, importance of accuracy, precision and sources of error in analytical measurements, presentation of experimental data and results, role of significant figures

8 Hours

3. **Analysis of soil**

Composition of soil, concept of pH and pH measurement, complexometric titrations, chelation, chelating agents, use of indicators

6 Hours

3. Analysis of water

Definition of pure water, contaminants (different types), water sampling methods, water purification methods

6 Hours

4. Analysis of food products

Nutritional value of a food, idea about food processing and food preservations, and adulteration *6 Hours*

5. **Chromatography**

Definition, general introduction on principles of chromatography, paper chromatography, TLC etc., column chomatography, ion-exchange chromatography, etc., determination of ion exchange capacity of anion /cation exchange resin *10 Hours*

6. Analysis of cosmetics

Major and minor constituents of cosmetics and their functions, analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate

9 Hours

Reference Books

1. Willard, H.H., Merritt, L.L., Dean, J. &Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A., Holler, F.J. & Crouch, S. Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.
3. Skoog, D.A.; West, D.M. & Holler, F.J. Analytical Chemistry: An Introduction sixth Ed., Saunders College Publishing, Fort Worth, Philadelphia (1994).
4. Harris, D. C. Quantitative Chemical Analysis, 9th ed. Macmillan Education, 2016.
5. Dean, J. A. Analytical Chemistry Handbook, McGraw Hill, 2004.
6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India, 1992.
7. Freifelder, D.M. Physical Biochemistry 2nd Ed., W.H. Freeman & Co., N.Y. USA (1982).
8. Cooper, T.G. The Tools of Biochemistry, John Wiley & Sons, N.Y. USA. 16 (1977).
9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.
10. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
11. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).
12. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

Semester-III

Chemistry MAJOR

Paper code: CHEM3011 (3 and 4 years)
Paper title: Inorganic Chemistry (Theory)
Credit: 5

Course objective

- Discussion of bonding theories (advanced parts)
- Application of the basic theories discussed so far towards coordination chemistry and s- and p-block elements

Course outcome

After studying several basic aspects of chemistry, students will go through their applications in studying coordination chemistry, s- and p-block elements. On studying different comparative properties s- and p-block elements, proper chemical logic will start to be developed among the students.

1. Chemical Bonding-II

Molecular orbital concept of bonding (The approximations of the theory, Linear combination of atomic orbitals (LCAO) (elementary pictorial approach): sigma and pi-bonds and delta interaction, multiple bonding. Orbital designations: gerade, ungerade, HOMO, LUMO. Orbital mixing, MO diagrams of H_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, and their ions wherever possible; Heteronuclear molecular orbitals: CO, NO, NO^+, CN^-, HF, BeH_2, CO_2 and H_2O. Bond properties: bond orders, bond lengths.

Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids – stoichiometric and non-stoichiometric.

Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Intermolecular forces: Hydrogen bonding (theories of hydrogen bonding, valence bond treatment), receptor-guest interactions, Halogen bonds. Effects of chemical force, melting and boiling points. *20 Hours*

2. Coordination Chemistry-I

Double and complex salts. Werner's theory of coordination complexes, Classification of ligands, chelates, coordination numbers, IUPAC nomenclature of coordination complexes (up to two metal centers), Isomerism in coordination compounds, constitutional and stereo isomerism, Geometrical and optical isomerism in square planar and octahedral complexes. *12 Hours*

3. Chemistry of s and p-block elements

Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Beryllium hydrides and halides. Boric acid and borates, boron nitrides, borohydrides (diborane) and

graphitic compounds, silanes. Oxides and oxoacids of nitrogen, phosphorus, sulphur and chlorine. Peroxo acids of sulphur. Sulphur-nitrogen compounds, Basic properties of halides and polyhalides, interhalogen compounds, pseudohalides, fluorocarbons and chlorofluorocarbons. *35 Hours*

Noble Gases

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation, structures (VSEPR theory) and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2 and XeF_4). Xenon-oxygen compounds. *8 Hours*

Reference Books

1) Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006
2) Greenwood, N.N. & Earnshaw A. Chemistry of the Elements, Butterworth-Heinemann, 1997
3) Cotton, F.A., Wilkinson, G., Murrillo, C. A., Bochmann, M., Advanced Inorganic Chemistry, 6th Ed. 1999., Wiley
4) Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4th Ed., Pearson, 2010
5) Purecell, K.F. and Kotz, J.C., An Introduction to Inorganic Chemistry, Saunders: Philadelphia, 980
6) Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998)
7) Sarkar, R, General and inorganic chemistry, Volume II, New central book agency, (2012)

Chemistry MAJOR

Paper code: CHEM3012 (3 and 4 Years)

Paper title: Inorganic Chemistry (Practical)

Credit: 5

Course objective

- Development of chemical knowledge through several hands-on qualitative experiments
- Learning to synthesize several coordination compounds

Course outcome

Towards qualitative detection of several radicals, different experiments have to be covered. These will actually grow a clear knowledge and conception in chemistry. Moreover, preparation of modern coordination compounds will create an insight to the synthetic coordination chemistry.

1. *Qualitative analysis of Acid and Basic radicals from an inorganic sample* containing four radicals (oxide, hydroxide and carbonate may not be counted among four radicals). Emphasis should be given to the understanding of the chemistry of different reactions and to assign the most probable composition. Semi-micro analysis may also be followed. The use of centrifuge machine, thioacetamide instead of H_2S and spot tests for specific radicals should be introduced

Basic radicals: Na^+, K^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Al^{3+}, Cr^{3+}, Mn^{2+}/Mn^{4+}, Fe^{2+}/Fe^{3+}, Co^{2+}/Co^{3+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Pb^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}/Sn^{4+}, As^{3+}/As^{5+}, Sb^{3+}/Sb^{5+}, NH_4^+, Mg^{2+}.

Acid Radicals: F^-, Cl^-, Br^-, I^-, $S_2O_3^{2-}$, S^{2-}, SO_4^{2-}, SO_3^{2-}, NO_3^-, NO_2^- , PO_4^{3-}, AsO_4^{3-}, BO_3^{3-}, CrO_4^{2-}.

Insoluble Materials: Al_2O_3 (ig), Fe_2O_3 (ig), Cr_2O_3 (ig), SnO_2, $SrSO_4$, $BaSO_4$, CaF_2, $PbSO_4$.

45 Hours

2. *Inorganic preparations*

1) $[Cu(CH_3CN)_4]PF_6/ClO_4$
2) Potassium dioxalatodiaquachromate(III)
3) Tetraamminecarbonatocobalt(III) ion
4) Potassium tris(oxalato)ferrate(III)

5) Tris(ethylenediamine)nickel(II) chloride

6) $[Mn(acac)_3]$ and $[Fe(acac)_3]$ (acacH = acetylacetone)

30 Hours

Reference Books

1) Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.

2) Karmakar, P., Sarkar (Sain), R., Ray, S., Ghosh, A.K. Concise Practical Chemistry (B.Sc. General and Honours), PART-I, The New Book Stall, Kolkata (2018).

3) Ghosh, Das Sharma, Majumdar, Manna, Chemistry in Laboratory, Santra Publication (P) Ltd.

4) Ghoshal, A., Mahapatra, B., Nad, A. K. An Advanced Course in Practical Chemistry, New Central Book Agency (2007).

5) Bhattacharyya, R. C, A Manual of Practical Chemistry.

6) K. S. Mukherjee, Textbook on Practical Chemistry, New Central Book Agency (P) Ltd.

MULTIDISCIPLINARY

Paper code: CHEM3031

Paper title: Chemistry of Soil, Fertilizer and detergent

Credit: 3

Course objective

- Development of knowledge of soil
- Development of knowledge of fertilizer
- Idea of pesticide, etc
- Idea of development of several surface-active agents like soap, etc

Course outcome

Exploring the knowledge of fundamental chemistry towards soil, fertilizer, detergent will not only create general chemical knowledge of the students but also will generate the possibility of employability.

1. Soil: Composition, texture, micro & macro nutrients, soil health, soil conditioner, growth factor, NPK and their determination, soil productivity and effect of pH

10 hours

2. Fertilizer: Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate. *15 hours*

3. Fungicide, pesticide, herbicide with examples, advantage and disadvantage. *10 hours*

4. Soap & Detergents: Different types of soap and detergents with example, surface active and surface inactive substances *10 hours*

Reference Books

1) Thapar, Food Chemistry, Pacific Book International
2) Gayatri Baidya, Textbook of Food Chemistry, Book Rivers
3) Mandal, S.K., Pharmaceutical Chemistry and Production: An Introductory Textbook Rebeca Ghanta; Bentham Science Publishers 2022, ISBN: 978-1-68108-890-7
4) Sengupta, S. Application Oriented Chemistry Books Syndicate Pvt. Ltd., 2000

SKILL ENHANCEMENT COURSE

Paper code: CHEM3051

Paper title: IT skills in Chemistry

Credit: 3

Course objective

- Development of mathematical knowledge and knowledge for computer programming
- Development of knowledge for different data handling softwares

Course outcome

The course will help the students sound for doing several chemical computations.

Mathematical tools

1. Fundamentals: mathematical functions, polynomial expressions, logarithms, the exponential function, units of a measurement, interconversion of units, constants and variables, equation of a straight line, plotting graphs.

2. Uncertainty in measurement: Displaying uncertainties, types of uncertainties, combining uncertainties. Statistical treatment. Mean, standard deviation, relative error. Data reduction and the propagation of errors. Graphical and numerical data reduction. Numerical curve fitting: the method of least squares (regression).

3. Algebraic operations on real scalar variables (e.g. manipulation of van der Waals equation in different forms). Roots of quadratic equations analytically and iteratively (e.g. pH of a weak acid). Numerical methods of finding roots (Newton-Raphson, binary-bisection, e.g. pH of a weak acid not ignoring the ionization of water, volume of a van der Waals gas, equilibrium constant expressions).

4. Differential calculus: The tangent line and the derivative of a function, numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations).

5. Numerical integration (Trapezoidal and Simpson's rule, e.g. entropy/enthalpy change from heat capacity data).

15 Hours

Computer Programming

Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.

Fortran or C programming for curve fitting, numerical differentiation and integration (Trapezoidal rule, Simpson's rule), finding roots (quadratic formula, iterative, Newton-Raphson method). *15 Hours*

Handling numeric data

Spreadsheet software (Excel), creating a spreadsheet, entering and formatting information, basic functions and formulae, creating charts, tables and graphs. Incorporating tables and graphs into word processing documents. Simple calculations, plotting graphs using a spreadsheet (Planck's distribution law, radial distribution curves for hydrogenic orbitals, gas kinetic theory- Maxwell Boltzmann distribution curves as function of temperature and molecular weight), spectral data, pressure-volume curves of van der Waals gas (van der Waals isotherms), data from phase equilibria studies. Graphical solution of equations.

15 Hours

Reference Books

1) McQuarrie, D. A. Mathematics for Physical Chemistry University Science Books (2008).

2) Mortimer, R. Mathematics for Physical Chemistry. 3rd Ed. Elsevier (2005).

3) Steiner, E. The Chemical Maths Book Oxford University Press (1996).

4) Yates, P. Chemical calculations. 2nd Ed. CRC Press (2007).

5) Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.

6) Levie, R. de. How to use Excel in analytical chemistry and in general scientific data analysis, Cambridge Univ. Press (2001) 487 pages.

7) Noggle, J. H. Physical chemistry on a Microcomputer. Little Brown & Co. (1985).

8) Venit, S.M. Programming in BASIC: Problem solving with structure and style. Jaico Publishing House: Delhi (1996).

Semester-IV

Chemistry MAJOR

Paper code: CHEM4011 (3 and 4 Years)

Paper title: Organic Chemistry (Theory)

Credit: 5

Course objective

Development of knowledge for several basic and advanced topics of organic chemistry

Course outcome

The course will help the students to develop a complete knowledge on stereochemistry, reaction mechanism and others of organic chemistry.

1. Stereochemistry II

Chirality arising out of stereoaxis: stereoisomerism of substituted cumulenes with even and odd number of double bonds; chiral axis in allenes, spiro compounds, alkylidenecycloalkanes and biphenyls; related configurational descriptors (Ra/Sa and P/M); atropisomerism; racemisation of chiral biphenyls; buttressing effect.

Concept of prostereoisomerism: prostereogenic centre; concept of (pro)n-chirality: topicity of ligands and faces (elementary idea); pro-R/pro-S, pro-E/pro-Z and Re/Si descriptors; pro-r and pro-s descriptors of ligands on propseudoasymmetric centre.

Conformation: conformational nomenclature: eclipsed, staggered, gauche, syn and anti; dihedral angle, torsion angle; Klyne-Prelog terminology; P/M descriptors; energy barrier of rotation, concept of torsional and steric strains; relative stability of conformers on the basis of steric effect, dipole-dipole interaction and H-bonding; butane gauche interaction; conformational analysis of ethane, propane, n-butane. 2-methylbutane and 2,3-dimethylbutane; haloalkane, 1,2-dihaloalkanes and 1,2-diols (up to four carbons); 1,2-halohydrin; conformation of conjugated systems (*s*-cis and *s*-trans).

18 Hours

2. Chemistry of alkenes and alkynes

Addition to C=C and C≡C: Mechanism (with evidence wherever applicable), reactivity, regioselectivity (Markownikoff and anti-Markownikoff additions) and stereoselectivity; reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercuration-demercuration, hydroboration-oxidation, ozonolysis; epoxidation, syn and anti-hydroxylation, iodolactonisation, addition of singlet and triplet carbenes (for alkenes); electrophilic addition to diene (conjugated dienes and allene); radical addition: HBr addition; use of NBS for allylic and benzylic bromination with mechanism, competition with brominations across C=C;; Birch reduction of benzenoid aromatics; interconversion of *E*- and *Z*-alkenes. dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity. *15 Hours*

3. Aromatic Substitution

Electrophilic aromatic substitution: mechanisms and evidences in favour of it; orientation and reactivity; reactions: nitration, nitrosation, sulfonation, halogenation, Friedel-Crafts reaction; one-carbon electrophiles (reactions: chloromethylation, Gatterman-Koch, Gatterman, Houben-Hoesch, Vilsmeier-Haack, Reimer-Tiemann, Kolbe-Schmidt); Ipso substitituion.

Nucleophilic aromatic substitution: addition-elimination mechanism and evidences in favour of it; cine substitution (benzyne mechanism), structure of benzyne and unimolecular mechanism. *10 Hours*

4. Carbonyl and Related Compounds

Addition to C=O: structure, reactivity and preparation of carbonyl compounds; mechanism (with evidence), reactivity, equilibrium and kinetic control; Burgi-Dunitz

trajectory in nucleophilic additions; formation of hydrates, cyano hydrins and bisulphite adduct; nucleophilic addition-elimination reactions with alcohols, thiols and nitrogen- based nucleophiles; reactions: benzoin condensation, Cannizzaro and Tischenko reactions, reactions with ylides: Wittig reaction; oxidations and reductions: Clemmensen, Wolff-Kishner, LiAlH4, NaBH4, MPV, Oppenauer, Bouveault-Blanc, acyloin condensation; oxidation of alcohols with PDC and PCC; periodic acid and lead tetraacetate oxidation of 1,2-diols.

Exploitation of acidity of α-H of C=O: formation of enols and enolates; kinetic and thermodynamic enolates; reactions (mechanism with evidence): halogenation of carbonyl compounds under acidic and basic conditions, Hell-Volhard-Zelinsky (H. V. Z.) reaction, nitrosation, SeO_2 (Riley) oxidation; condensations (mechanism with evidence): Aldol, Tollens', Knoevenagel, Claisen-Schmidt, Claisen ester including Dieckmann, Stobbe; Mannich reaction, Perkin reaction, Favorskii rearrangement; alkylation of active methylene compounds; preparation and synthetic applications of diethyl malonate and ethyl acetoacetate; specific enol equivalents (lithium enolates, enamines) in connection with alkylation, acylation and aldol type reaction.

Nucleophilic addition to α, β-unsaturated carbonyl system: general principle and mechanism (with evidence); direct and conjugate addition, addition of enolates (Michael reaction), Robinson annulation.

Substitution at sp^2 carbon (C=O system): mechanism (with evidence): BAC^2, AAC^2, AAC^1, AAL^1 (in connection to acid and ester); acid derivatives: amides, anhydrides and acyl halides (formation and hydrolysis including comparison).

24 Hours

5. Organometallics

Grignard reagent; Organolithiums; Gilman cuprates: preparation and reactions (mechanism with evidence); addition of Grignard and organo-lithium to carbonyl compounds; substitution on - COX; conjugate addition by Gilman cuprates; Corey-House synthesis; abnormal behavior of Grignard reagents; comparison of reactivity among Grignard, organo-lithium and organo-copper reagents; Reformatsky reaction; concept of umpolung and base-nucleophile dichotomy in case of organometallic reagents.

8 Hours

Reference Books

1) Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.
2) Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.
3) Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4) Pathak & Saha, Organic Chemistry (Volume-1 & 2), Books and Allied (P) Ltd.
5) Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearsonn Education).
6) Morrison, R. T. Study guide to organic Chemistry, Pearson.
7) Nasipuri, D. Stereochemistry of Organic Compounds, New Age International (P) Ltd.
8) Sengupta, S. Basic Stereochemistry of Organic Molecules, Oxford University Press

Chemistry MAJOR

Paper code: CHEM4012 (3 and 4 Years)

Paper title: Physical Chemistry (Theory)

Credit: 5

Course objective

Development of knowledge of theories of several experimental and theoretical aspects of chemistry

Course outcome

The course will help to develop physical chemistry knowledge of solid, liquid and gaseous states of matter. Students will also learn to do quantum chemical calculations for various systems.

1. Chemical Kinetics-II and Catalysis

Theories of reaction rate: Collision theory; Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment).

Homogeneous catalysis: Homogeneous catalysis with reference to acid-base catalysis; Primary kinetic salt effect; Enzyme catalysis; Michaelis-Menten equation, Lineweaver-Burk plot, turn over number, autocatalysis; periodic reactions. *12 Hours*

2. Electrochemistry-I

Conductance and transport number: Ion conductance; Conductance and measurement of conductance, cell constant, specific conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak electrolytes; Debye-Hückel theory of ion atmosphere (qualitative)-asymmetric effect, relaxation effect and electrophoretic effect; Ostwald's dilution law; Ionic mobility; Application of conductance measurement (determination of solubility product and ionic product of water); Conductometric titrations.

Transport number, Principles of Hittorf's and Moving-boundary method; Wien effect, Debye-Falkenhagen effect, Walden's rule. *15 Hours*

3. Partial molar properties and Chemical potential

Chemical potential and activity, partial molar quantities, relation between Chemical potential and Gibb's free energy and other thermodynamic state functions; variation of Chemical potential (μ) with temperature and pressure; Gibbs-Duhem equation; fugacity and fugacity coefficient; Variation of thermodynamic functions for systems with variable composition; Equations of states for these systems, Change in G, S, H and V during mixing for binary solutions. *12 Hours*

4. Chemical Equilibrium

Thermodynamic conditions for equilibrium, degree of advancement; van't Hoff's reaction isotherm (deduction from chemical potential); Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs free energy change; Definitions of K_P, K_C and K_x; van't Hoff's reaction isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure; variation of equilibrium constant with addition to inert gas; Le Chatelier's principle and its derivation. *14 Hours*

5. Specific heats of solid

Coefficient of thermal expansion, thermal compressibility of solids; Dulong –Petit's law; Perfect Crystal model, Einstein's theory – derivation from partition function, limitations;

Debye's T^3 law – analysis at the two extremes (without derivation of T^3 law).

5 Hours

6. Thermodynamics-III

Third law of Thermodynamics: Absolute entropy, Planck's law, Calculation of entropy, Nernst heat theorem *3 Hours*

7. Quantum Mechanics-I

Beginning of Quantum Mechanics: Wave-particle duality, light as particles: photoelectric and Compton effects; electrons as waves and the de Broglie hypothesis; Uncertainty relations (without proof).

Postulates of Quantum Mechanics, Wave function: Schrödinger time-independent equation; nature of the equation, acceptability conditions imposed on the wave functions and probability interpretations of wave function.

Concept of Operators: Elementary concepts of operators, eigenfunctions and eigenvalues; Linear and Hermitian operators; Commutation of operators, commutator and uncertainty relation; Expectation value. *14 Hours*

Reference Books

1) Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press.
2) Castellan, G. W., Physical Chemistry, Narosa Publishing House.
3) McQuarrie, D. A. & Simons, J. D. Physical Chemistry: A Molecular Approach, Viva Press.
4) Engel, T. & Reid, P. Physical Chemistry, Pearson.
5) Maron, S. & Prutton, Principles of Physical Chemistry, Collier Macmillan Ltd.
6) Mortimer, R. G. Physical Chemistry, Elsevier.
7) Ball, D. W., Physical Chemistry, Thomson Press.
8) Glasstone, S. & Lewis, G.N. Elements of Physical Chemistry.
9) Rakshit, P.C., Physical Chemistry, Sarat Book House.
10) Zemansky, M. W. &Dittman, R.H. Heat and Thermodynamics, Tata-McGraw-Hill.
11) Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas Publishing House.
12) Clauze & Rosenberg, Chemical Thermodynamics: Basic concepts & Methods, John Wiley & Sons, 2008.

13) Sharma, K. K. & Sharma, L. K., A Textbook of Physical Chemistry, Vikas Publishing House.
14) Chatterjee Hrishikesh, Physical Chemistry (Volume-1), Platinum Publisher
15) Kapoor, K.L., Textbook of Physical Chemistry (Volume 1 and Volume-2), McGraw Hill Education
16) Ghoshal, A. Numerical problems & short questions on Physical Chemistry, Books and Allied (P) Ltd.
17) Bajpai, D. N., Advanced Physical Chemistry, S. Chand Publication.
18) Levine, I. N. Physical Chemistry, Tata McGraw-Hill.

Chemistry MAJOR

Paper code: CHEM4013 (3 and 4 Years)

Paper title: Organic Chemistry (Practical)

Credit: 5

Course objective

- Detection of several elements in organic molecules
- Detection of functional group in organic molecules
- Organic preparations

Course outcome

Students will have a hands-on training for detection of elements (N, S, Cl, Br, etc) and synthesis/derivatization of several organic compounds.

A. ***Qualitative Analysis of single solid organic compound***

1) Detection of special elements (N, S, Cl, Br) by Lassaigne's test
2) Solubility and classification (solvents: H_2O, 5% HCl, 5% NaOH and 5% $NaHCO_3$)
3) Detection of the following functional groups by systematic chemical tests:
4) Aromatic amino ($-NH_2$), aromatic nitro ($-NO_2$), amido ($-CONH_2$), anilide (-CONHAr), phenolic – OH, carboxylic acid (-COOH), ester (-COOR), carbonyl (-CHO and > C=O)
5) Melting point of the given compound
6) Preparation of one suitable derivative of the given sample, crystallization and determination of melting point.

Each student, during laboratory session, is required to carry out qualitative chemical tests for all the special elements and the functional groups with relevant derivatisation in known and unknown (at least six) organic compounds. *45 Hours*

B. ***Organic Preparations***

The following reactions are to be performed, noting the yield of the crude product with melting point:

1) Nitration of acetanilide
2) Condensation reactions: Synthesis of 7-hydroxy-4-methylcoumarin
3) Hydrolysis of amides/imides/esters
4) Acetylation of phenols/aromatic amines (using Zn-dust/Acetic Acid)
5) Benzoylation of phenols/aromatic amines
6) Side chain oxidation of toluene and p-nitrotoluene
7) Diazo coupling reactions of aromatic amines
8) Bromination of acetanilide using green approach (Bromate-Bromide method)
9) Selective reduction of m-dinitrobenzene to m-nitroaniline
10) Students must also calculate percentage yield, based upon isolated yield (crude) and theoretical yield.

Purification of the crude product is to be made by crystallisation from water/alcohol, crystallization after charcoal treatment, or sublimation, whichever is applicable.

30 Hours

Reference Books

1) Vogel, A. I. Elementary Practical Organic Chemistry, Part 2: Qualitative Organic Analysis, CBS Publishers and Distributors.

2) Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. Practical Organic Chemistry, 5th Ed.,Pearson (2012)

3) Clarke, H. T., A Handbook of Organic Analysis (Qualitative and Quantitative), Fourth Edition, CBS Publishers and Distributors (2007).

4) Ghoshal, A., Mahapatra, B., Nad, A. K. An Advanced Course in Practical Chemistry, New Central Book Agency (2007).

5) Bhattacharyya, R. C, A Manual of Practical Chemistry.

Chemistry MINOR

Paper code: CHEM4021

Paper title: General Chemistry-II

Credit: 3 + 1

Course objective

Discussion on several general aspects of inorganic, organic and physical chemistry

Course outcome

This course will help the students to develop advanced topics of chemistry, physics and biology. Students will learn to synthesize several coordination compounds. Students will also learn to estimate hardness of water by chemical analysis.

Theory Credit: 3

1. Liquid state

Definition of Surface tension, its dimension and principle of its determination using stalagmometer; Viscosity of a liquid and principle of determination of coefficient of viscosity using Ostwald viscometer; Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). *6 Hours*

2. Colligative properties

Raoult's law of relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmosis and osmotic pressure, abnormal colligative property and vant Hoff factor, molecular weight determination of unknown solute *6 Hours*

3. Solutions

a. Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions; Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions; Distillation of solutions; Lever rule; Azeotropes

b. Critical solution temperature; effect of impurity on partial miscibility of liquids; Immiscibility of liquids- Principle of steam distillation; Nernst distribution law and its applications, solvent extraction *8 Hours*

4. Aromatic hydrocarbons

Benzene: Preparation: from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: electrophilic substitution (general mechanism); nitration (with

mechanism), halogenations (chlorination and bromination), sulphonation and Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene); side chain oxidation of alkyl benzenes (up to 4 carbons on benzene). *6 Hours*

5. Synthetic uses of Grignard reagent & Active methylene compounds

Synthetic uses of Grignard reagent (GR), ethylacetoacetate (EAA) and diethylmalonate (DEM) *6 Hours*

6. Coordination chemistry

Double and complex salts, Warner's theory of coordination complexes, classification of ligands, chelates, coordination numbers, IUPAC nomenclature of coordination complexes (up to two metal centers), isomerism in coordination compounds, constitutional and stereo isomerism, geometrical and optical isomerism in square planar and octahedral complexes. *10 Hours*

7. Radioactivity

Characteristics, α, β and γ-rays, radioactive disintegration and equilibrium, decay constant, half-life and average life, artificial transmutation and artificial radioactivity, uses *3 Hours*

Reference Books

1) Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.
2) Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.
3) Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.
4) Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998).
5) Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6) Sarkar, R, General and inorganic chemistry, Volume II, New central book agency, (2012).
7) Rakshit, P. C., Physical Chemistry, Sarat Book House.

8) Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas Publishing House.
9) Sharma, K. K. & Sharma, L. K., A Textbook of Physical Chemistry, Vikas Publishing House.
10) Bajpai, D. N., Advanced Physical Chemistry, S. Chand Publication.
11) Kapoor, K.L., Textbook of Physical Chemistry (Volume 1 and Volume 2), McGraw Hill Education
12) Ghoshal, A. Numerical problems & short questions on Physical Chemistry, Books and Allied (P) Ltd.

Practical Credit 1

A. *Inorganic preparations*

1) Tetraamminecarbonatocobalt(III) ion
2) Potassium tris(oxalato)ferrate(III)
3) Tris(ethylenediamine) nickel (II) chloride *10 Hours*

B. *Complexometric titration*

Determination of total hardness of water by using standard EDTA solution *5 Hours*

Reference Books

1) Bhattacharyya, R. C, A Manual of Practical Chemistry.
2) Nad, Mahapatra, Ghosal, An Advance course in Practical Chemistry, New Central Book Agency (P) Ltd.
3) K. S. Mukherjee, Textbook on Practical Chemistry, New Central Book Agency (P) Ltd.
4) Ghosh, Das Sharma, Majumdar, Manna, Chemistry in Laboratory, Santra Publication (P) Ltd.
5) Poddar and Ghosh, Degree Practical Chemistry, Book Syndicate (P) Ltd.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: HRM3021

Course Title: Human Resource Management –Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

Introduction HR Executive (Duration: 4 Hours)

- Describe the roles and responsibilities of an HR Executive - Payroll and Employee Data Management.
- Explain the importance of the role.
- Explain organisation structure and various functions carried out in an organisation.
- Describe organisational, external agency and employee requirements for information.

Maintain employee records for compensation and benefits calculations (Duration: 15 Hours)

- List various data recording systems used in organisations to capture and process employee data.
- Record data manually in physical registers and files.
- List various sources of information related to payroll and employee data management.
- Describe various methods of taking attendance.
- Describe overtime and leave marking and approval process.
- List income tax-related investments and declaration form and evidence required with it.
- Describe various headers in a salary slip.
- List various information required to be maintained during the entire employee lifecycle in an organisation.
- Describe procedures for keeping data confidential and secure. Maintain records of new employees for details such as employee name, ID, team, salary, date of birth, address, etc.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: HRM3021

Course Title: Human Resource Management –Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

• Seek necessary details of new employees from relevant authorities/ departments in the organisation such as employee number, access card number, date of joining, salary break-up, bands/levels, etc.

• Obtain records of existing employees assigned to new roles, in a timely manner pertaining to new designations, salary hikes, changes in pay bands, salary structure, departments, etc.

• Update records of existing employees assigned to new roles, in the database to reflect changes accurately and in a timely manner.

• Update leave details of employees into the database.

• Record the leave without pay details of employees.

• Record the overtime details of employees (when applicable).

• Update the date of resignation of the employees as well as the employee status to indicate resignation.

• Obtain salary calculation that forms part of a full and final settlement.

• Obtain previous employment detail /salary details if required/applicable.

• Seek clarifications and supporting information to address gaps in information in a timely manner, from appropriate department/authority.

• State standards, policies and procedures followed in the company relevant to own employment and performance conditions.

• List the organisation’s hierarchy, departments, authorised signatories and authorisation’s procedures.

• State the organisation’s policies for recording and storing data.

• State the organisation’s procedures for maintaining the security and confidentiality of information.

• State the organisation’s policies and procedures for resolving discrepancies.

• State the organisations’ human resource policies.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: HRM3021

Course Title: Human Resource Management –Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

Process statutory entitlements for finalizing compensation and benefits (Duration: 15 Hours)

• Describe how to process statutory entitlements and deductions with respect to staff compensation and benefits.

• State current rules relating to statutory payments and deductions.

• State relevant concepts and terms regarding provident fund deduction such as employee's contribution, employer's contribution, minimum and maximum PF deduction allowed, government website through which payment is to be made, eligibility criteria, etc.

• State relevant concepts and terms regarding ESI deduction such as employee's contribution, employer's contribution, minimum and maximum ESI deduction allowed, government website through which payment is to be made, the applicability of ESI provisions to employees with salary as limited by present rules, etc.

• List statutory and regulatory authorities related to compensation and benefits.

• List documentation to be maintained for statutory compliances for PF, ESIC, Professional Tax, Income Tax, etc.

• Determine entitlement to statutory payments, provident fund (PPF), employees state insurance (ESI), professional tax, etc. for staff compensation and benefits.

• Calculate any applicable pre-tax deductions and all relevant statutory and non-statutory deductions.

• Identify the tax liabilities for various salary amounts and types.

• Identify relevant concepts and terms regarding Provident Fund deduction such as employee's contribution, employer's contribution, minimum and maximum PF deduction allowed and government website through which payment is to be made, eligibility criteria, etc.

• Calculate the amount of PF to be deducted individually from employees' salaries.

• Process PF Nomination, PF-Withdrawal and PFTransfer documents.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: HRM3021

Course Title: Human Resource Management –Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

• Identify relevant concepts and terms regarding ESI deduction such as employee's contribution, employer's contribution, minimum and maximum ESI deduction allowed, government website through which payment is to be made, the applicability of ESI provisions to employees with salary as limited by present rules, etc.

• Calculate the amount of ESI to be deducted individually from employees' salaries.

• State organization's standards, policies, procedures, guidelines and service level agreements for dealing with queries and your role and responsibilities in relation to these.

Process salary packages in the payroll system (Duration: 15 Hours)

• Describe how to process salary packages in the payroll system.

• State key features of the legislation, regulations and taxation systems relevant to salary packaging arrangements and additional allowances.

• List benefits and costs to organisations and employees of salary packaging arrangements.

• Explain different models for salary packaging, including gross salary plus benefits, total employment costing.

• Describe external and organisational sources that can be accessed for additional information on salary packaging arrangements and additional allowances.

• Describe salary slip information.

• Prepare standard information for employees on available salary packaging options.

• Provide information to employees according to organisational policies and procedures

• Obtain employee information required to process salary packaging arrangements in line with organisational procedures.

• Determine tax and non-tax components of salary packaging arrangements.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: HRM3021

Course Title: Human Resource Management –Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

• Calculate the impact of additional allowances on employee's gross income in the payroll system.

• Maintain payroll records relating to employee salary packaging arrangements and additional allowances according to organisational policies and procedures

• State standards, policies, and procedures followed in the company relevant to own employment and performance conditions.

Process payroll data (Duration: 11 Hours)

• List different types of payroll systems.

• List the organisation's methods of salary and payroll disbursement.

• Describe operational work systems, equipment, management and site operating systems for payroll activities.

• Explain workplace procedures and policies for carrying out employee payroll activities.

• List documentation requirements for carrying out employee payroll activities.

• Explain problems that may occur and appropriate action that can be taken to resolve these problems.

• State regulations relevant to payroll activities.

• Describe workplace grading systems.

• Describe workplace leave and roster systems.

• Ensure all earnings are authorised and calculated in accordance with defined remuneration policies and workplace procedures.

• Maintain a record of leave entitlements; leave taken, loadings and allowances.

• Calculate gross pay and deductions accurately from information contained in relevant documents.

• Prepare payroll within designated timelines and in accordance with organisational policy and procedures.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: HRM3021

Course Title: Human Resource Management –Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

• Reconcile total wages for a pay period, check or correct irregularities or refer to designated persons for resolution.

• Make arrangements for payment in accordance with organisational and individual requirements.

• Produce payroll records in accordance with organisational policy and security procedures.

• Check the accuracy of payroll records in accordance with organisational policy and security procedures.

• Coordinate with accounts team for final salary payments by sharing accurate and timely information in required formats

• Follow security procedures for processing payroll and for maintaining payroll records.

• Respond to payroll enquiries in accordance with organisational and legislative requirements. • Provide information in accordance with organisational and legislative requirements.

• State organisational policies and procedures across the full range of tasks for the required payroll processes.

Reference Books on Human Resource Management

1) Human Resource Management in India – Sage Publications India Pvt Ltd

2) Strategic Human Resource Management – Pearson India.

3) Human Resource Management in India – Excel Books

4) Human Resource Management in India – Tata Mc Grow Hill Education

5)Human Resource Management an Indian Context—Himalaya Publishing House

6)Human Resource Management in India—Thi Learning Pvt Ltd

7)Indian Ethos and Human Resource Management—Excel Books

8)Human Resource Management in India—Oxford University Press

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: HRM5021

Course Title: Human Resource Management –Module 2

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Fifth Semester

Communicating with Colleagues (Seniors, Peers and Subordinates) (Duration: 6 Hours)

• Identify job-related requirements, performance indicators and incentives by seeking clarification from reporting superior.

• Record work output, exceptions and any anticipated reasons for delays as per organisational requirements.

• Report work output, exceptions and any anticipated reasons for delays to supervisor as per organisational requirements.

• Seek and receive feedback on performance output and quality.

• Receive information and instructions from colleagues accurately getting clarification where required.

• Accurately pass on information to authorized persons who require it and within agreed timescale and confirm its receipt.

• Give information to others clearly, at a pace and in a manner that helps them to understand. • State the common reasons for interpersonal conflict.

• Explain the importance of developing effective working relationships for professional success.

• Describe how to express and address grievances appropriately and effectively.

• Explain the importance and ways of managing interpersonal conflict effectively.

• Explain the importance of teamwork in organizational and individual success.

• Display helpful behaviour by assisting others in performing tasks in a positive manner, where required and possible.

• Consult with and assist others to maximize effectiveness and efficiency in carrying out tasks.

• State the various components of effective communication.

• Explain the importance of effective communication in the workplace.

• Display appropriate communication etiquette while working.

• Explain the key elements of active listening.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: HRM5021

Course Title: Human Resource Management –Module 2

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Fifth Semester

• Explain the value and importance of active listening and assertive communication.

• Explain the barriers to effective communication.

• Explain the importance of tone and pitch in effective communication and how to use it.

• Use appropriate tone, pitch and language to convey politeness, assertiveness, care and professionalism.

• Demonstrate responsible and disciplined behaviours at the workplace such as punctuality; completing tasks as per given time and standards; not gossiping and idling time; eliminating waste, honesty, etc. Interact with colleagues from different functions clearly and effectively on all aspects to carry out the work among the team and understand the nature of their work.

• Explain the importance of avoiding casual expletives and unpleasant terms while communicating professional circles.

• Explain the importance of discipline for professional success.

• State what constitutes disciplined behaviour for a working professional.

Communicating with Clients and Visitors (Duration: 6 Hours)

• Meet and greet visitors promptly, treating them politely and making them feel welcome.

• Ask questions politely to the visitors in order to identify them and their needs.

• Provide clear and accurate information visitors as per their requirement, while following organisation policies for information access and confidentiality.

• Listen actively in two-way communication.

• Display sensitivity to gender, cultural and social differences such as modes of greeting, formality, etc.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: HRM5021

Course Title: Human Resource Management –Module 2

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Fifth Semester

• State the various categories of people that one is required to communicate and coordinate within the organization.

• Identify customer dissatisfaction, the reason for dissatisfaction and address their complaints effectively.

• Ensure to maintain a proper body language, dress code, gestures and etiquettes towards the customers.

• Allow the visitors to complete what they have to say without interrupting them while they talk.

• Ensure to avoid negative questions and statements to the customers.

• Inform the customers on any issues or problems beforehand and also on the developments involving them.

Professional Development (Duration: 10 Hours)

• Develop personal and professional goals and objectives.

• Classify goal and objectives into various timelines such as short, medium and long-term.

• Explain the importance of developing personal and professional goals and objectives.

• Identify strengths and weaknesses in relation to goals and objectives.

• Explain the importance of identifying strengths and weaknesses in relation to goals and objectives.

• Evaluate own capacity to meet goals and objectives.

• Explain how to identify strengths and weaknesses and evaluate own capacity to meet goals and objectives.

• Determine personal development needs to perform role as per desired standards.

• Develop a professional development plan to enhance professional capabilities.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: HRM5021

Course Title: Human Resource Management –Module 2

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Fifth Semester

• Explain the importance of continuous learning and developing a professional development plan.

• Document a professional practice plan designed to support the achievement of goals.

• Select and implement development opportunities to support continuous learning and maintain the currency of professional practice.

• Development opportunities to support continuous learning and maintain the currency of professional practice.

• Research developments and trends impacting on professional practice and integrate information into work performance.

• Explain how to source information on developments and trends impacting on professional practice and why is it important.

• Invite peers and others to observe, and provide feedback, on own performance and practices.

• Use feedback from colleagues and clients to identify and introduce, improvements in work performance.

• Explain the importance of taking and using feedback from colleagues and clients to identify and introduce, improvements in work performance.

Professional Practice (Duration: 10 Hours)

• Display appropriate professional appearance for the workplace.

• Explain the importance of displaying professional appearance behaviour at all times.

• Interact with team members, clients, vendors, visitors and other stakeholders in a Professional manner.

• Perform tasks to the required workplace standard.

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Minor Course under Vocational Education & Training

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Detailed Syllabus – Fifth Semester

• Complete duties accurately, systematically and within required timeframes.

• Follow organisational policies while carrying out tasks.

• State reliable sources of information for finding out about organisation policies.

• Seek clarifications where organisational policies are not clear, from authorised and reliable sources.

• Protect the rights of the client and organisation when delivering services.

• State the nature of rights that clients and organisations have.

• Explain how the wrong actions can deny clients and organisations of their rights.

• Ensure services are delivered equally to all clients regardless of personal and cultural beliefs.

• Plan to meet team performance targets and standards.

• Monitor own and team performance as per agreed plan.

• Share all relevant information with stakeholders in agreed formats and as per agreed timelines.

• Work collaboratively with colleagues through sharing information and ideas and working together on agreed outcomes.

• Explain the importance of working collaboratively with colleagues through sharing information and ideas and working together on agreed outcomes.

• Recognise, avoid and/or address any conflict of interest.

• Explain the concept of conflict of interest and why it is important to recognise, avoid and/or address any conflict of interest.

• Use of conflict resolution and negotiation skills to identify critical points, issues, concerns and problems identify options for changing behaviours.

• Recognize and respond to inappropriate behaviour towards self or others in a professional manner and as per organisational policy. Explain types of inappropriate behaviours at the workplace such as violence, inappropriate language, verbal or physical abuse or bullying, insensitive verbal or physical behaviour in terms of

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cultural, racial, disability and gender-based insensitivities, dominant or overbearing behaviour, disruptive behaviour, non-compliance with safety instructions, unethical behaviour.

Labour Law (Duration: 28)

- •Law relation to Labour relation and Trade union
- •Law relation to Law welfare
- •Factories Act
- •Employee state insurance Act
- •Payment of wages Act
- •Minimum wage Act
- •Payment of Bonus Act
- •Workmen Compensation Act
- •Trade union Act
- •Industrial disputes Act

Reference Books on Human Resource Management

1) Human Resource Management in India – Sage Publications India Pvt Ltd
2) Strategic Human Resource Management – Pearson India.
3) Human Resource Management in India – Excel Books
4) Human Resource Management in India – Tata Mc Grow Hill Education
5)Human Resource Management an Indian Context—Himalaya Publishing House
6) Human Resource Management in India—Thi Learning Pvt Ltd
7)Indian Ethos and Human Resource Management—Excel Books
8) Human Resource Management in India—Oxford University Press

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Minor Course under Vocational Education & Training

Course Code: HRM6021

Course Title: Human Resource Management –Module 3

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Detailed Syllabus – Sixth Semester

Introduction Recruitment Executive – Human Resources (HR) (Duration: 3 Hrs.)

- Describe job roles and responsibilities of a 'Recruitment Executive – Human Resources (HR)'.
- List various sectors and industry.
- Describe various types of organizations and their purpose.
- Describe common types of classification used for various organizations such as size, sector, spread, registration type, etc.
- Describe common organizational structures and various functions carried out in an organization.
- List various departments in organizations and their key purpose.
- State the key tasks of the department for human resource management.

Gather job-related information from employer organizations (Duration: 15 Hrs.)

- Describe the products, services and reporting procedure of client organization, for whom the recruitment has to be done.
- List the targeted customer segments of the client organization.
- Identify client-end recruitment and selection process details through interactions with the client.
- Confirm the roles and number of positions that are required to be filled from the client(s).
- Determine the candidate specifications and the selection parameters by discussing with the client.
- Determine the degree of flexibility allowed for each selection parameter while selecting candidates.
- Confirm the specifications for each role with the client prior to undertaking recruitment as per organization procedures.

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Detailed Syllabus – Sixth Semester

• Identify the extent of services required by the client, for items such as background verification, credential document verifications, salary negotiation, etc.

• Identify details such as costs, organizational procedures, anticipated time frames and other terms and conditions from the client contract.

• Create a well-developed job description and recruitment specifications summary.

• Prepare a recruitment plan for the positions to be recruited based on client preferences, nature of thejobs, organizational constraints and procedures, reporting requirements, etc.

• Modify and finalize the recruitment plan in discussion with the client.

• Describe methods of charging clients and the rates applicable for products and services.

• Maintain confidentiality of client information as per data privacy requirements.

• Explain importance of client satisfaction for business success.

• State data security and privacy policies of the organization.

• Describe organization processes related to recruitment.

Source candidates for recruitment based on client requirement (Duration: 15 Hrs.)

• List factors that enhance effectiveness in recruitment and selection.

• Explain industry and sector-specific recruitment practices, working conditions and terms of employment.

• Determine criteria for candidate search based on client-defined parameters.

• Write and place recruitment advertisements in relevant media as per job specifications, organizational policy and client permissions.

• Access candidate profiles from internally available sources such as organizational databases, candidate curriculum vitae, (cv) banks and assess fitment to applicable criteria.

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Duration: 60 Hours

Detailed Syllabus – Sixth Semester

• Access candidate profiles from externally available sources online databases, recruitment sites, social media, references and assess fitment to applicable criteria.

• Evaluate applicant profiles for suitability to client requirements.

• Prepare a preliminary shortlist based on a desk review, and then prioritize candidates for direct contact based on fitment.

• Acquire current contact details of shortlisted potential candidates.

• State aspects of working conditions that commonly impact choice of a workplace by prospective employees.

• State the components of salary, related legislation and statutory provisions and guidelines.

• Describe work culture and common attributes related to different types of work culture.

• Describe common types of compensation, rewards and benefits.

• Develop a communication or contact plan for communicating with potential candidates.

• Communicate details of the offer to the candidate and seek an expression of interest.

• Evaluate information obtained from each candidate against specified selection criteria and note any additional influencing factors.

• Describe data security and privacy policies of the organization.

• Maintain confidentiality of candidate information as per data privacy requirements of client organization and the candidates.

• Conduct assessment and selection process in accordance with organizational policy, customer agreement and legislative requirements.

• Shortlist suitable candidates for the next stage of the recruitment and selection process.

• Describe the challenges and risks in recruitment and selections.

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Course Title: Human Resource Management –Module 3

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Duration: 60 Hours

Detailed Syllabus – Sixth Semester

Coordinate between candidates and employer organizations for the selection process (Duration:15 Hrs.)

- Describe the importance of timely communication to all during the recruitment process.
- Describe key information required by both parties for effective recruitment.
- Describe employer and candidate information required in relation to the recruitment and selection process, and the importance of recording it.
- List key recruitment parameters for employer organizations.
- List documentation required of candidates for recruitment and selection processes.
- Describe various modes of communication that can be used to connect with candidates and employers along with the advantages, disadvantages, risks and related considerations.
- Describe the importance of seeking effective feedback from both recruiters and candidates regarding their experience during various stages of the process.
- Describe the importance of reviewing the screening criteria continuously based on employer and candidate experiences and results of the recruitment efforts.
- Seek feedback from employer organizations regarding the suitability of shortlisted candidates.
- Seek clarifications from client organization for further streamlining the selection criteria.
- Confirm schedule of next steps for the recruitment and selection process to be undertaken.
- Adjust screening and short-listing process based on employer feedback, when candidates are not found suitable for selection.
- Apply modified criteria for selection to candidates already shortlisted to prune/modify the list.

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Duration: 60 Hours

Detailed Syllabus – Sixth Semester

• Inform all candidates promptly and accurately of the selection decision made by the client.

• Explain the types of queries and guidance that can be provided to candidates to conduct themselves well in recruitment scenarios.

• Provide guidance and instructions to the candidate in preparation for undertaking the next steps in the recruitment and selection process.

• Follow-up with candidates for execution of next steps with timely reminders.

Execute post-selection recruitment processes and reviews (Duration: 12 Hrs.)

• Describe the various background and documentation checks conducted during recruitment.

• Conduct necessary checks as required by employer organization on the candidates finalized for selection.

• Describe employer and employee responsibilities to complete documentation and contracts related to recruitment.

• Verify candidate documentation as required for submission to the employer organization.

• Provide the candidate with necessary documentation from the employer and answer queries and provide clarification where required.

• Ensure delivery of on boarding services as per agreement with the client.

• Record candidate and client information and feedback on the recruitment database accurately.

• Complete records required by employer and client organization regarding the recruitment process accurately and in a timely manner.

• Update records of recruitment results and performance accurately, which could be successfully closed/failed, time to closure, salary level, client, number of positions, etc.

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Detailed Syllabus – Sixth Semester

• Prepare documentation with required details to other departments such as accounts, for further processing.

• Explain the importance and process of conducting reviews.

• Describe performance metrics for recruitment executives.

• Describe the importance of reviewing one's own work and improving performance.

• List organization processes for follow-up documentation for processing payments and account updating, etc.

• Record service reviews with both clients and candidates to ensure continuous improvement.

• Review the recruitment assignment performance to assess effectiveness and productivity based on established metrics such as hit-miss ratio, calls made, CVs sourced per job, time metrics, feedback metrics, etc.

• Identify areas of improvement through comparing performance with organizational and industry standards, previous performance and peers.

Reference Books on Human Resource Management

1) Human Resource Management in India – Sage Publications India Pvt Ltd

2) Strategic Human Resource Management – Pearson India.

3) Human Resource Management in India – Excel Books

4) Human Resource Management in India – Tata Mc Grow Hill Education

5)Human Resource Management an Indian Context—Himalaya Publishing House

6) Human Resource Management in India—Thi Learning Pvt Ltd

7)Indian Ethos and Human Resource Management—Excel Books

8) Human Resource Management in India—Oxford University Press

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: MSR3021

Course Title: Medical Sales Representative –Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

Orientation Module (Duration: 4 Hrs.)

- Collect information of key persons at hospitals, pharmacies and dealers
- Summarize the healthcare ecosystem including relevant govt. scheme, social security benefits
- Gather information about health and other relevant standards and the possible company's tie up with various regulatory bodies and authorities
- Explain regulatory authorities and government policies, rules and regulations (CDSCO/NPPA/ MRTP Act) and their impact on business dynamics, relevant to Life Sciences industry.

Understand Role of MSR and Regulations for MSR (Duration: 6 Hrs.)

- Perform the occupation effectively as per company's standard guidelines
- Recall the organization structure and employment benefits in Life Sciences organizations
- Outline the role of MSR, required skills and knowledge (As per qualification pack) including its career path as well as identify the MCI code of conduct guidelines for MSR and UCP-MP Act
- Practice soft communication skills while communicating with doctors, physicians, pharmacists & cross functional colleagues.

Major Stakeholders and Sale & Distribution System in Pharma & Bio Pharma (Duration: 5 Hrs.)

- Follow-up with key persons at hospitals, pharmacies and dealers to ensure smooth coordination with product distribution related stakeholders
- Describe drug distribution system of pharmaceutical, vaccines, ayurvedic and homeopathic products and role of various stakeholders involved like CFA, distributor, stockist, and liasioning agents.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

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Course Title: Medical Sales Representative –Module 1

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Duration: 60 Hours

Detailed Syllabus – Third Semester

Understanding of Human Body: Anatomy and Physiology (Duration:12 Hrs.)

- Summarize technical/ scientific data presentations and briefings about product and market
- Use the basics of general anatomy, physiology, and various systems of the human body while performing the product presentation to healthcare professionals
- Correlate medical specialties and their common diseases.

English Speaking and Personality Development Part 1 (Duration: 33 Hrs.)

- Understanding the communication process.
- The different types of communication methods.
- Communicating in English.
- First Language (Mother Tongue) Interference.
- Importance of Listening when learning English.
- Time Management.

Reference Books on Medical Sales Representative

1. Community Pharmacy Handbook - Jon Waterfield
2. Essential of Pharmaceutical Chemistry - Donald Cairns
3. Pharmaceutical Innovation and Access to Medicines- OECD 2018
4. Essential of Human Physiology for Pharmacy- Laurie Kelly
5. Textbook of Organic Medicinal and Pharmaceutical Chemistry 11th edition- Wilson and Gisvold's
6. Review of Medical Physiology 26th Edition- Gannong
7. Soft Skill for everyone- Jeff Butterfeild

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: MSR5021

Course Title: Medical Sales Representative –Module 2

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Fifth Semester

Pharmaceutical Science Basics for MSR (Duration: 8 Hrs.)

- Use fundamentals of pharmacology by defining related terms and their significance and basics of drug metabolism while performing the product presentation to healthcare professionals
- Classify methods of drug administration and various routes of drug administration
- Classify the therapeutic drug classes & categories and their use in understanding the product
- Recall drug formularies and their relevance for product presentation
- Interpret technical/ scientific data presentations and briefings to deliver convincing presentations to doctors, pharmacists and other potential customers
- Summarize technical/ scientific data, presentations, briefings and clinical data supplied by company.

Organizational Policy & Internal Processes at Work (Duration: 4 Hrs.)

- Follow the company's guidelines, process and standard.
- Follow generic organizational policy & various internal process relevant for MS.

Market Research and Analysis and Retail Chemist Prescription Audit (Duration: 8 Hrs.)

- Gather information about competitor's products, selling and promotional activities, current market information on pricing, new products, delivery schedules, promoting techniques
- Use the techniques of market research.
- Identify needs of potential customers by going through the prescriptions given by the doctors to their patients in the defined geography
- Perform the data analysis for the information collected during RCPA.

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Minor Course under Vocational Education & Training

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Course Title: Medical Sales Representative –Module 2

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Duration: 60 Hours

Detailed Syllabus – Fifth Semester

Pharmaceutical Marketing (Duration: 7 Hrs.)

- Identify the role of marketing across product lifecycle.
- Outline trends in life sciences marketing and implications of changing marketplace on promotional activities in Pharma/Biopharma/AYUSH sub sectors.

English Speaking and Personality Development Part 2 (Duration: 33 Hrs.)

- Organs of Speech.
- Vowels & Vowels Sounds practice.
- Consonants & Consonant Sounds practice.
- Pronunciation.
- Vocabulary.
- Work Ethic.

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1. Community Pharmacy Handbook - Jon Waterfield
2. Essential of Pharmaceutical Chemistry - Donald Cairns
3. Pharmaceutical Innovation and Access to Medicines- OECD 2018
4. Essential of Human Physiology for Pharmacy- Laurie Kelly
5. Textbook of Organic Medicinal and Pharmaceutical Chemistry 11th edition- Wilson and Gisvold's
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THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: MSR6021

Course Title: Medical Sales Representative –Module 3

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Sixth Semester

Orientation with Pre-Sales Activities (Duration: 8 Hrs.)

- Arrange appointments with medical professionals
- Perform pre-sales activity in reference to communication strategies for products
- Deliver presentations to doctors, pharmacists and other potential customers/ healthcare professionals
- Practice basics of effective business communication and conduct effective business meetings
- Identify Patient-Physician relationship and Physician-MSR relationship
- Develop strategies to increase opportunities to meet and connect with contacts in the medical and healthcare sector.

Sales in Life Sciences (Duration:8 Hrs.)

- Sell and promote medical and pharmaceutical products and services using basics of selling process.
- Develop strategies to increase opportunities to meet and connect with contacts in the medical and healthcare sector
- Identify different sales approaches in life sciences sales
- Engage the potential customers using various methods, tolls and approaches to convince him/her to prescribe your products
- Handle healthcare professional's objections by applying basics of emotional quotient (EQ) and product literature given by company
- Identify the target population and strategy to reach sales and collection targets
- Follow company's legal guidelines and pharmacovigilance process while selling products and providing after-sales service, including channeling queries through the company defined process understand importance of ethics, privacy and confidentiality for MSR

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Minor Course under Vocational Education & Training

Course Code: MSR6021

Course Title: Medical Sales Representative –Module 3

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Sixth Semester

Orientation on Pharmacovigilance for MSR (Duration:3 Hrs.)

- Follow company's legal guidelines and pharmacovigilance process
- Identify common terms used and their reference in pharmacovigilance system
- Outline national & international pharmacovigilance regulatory authorities
- Perform basic processing of a typical "pharmacovigilance case" through case studies as and when required

Organizing Medical Conferences and promotional events (Duration:4 Hrs.)

- Develop contact with maximum people within and outside the company to gather inputs on arranging the conference/ promotional event (CMEs)
- Use techniques for collaborating with other groups and divisions
- Outline ideas from the event related to business/ brand/ company in identifying partnering opportunities during meetings/ seminars and providing support for event management
- Manage events within the approved budget
- Cover all important aspects related to the topic of the conference in the agenda/ theme of promotional event and to plan and complete all logistical arrangements to execution
- Practice planning & organizing skills at work.

Core Skills and Professional Skills related to MSR (Duration: 4 Hrs.)

- Practice the required skill set and learn application of related Core Skills and Professional Skills to gather information about the product and competitors
- Practice the required skill set and learn application of related Core Skills and Professional Skills to promote and sell pharmaceutical/ biopharmaceuticals and AYUSH products to potential customers and for providing after sales service

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Minor Course under Vocational Education & Training

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Course Title: Medical Sales Representative –Module 3

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Sixth Semester

• Practice the required skill set and learn application of related Core Skills and Professional Skills to organize medical conferences and promotional events (CMEs)

English Speaking and Personality Development Part 3 (Duration: 33 Hrs.)

- Speaking as a Language Skill.
- Business communication.
- Public Speaking and presentation Skills.
- Presentation by Trainees.
- Leadership
- personal responsibility

Reference Books on Medical Sales Representative

1. Community Pharmacy Handbook - Jon Waterfield
2. Essential of Pharmaceutical Chemistry - Donald Cairns
3. Pharmaceutical Innovation and Access to Medicines- OECD 2018
4. Essential of Human Physiology for Pharmacy- Laurie Kelly
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THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: RSA3021

Course Title: Retail Sales Associate–Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

To process credit applications for purchases (Duration: 6 Hours)

- Identify the customer's needs for credit facilities.
- Clearly explain to the customer the features and conditions of credit facilities.
- Provide enough time and opportunities for the customer to ask for clarification or more information.
- Accurately fill in the documents needed to allow the customer to get credit.
- Successfully carry out the necessary credit checks and authorisation procedures.
- Promptly refer difficulties in processing applications to the right person.

To help keep the store secure (Duration: 6 Hours)

- Take prompt and suitable action to reduce security risks as far as possible, where it is within the limits of his/her responsibility and authority to do so.
- Follow company policy and legal requirements when dealing with security risks.
- Recognise when security risks are beyond his/her authority and responsibility to sort out, and report these risks promptly to the right person.
- Use approved procedures and techniques for protecting personal safety when security risks arise.
- Follow company policies and procedures for maintaining security while working.
- Follow company policies and procedures for making sure that security will be maintained when he/she goes on breaks and when he/she finishes work.

To help maintain health and safety (Duration: 6 Hours)

- Follow company procedures and legal requirements for dealing with accidents and emergencies.
- Speak and behave in a calm way while dealing with accidents and emergencies.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: RSA3021

Course Title: Retail Sales Associate–Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

- Report accidents and emergencies promptly, accurately and to the right person.
- Recognize when evacuation procedures have been started and follow company procedures for evacuation.
- Follow the health and safety requirements laid down by the company and by law, and encourage colleagues to do the same.
- Promptly take the approved action to deal with risks if he/she is authorised to do so.
- Report risks promptly to the right person, if he/she does not have the authority.

To demonstrate products to customers (Duration: 9 Hours)

- Prepare the demonstration area and check that it can be used safely.
- Check whether the required equipment and products for demonstration are in place.
- Demonstrate products clearly and accurately to customers.
- Present the demonstration in a logical sequence of steps and stages.
- Cover all the features and benefits he/she thinks are needed to gain the customer's interest.
- Promptly clear away the equipment and products at the end of the demonstration and connect with the customer.

To help customers choose right products (Duration: 12 Hours)

- Find out which product features and benefits interest individual customers and focus on these when discussing products.
- Describe and explain clearly and accurately relevant product features and benefits to customers.
- Compare and contrast products in ways that help customers choose the product that best meets their needs.

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Minor Course under Vocational Education & Training

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Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

- Check customers' responses to his/her explanations, and confirm their interest in the product.
- Encourage customers to ask questions & respond to their questions, comments & objections in ways that promote sales & goodwill.
- Identify suitable opportunities to tell the customer about associated or additional products and do so in a way that promotes sales and goodwill.
- Constantly check the store for security, safety and potential sales whilst helping customers.
- Give customers enough time to evaluate products and ask questions.
- Handle objections and questions in a way that promotes sales and keeps the customer's confidence.
- Identify the need for additional and associated products and take the opportunity to increase sales.
- Clearly acknowledge the customer's buying decisions.
- Clearly explain any customer rights that apply.
- Clearly explain to the customer where to pay for their purchases.

<u>To provide specialist support to customers facilitating purchases (Duration: 11 Hours)</u>

- Talk to customers politely and in ways that promote sales and goodwill.
- Use the information given by the customer to find out what they are looking for.
- Help the customer understand the features and benefits of the products they have shown an interest in.
- Explain clearly and accurately the features and benefits of products and relate these to the customer's needs.
- Promote the products that give the best match between the customer's needs and the store's need to make sales.

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Minor Course under Vocational Education & Training

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Course Title: Retail Sales Associate–Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

- Spot and use suitable opportunities to promote other products where these will meet the customer's needs.
- Control the time he/she spends with the customer to match the value of the prospective purchase.
- Constantly check the store for safety, security and potential sales while helping individual customers.
- Find out if the customer is willing to see a demonstration.
- Set up demonstrations safely and in a way that disturbs other people as little as possible.
- Check whether he/she has everything needed to give an effective demonstration.
- Give demonstrations that clearly show the use and value of the product.
- Offer customers the opportunity to use the product themselves, where appropriate.
- Give customers enough chance to ask questions about the products or services he/she is demonstrating to them.
- Check that the store will be monitored for security, safety and potential sales while he/she is carrying out demonstrations.

<u>To maximize sales of goods & services (Duration: 10 Hours)</u>

- Identify promotional opportunities and estimate their potential to increase sales.
- Identify promotional opportunities which offer the greatest potential to increase sales.
- Report promotional opportunities to the right person.
- Fill in the relevant records fully and accurately.
- Tell customers about promotions clearly and in a persuasive way.
- Identify and take the most effective actions for converting promotional sales into regular future sales.

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Minor Course under Vocational Education & Training

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Course Title: Retail Sales Associate–Module 1

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Third Semester

- Gather relevant and accurate information about the effectiveness of promotions, and communicate this information clearly to the right person.
- Record clearly and accurately the results of promotions.

Reference Books on Retail Sales Associate

1) Retail Management - Charulata Publications
2) Retail Management - Gullybaba Publishing House Pvt. Ltd.
3) Retail Sales Associate - National Council of Educational Research and Training
4) Your Future is Retail - ICA Retail

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: RSA5021

Course Title: Retail Sales Associate –Module 2

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Fifth Semester

To provide personalised sales & post-sales service support (Duration: 12 Hours)

- Use available information in the client records to help prepare for consultations.
- Check whether the work area is clean and tidy and that all the required equipment is in hand before starting a consultation.
- Quickly create a rapport with the client at the start of the consultation.
- Talk and behave towards the client in ways that project the company image effectively.
- Ask questions to understand the client's buying needs, preferences and priorities.
- Tactfully check, where appropriate, how much the client wants to spend.
- Explain clearly to the client the features and benefits of the recommended products or services and relate these to the client's individual needs.
- Identify suitable opportunities to sell additional or related products or services that are suited to the client's needs.
- Make recommendations to the client in a confident and polite way and without pressurising them.
- Pace client consultations to make good use of the selling time while maintaining good relations with the client.
- Meet the company's customer service standards while dealing with the client
- Follow the company's procedures for keeping client records up-to-date.
- Record client information accurately and store it in the right places in the company's system. • Keep client information confidential and share it only with people who have a right to it.
- Keep to clients' wishes as to how and when they may be contacted.
- Follow the company's policy and procedures for contacting clients.

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Minor Course under Vocational Education & Training

Course Code: RSA5021

Course Title: Retail Sales Associate –Module 2

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Fifth Semester

- Tell clients promptly and offer any other suitable products or services, where promises cannot be kept.

To create a positive image of self & organisation in the customers mind (Duration: 10 Hours)

- Meet the organisation's standards of appearance and behaviour.
- Greet customers respectfully and in a friendly manner.
- Communicate with customers in a way that makes them feel valued and respected.
- Identify and confirm customer's expectations.
- Treat customers courteously and helpfully at all times.
- Keep customers informed and reassured.
- Adapt appropriate behaviour to respond effectively to different customer behaviour.
- Respond promptly to a customer seeking assistance.
- Select the most appropriate way of communicating with customers.
- Check with customers to ensure complete understanding of their expectations.
- Respond promptly and positively to customers' questions and comments.
- Allow customers time to consider his/her response and give further explanation when appropriate.
- Quickly locate information that will help customers.
- Give customers the information they need about the services or products offered by the organisation.
- Recognise information that customers might find complicated and check whether they fully understand.
- Explain clearly to customers any reasons why their needs or expectations cannot be met.

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Minor Course under Vocational Education & Training

Course Code: RSA5021

Course Title: Retail Sales Associate –Module 2

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Fifth Semester

To resolve customer concerns (Duration: 10 Hours)

- Identify the options for resolving a customer service problem.

- Work with others to identify and confirm the options to resolve a customer service problem. • Work out the advantages and disadvantages of each option for customers and the organisation.
- Pick the best option for customers and the organisation.
- Identify for customers, other ways that problems may be resolved if you are unable to help.
- Identify the options for resolving a customer service problem.
- Work with others to identify and confirm the options to resolve a customer service problem. • Work out the advantages and disadvantages of each option for your customer and your organisation.
- Pick the best option for your customer and your organisation.
- Identify for your customer other ways that problems may be resolved if you are unable to help.
- Discuss and agree the options for solving the problem with customers.
- Take action to implement the option agreed with the customer.
- Work with others and the customer to make sure that any promises related to solving the problem are kept.
- Keep customers fully informed about what is happening to resolve problem.
- Check with customers to make sure the problem has been resolved to their satisfaction.
- Give clear reasons to customers when the problem has not been resolved to their satisfaction.

To organise the delivery of reliable service (Duration: 9 Hours)

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Detailed Syllabus – Fifth Semester

- Plan, prepare and organise everything that is needed to deliver a variety of services or products to different types of customers.
- Organise what he/she does to ensure consistency in giving prompt attention to customers.
- Reorganise his/her work to respond to unexpected additional workloads.
- Maintain service delivery during very busy periods and unusually quiet periods and when systems, people or resources have let you down.
- Consistently meet customers' expectations.
- Balance the time he/she takes with customers with the demands of other customers seeking attention.
- Respond appropriately to customers when they make comments about the products or services being offered.
- Alert others to repeated comments made by customers.
- Take action to improve the reliability of his/her service based on customer comments.
- Monitor whether the action taken has improved the service given to customers.
- Record and store customer service information accurately following organisational guidelines.
- Select and retrieve customer service information that is relevant, sufficient and in an appropriate format.
- Quickly locate information that will help solve a customer's query.
- Supply accurate customer service information to others using the most appropriate method of communication.

<u>To improve customer relationship (Duration: 10 Hours)</u>

- Select and use the best method of communication to meet customers' expectations.

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Detailed Syllabus – Fifth Semester

- Take the initiative to contact customers to update them when things are not going as per plan or when further information is required.
- Adapt appropriate communication to respond to individual customers' feelings.
- meet customers' expectations within the organisation's service offer.
- Explain the reasons to customers sensitively and positively when their expectations cannot be met.
- Identify alternative solutions for customers either within or outside the organisation.
- Identify the costs and benefits of these solutions to the organisation and to customers.
- Negotiate and agree solutions with customers which satisfy them and are acceptable to the organisation.
- Take action to satisfy customers with the agreed solution.
- Make extra efforts to improve his/her relationship with customers.
- Recognise opportunities to exceed customers' expectations.
- Take action to exceed customers' expectations within the limits of his/her authority.
- Gain the help and support of others to exceed customers' expectations.

To monitor and solve service concerns (Duration: 9 Hours)

- Respond positively to customer service problems following organizational guidelines.
- Solve customer service problems when he/she has sufficient authority.
- Work with others to solve customer service problems.
- Keep customers informed of the actions being taken.
- Check with customers that they are comfortable with the actions being taken.
- Solve problems with service systems and procedures that might affect customers before they become aware of them.
- Inform managers and colleagues of the steps taken to solve specific problems.

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Minor Course under Vocational Education & Training

Course Code: RSA5021

Course Title: Retail Sales Associate –Module 2

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Fifth Semester

- Identify repeated customer service problems.
- Identify the options for dealing with a repeated customer service problem and consider the advantages and disadvantages of each option.
- Work with others to select best options for solving repeated customer service problems, balancing customer expectations with the needs of the organisation.
- Obtain the approval of somebody with sufficient authority to change organisational guidelines in order to reduce the chance of a problem being repeated.
- Action the agreed solution.
- Keep customers informed in a positive and clear manner of steps being taken to solve any service problems.
- Monitor the changes that have been made and adjust them if appropriate.

Reference Books on Retail Sales Associate

1) Retail Management - Charulata Publications
2) Retail Management - Gullybaba Publishing House Pvt. Ltd.
3) Retail Sales Associate - National Council of Educational Research and Training
4) Your Future is Retail - ICA Retail

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: RSA6021

Course Title: Retail Sales Associate –Module 3

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Sixth Semester

To promote continuous improvement in service (Duration: 9 Hours)

- Gather feedback from customers that will help identify opportunities for customer service improvement.
- Analyse and interpret feedback to identify opportunities for customer service improvements and propose changes.
- Discuss with others the potential effects of any proposed changes for customers and the organisation.
- Negotiate changes in customer service systems & improvements with somebody of sufficient authority to approve trial / full implementation of the change
- Organise the implementation of authorised changes.
- Implement the changes following organisational guidelines.
- Inform people inside and outside the organisation who need to know of the changes being made and the reasons for them.
- Monitor early reactions to changes and make appropriate fine-tuning adjustments.
- Collect and record feedback on the effects of changes.
- Analyse and interpret feedback and share the findings on the effects of changes with others. • Summarise the advantages and disadvantages of the changes.
- Use your analysis and interpretation of changes to identify opportunities for further improvement.
- Present these opportunities to somebody with sufficient authority to make them happen.

To work effectively in a retail team (Duration: 7 Hours)

- Display courteous and helpful behaviour at all times.
- Take opportunities to enhance the level of assistance offered to colleagues.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: RSA6021

Course Title: Retail Sales Associate –Module 3

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Sixth Semester

- Meet all reasonable requests for assistance within acceptable workplace timeframes.
- Complete allocated tasks as required.
- Seek assistance when difficulties arise.
- Use questioning techniques to clarify instructions or responsibilities.
- Identify and display a non-discriminatory attitude in all contacts with customers and other staff members.
- Observe appropriate dress code and presentation as required by the workplace, job role and level of customer contact.
- Follow personal hygiene procedures according to organisational policy and relevant legislation.
- Interpret, confirm and act on workplace information, instructions and procedures relevant to the particular task.
- Interpret, confirm and act on legal requirements in regard to antidiscrimination, sexual harassment and bullying.
- Ask questions to seek and clarify workplace information.
- Plan and organise daily work routine within the scope of the job role.
- Prioritise and complete tasks according to required timeframes.
- Identify work and personal priorities and achieve a balance between competing priorities.

<u>To work effectively in your organisation (Duration: 7 Hours)</u>

- Share work fairly with colleagues, taking account of own and others' preferences, skills and time available.
- Make realistic commitments to colleagues and do what has been promised.
- Let colleagues know promptly if he/she will not be able to do what has been promised and suggest suitable alternatives.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: RSA6021

Course Title: Retail Sales Associate –Module 3

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Sixth Semester

- Encourage and support colleagues when working conditions are difficult.
- Encourage colleagues who are finding it difficult to work together to treat each other fairly, politely and with respect.
- Follow the company's health and safety procedures while working
- Discuss and agree with the right people goals that are relevant, realistic and clear.
- Identify the knowledge and skills needed to achieve his/her goals.
- Agree action points and deadlines that are realistic, taking account of past learning experiences and the time and resources available for learning.
- Regularly check his/her progress and, when necessary, change the way of working.
- Ask for feedback on his/her progress from those in a position to give it, and use their feedback to improve his/her performance.
- Encourage colleagues to ask him/her for work-related information or advice that he/she is likely to be able to provide.
- Notice when colleagues are having difficulty performing tasks at which you are competent, and tactfully offer advice.
- Give clear, accurate and relevant information and advice relating to tasks and procedures.
- Explain and demonstrate procedures clearly, accurately and in a logical sequence.
- Encourage colleagues to ask questions if they don't understand the information and advice given to them.
- Give colleagues opportunities to practice new skills, and give constructive feedback.
- Check that health, safety and security are not compromised when helping others to learn.

THE UNIVERSITY OF BURDWAN

Minor Course under Vocational Education & Training

Course Code: RSA6021

Course Title: Retail Sales Associate –Module 3

Total Credit: 4 (Lecture -3, Tutorial -1)

Duration: 60 Hours

Detailed Syllabus – Sixth Semester

Employability & Entrepreneurship (Duration: 37 Hours)

- Introduction to Employability Skills
- Constitutional values - Citizenship
- Becoming a Professional in the 21st Century
- Basic English Skills
- Career Development & Goal Setting
- Communication Skills
- Diversity & Inclusion
- Financial and Legal Literacy
- Essential Digital Skills
- Entrepreneurship
- Customer Service
- Getting ready for Apprenticeship & Jobs.

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