



The Kelkar Education Trust's
Vinayak Ganesh Vaze College of Arts, Science & Commerce

AUTONOMOUS

Mithaghar Road, Mulund East, Mumbai-400081, India

College with Potential for Excellence

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Syllabus for Program F.Y. B. Sc.

Chemistry Major & Minor

Syllabus as per Choice Based Credit System (NEP-2020)

(July 2023 Onwards)

Submitted by

Department of chemistry

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❖ **Syllabus as per Choice Based Credit System (NEP-2020)**

Name of the Programme	❖ F. Y. B. Sc. Chemistry : CBCS (NEP-2020)	
<p>The F. Y. B. Sc. in Chemistry course is a one Year Full Time Course consisting of two semesters, to be known as Semester I and Semester II. Each semester consists of one major course and one minor course along with other courses- OE, VSC/SEC, AEC, VEC, IKS, OJT, FP, CEP, CC, RP</p>		
1. Course Code	VGUSMCH101	VGUSMCHP101
	VGUSMCH201	VGUSMCHP201
2. Course Title	General Chemistry : Paper - I	
	General Chemistry : Paper - II	
3. Semester wise Course Contents	Copy of the detailed syllabus Enclosed	
4. References and additional references	Enclosed in the Syllabus	
5. No. of Credits per Semester	22	
6. No. of lectures per Unit	10 Hrs.	
7. No. of lectures per week	13	
8. No. of Tutorial per week	--	
9. Scheme of Examination	Semester End Exam: 60 marks (4 Questions of 15 marks each)	
	Internal Assessment : 40 marks	
	Class Test : 15 marks	
	Project/ Assignment : 15 marks	
	Class Participation : 10 marks	
10. Special notes, if any	No	
11. Eligibility, if any	As laid down in the College Admission brochure / website	
12. Fee Structure	As per College Fee Structure specifications	
13. Special Ordinances / Resolutions, if any	No	

Programme Structure and Course Credit Scheme :

Semester	Major		Minor	OE	VSC/SEC	AEC,VEC,IKS	OJT, FP,CE P,CC, RP	Total
	Mandatory	Elective						
I	4 Credit (2L+2P) (One Paper)	--	4 Credit 2L+2P (One Paper)	4 Credit (3L+1P) (One Paper)	4 Credit VSC (2L+2P) (One Paper)	AEC - 2 Credit VEC-2 Credit IKS - 2 Credit (One Paper)	--	22
II	4 Credit (2L+2P) (One Paper)	--	4 Credit 2L+2P (One Paper)	4 Credit (3L+1P) (One Paper)	4 Credit SEC (2L+2P) (One Paper)	AEC - 2 Credit VEC-2 Credit (One Paper)	CC-2	22
TOTAL	8		8	8	8	10	2	44

Programme : F. Y. B. Sc.

Semester	Course	Course Title	Course Code	Credits
I	Major & Minor	Course 1 : General Chemistry -I	SCH101	4 + 4
	Open Elective (OE)	1. Principles of Management 2. Paper from English Dept 3. Paper from Hindi Dept	---	4
	Vocational skill Courses (VSC)	Introduction to Practical Chemistry	--	4
	Ability Enhancement Courses (AEC)	Effective Communication	--	2
	Value Education Curses (VEC)	Understanding India	--	2
	Indian Knowledge System (IKS)	1. Indian Literature in Translation 2. Performing Arts in Ancient India 3. Ayurveda and Herbal Science 4. Disaster Management in India 5. Environmental Awareness in India	--	2
	Co-curricular Courses	---	--	--
II	Major & Minor	Course 2 : General Chemistry -II	SCH101	4 + 4
	Open Elective (OE)	1. Principles of Management 2. Paper from English Dept 3. Paper from Hindi Dept	---	4
	Skill Enhancement Courses (SEC)	Practical skills in chemistry	--	4
	Ability Enhancement Courses (AEC)	Effective Communication	--	2
	Value Education Curses (VEC)	Understanding India	--	2
	Indian Knowledge System (IKS)	---	--	--
	Co-curricular Courses	1. Sports 2. NSS 3. Cultural	--	2

❖ Semester-wise Details of Chemistry Course

Semester - I									
Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks			End Semester Examination Marks		Total
Course	L	P	Credit	CIA-1	CIA-2	CIA-3	Theory	Practical	
Major	02	4	4.0	15	15	10	60	100	100
Minor	02	4	4.0	15	15	10	60	100	100
VSC	02	4	4.0	15	15	10	60	100	100
OE	02	4	4.0	15	15	10	60	100	100
CIA-II : Assignment/Project CIA-III : APICID&A Max. Time, End Semester Exam (Theory) : 2.00 Hrs.									

Semester - II									
Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks			End Semester Examination Marks		Total
Course	L	P	Credit	CIA-1	CIA-2	CIA-3	Theory	Practical	
Major	02	4	4.0	15	15	10	60	100	100
Minor	02	4	4.0	15	15	10	60	100	100
SEC	02	4	4.0	15	15	10	60	100	100
OE	03	2	4.0				60	40	100
CIA-II : Assignment/Project CIA-III : APICID&A Max. Time, End Semester Exam (Theory) : 2.00 Hrs.									

- L - Lectures
- T - Tutorials
- P - Practical
- C - Credits

Learning/Course Objectives:

1. To infuse in the learner a spirit of inquiry into the fundamental aspects of the various core areas of Chemistry.
2. To make the learner capable of solving problems in the various units of this course.
3. To impart various skills of handling chemicals, reagents, apparatus, instruments and the care and safety aspects involved in such handling.

Course Content - Semester I

Course Code	Unit	Topics	Credits	L/Week
VGVUSMCH101	I	Chemical Thermodynamics, Chemical Kinetics	02	02
	II	Atomic Structure Periodic Table and Periodicity Comparative Chemistry of Main group Elements.		
	III	Basics of Organic Chemistry Stereochemistry		
VGVUSMCHP101		Chemistry Practical I	02	04

F. Y. B. Sc. CHEMISTRY : Choice Based Credit System				
Semester I				
PAPER : I				
Course Name: General Chemistry-I (30 lectures)		Course Code VGVUSMCH101		
Periods per week (1 period 60 minutes)		02		
Credits		02		
Evaluation System		Hours	Mark s	
		Theory Examination	2.0	60
		Theory Internal		40
			No. of Period	
Unit I	<p>1.1 Chemical Thermodynamics</p> <p>1.1.1 Thermodynamic terms: System, surrounding, boundaries, open, closed and isolated system, intensive and extensive properties, state functions and path functions, zeroth law of thermodynamics</p> <p>1.1.2 First law of thermodynamics: Concept of heat (q), work (w), internal energy (U), statement of first law, enthalpy, relation between heat capacities, sign conventions, calculations of heat (q), work (w), internal energy (U), and enthalpy (H) (Numericals expected)</p> <p>1.1.3 Thermochemistry: Heats of reactions, standard states, enthalpy of formation of molecules, enthalpy of combustion and its applications, calculation of Bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equation (Numericals expected)</p> <p>1.2 Chemical Kinetics</p> <p>1.2.1 Rate of reaction, rate constant, measurement of reaction rates, order and molecularity of reaction, integrated rate equation of first and second order reactions (with equal initial concentration of reactants) (Numericals expected).</p> <p>1.2.2 Determination of order of reaction by (a) Integration method (b) Graphical method (c) Ostwald's isolation method (d) Half time method (Numericals expected)</p>		<p>06</p> <p>04</p>	

Unit III	<p>Basics of Organic Chemistry</p> <p>3.1 Bonding and Structure of organic compounds:</p> <p>3.1.1. Hybridization: sp^3, sp^2, sp hybridization of carbon and nitrogen; sp^3 and sp^2 hybridizations of oxygen in Organic compounds.</p> <p>3.1.2. Overlap of atomic orbitals: Overlaps of atomic orbitals to form sigma and pi bonds, shapes of organic molecules.</p> <p>3.1.3 Influence of hybridization on bond properties</p> <p>3.2 Fundamentals of organic reaction mechanism:</p> <p>3.2.1 Electronic Effects: Inductive, electromeric, resonance and Mesomeric effects; Dipole moment; hydrogen bonding and their applications.</p> <p>3.2.2 Organic acids and bases and the factors affecting their relative strengths.</p> <p>3.2.3. Bond fission: Homolytic and Heterolytic fission with suitable examples.; Electrophiles and Nucleophiles.</p> <p>3.2.4. Intermediates: Carbocations, Carbanions and Free radicals. -structure and factors affecting stability</p> <p>3.3 Classification of organic reactions based on mechanism:</p> <p>3.3.1 Polar & Non-polar mechanism; use of curved arrows in depicting Mechanism.</p> <p>3.3.2 Polar Mechanism: Electrophilic addition; nucleophilic addition; electrophilic substitution; nucleophilic substitution (one example of each type, no Mechanism)</p> <p>3.3.3 Non polar mechanism: Free radical addition to alkenes; free radical substitution (one example of each type, no Mechanism)</p> <p>Stereochemistry</p> <p>3.1 Different types of isomerism: position , chain; functional group; stereoisomer; optical isomers; geometrical isomers.</p> <p>3.2 Fischer Projection, Newman and Sawhorse Projection formulae and their interconversions.</p> <p>3.3 Optical Isomerism: Asymmetric carbon; Optical Activity, Specific rotation, Chirality /Asymmetry, stereogenic centre ; Enantiomers, Molecules with two similar and dissimilar chiral-centres, Distereoisomers, meso structures, racemic mixture and resolution (methods of resolution not expected). Relative and absolute configuration: D/L and R/S designations.</p> <p>3.4 Geometrical isomerism in alkene and cycloalkanes: cis–trans and syn-anti</p>	<p>02</p> <p>02</p> <p>02</p> <p>04</p>
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Learning Outcomes:

On studying the syllabi the learner will be able to

- Define the terms system, surroundings, open system, closed system, isolated system ,internal→ energy, enthalpy
- Distinguish between state function and path function→ State the zeroth law and first law of thermodynamics

- Formulate the relationship between internal energy and enthalpy→ Elaborate the concept of thermochemistry and discuss its applications
- Explain the concept of bond enthalpy , bond dissociation enthalpy and resonance energy
- Solve numericals based on Kirchoff's equation, bond enthalpies and heat of reaction.
- Distinguish between order and molecularity of the reaction
- Derive first and second order integrated rate equation
- Recall J.J. Thomson's atomic model.
- Describe Rutherford's atomic model and Bohr's atomic model.
- Illustrate all the quantum numbers and outline the shapes of orbitals.
- Explain hydrogenic atoms and system of many electron atoms.
- Recollect Doberniers law of triads and Newlands law of octaves.
 - Illustrate Mendeleev's periodic table
 - Define Ionization potential, Electronegativity and electron affinity.
- Discuss electronegativity on Pauling scale.
- Correlate chemical properties of elements with their periodic properties.
- Draw the structures of organic compounds
- Identify the functional groups in organic compounds
- Predict the hybridization of different atoms in given organic compound
- Explain the effect of inductive and resonance effects on the properties of organic compounds
- Distinguish between heterolytic and homolytic fission
- Distinguish between polar and non polar reaction
- Identify intermediates and the factors which stabilise the
- Classify the reactions based on the mechanism
- Recognize and draw constitutional isomers, stereoisomers, including enantiomers and diastereomers, racemic mixture and meso compounds
- Define stereoisomers and classify isomers
- Interconvert molecules from Fischer to Sawhorse to Newman projection
- Determine configurations of simple chiral molecules
- Distinguish between conformations and configuration
- Draw the different conformations of ethane, propane and butane and compare their stability

Reference Books :

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University Press (2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd., New Delhi (2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series (2006).

10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
 11. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
 12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan(2000).
 13. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
 14. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
 15. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
 16. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
 17. Rodger, G.E. Inorganic and Solid-State Chemistry, Cengage Learning India Edition, 2002.
 18. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
 19. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd.(Pearson Education).
 20. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
 21. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London,1994.
 22. Kalsi, P.S.StereochemistryConformationandMechanism,NewAgeInternational, 2005.
 23. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
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PRACTICALS

SEMESTER : I

Paper- I

COURSE CODE: VGVUSMCHP101

CREDITS: 02

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1. To determine the rate constant for the hydrolysis of ester using HCl as catalyst.
 2. To determine enthalpy of dissolution of salt (like KNO_3)
 3. **Commercial analysis of (any two)**
 - a. Mineral acid
 - b. Organic acid
 4. Gravimetric analysis
 - a. To determine the percent purity of sample of BaSO_4 containing NH_4Cl
 - b. To determine the percent purity of ZnO containing ZnCO_3 .
 5. **Characterization of organic compound containing C, H, (O), N, S, X elements.**
(minimum 6 compounds : only solids)
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Reference Books :

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi(2011).
 2. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001).
 3. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.
 4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education(2009)
 5. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson(2012)
 6. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996
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SEMESTER : II**Course content - Semester II**

Course Code	Unit	Topics	Credits	L/Week
VGVUSNCH201	I	<ul style="list-style-type: none">• Gaseous State• Chemical Equilibria and Thermodynamic Parameters	02	02
	II	<ul style="list-style-type: none">• Concept of Qualitative Analysis• Acid Base Theories• Chemical Bond and Reactivity.		
	III	<ul style="list-style-type: none">• Alkanes, Alkenes, Alkynes• Aromatic Hydrocarbons		
VGVUSNCHP201		Chemistry Practical II	02	04

F. Y. B. Sc. CHEMISTRY : Choice Based Credit System				
Semester II				
PAPER : II				
Course Name: General Chemistry -II (45 lectures)		Course Code: VGVUSNCH201		
Periods per week (1 period 60 minutes)		02		
Credits		02		
Evaluation System			Hours	Marks
	Theory Examination		2.0	60
	Theory Internal			40
				No. of lectures
Unit I	1.1 Gaseous State			05
	<p>1.1.1 Ideal gas laws, kinetic theory of gases, Maxwell-Boltzmann's distribution of velocities (qualitative discussion), ideal gases, real gases, compressibility factor, Boyle's temperature (Numerical expected).</p> <p>1.1.2 Deviation from ideal gas laws, reasons for deviation from ideal gas laws, Van der Waals equation of state, Joule-Thomson effect: qualitative discussion. inversion temperature. (Numerical expected).</p> <p>1.1.3 Critical Phenomenon, critical constants of a gas in terms of van der Waal's constants.</p>			
Unit I	1.2 Chemical Equilibria and Thermodynamic Parameters			05
	1.2.1 Reversible and irreversible reactions, law of mass action, dynamic equilibria, equilibrium constant, (K_c and K_p), relationship between K_c and K_p ,			
	1.2.2 Le Chatelier's principle, factors affecting chemical equilibrium (Numerical expected)			
	1.2.3 Statement of second law of thermodynamics, concepts of entropy and free energy, spontaneity and physical significance of free energy, thermodynamic derivation of equilibrium constant (Numerical expected)			
Unit II	2.1 Concept of Qualitative Analysis			03
	Precipitation equilibria, effects of common ions, uncommon ions, oxidation states, buffer action, solubility product, complexing agents on precipitation of ionic compounds.(Balanced chemical equations and numerical problem			
	2.2 Acid Base Theories : Arrhenius, Lowry – Bronsted, Lewis, Solvent-Solute concept of acids and bases, Hard and soft acid and bases. Application of HSAB.			03
	2.3 Chemical Bond and Reactivity			
Types of Chemical bond : Comparison between Ionic and Covalent bond. Fajan's rules, Lewis electron dot structure			04	
2.2.3. Sidgwick - Powell Theory, VSEPR theory for AB_n with and without				

	Lone pairs of electrons, Limitations of VSEPR theory	
Unit III	<p>3.1 Chemistry of alkanes:</p> <p>3.1.1 Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, 3.1.2 Free radical Halogenation (mechanism expected) including relative reactivity and selectivity.</p> <p>3.2 Chemistry of alkenes:</p> <p>3.2.1 Formation of alkenes by elimination reactions 3.2.2 Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. 3.2.3 Reactions of alkenes: Mechanism of Polar and Non polar addition, allylic and benzylic bromination using N-Bromo succinimide (no mechanism) 3.2.4 Mechanism of oxymercuration - demercuration, hydroboration-oxidation 3.2.5 Ozonolysis, reduction; hydroxylation 3.2.6 Dienes: classification as isolated, conjugated and cumulenes; 1, 2 and 1, 4- addition reactions in conjugated dienes (with mechanism) and, Diels-Alder reaction (No mechanism).</p> <p>3.3 Chemistry of Alkynes</p> <p>3.3.1 Formation of alkynes 3.3.2 Reactions of alkynes: Acidity, Electrophilic addition reactions. Hydration of alkynes, Alkylation of terminal alkynes.</p> <p>3.4 Aromatic Hydrocarbons</p> <p>3.4.1 Aromaticity :Huckel's rule of aromaticity ; benzenoid and non benzenoid aromatic compounds 3.4.2 Antiaromatic and non aromatic compounds with suitable examples 3.4.3 General mechanism of electrophilic aromatic substitution: Friedel Craft alkylation /acylation with their mechanism. 3.4.4 Activating / deactivating effects and orienting effects in substituted benzenes Note: Synthesis of simple substituted aromatic compounds based on orienting and activating/deactivating effects is expected)</p>	<p>02</p> <p>02</p> <p>02</p> <p>04</p>

Learning Outcomes:

- At the end of this module, the learner should be able to
- Explain reasons for deviation of gases from ideal behaviour
 - Derive Van der Waal's equation
 - Deduce relationship between K_p and K
 - Interpret concepts of entropy, free energy and spontaneity
 - Identify various types of qualitative analysis.
 - Describe ionic product and solubility product.
 - Calculate the solubility product and ionic product.
 - Identify common ion and uncommon ion effect.
 - Explain the Arrhenius, Lowry Bronsted and Lewis concept of acids and bases.
 - Define HSAB concept.
 - Identify Hard, Border line, Soft acids and bases..

- Apply HSAB concept to explain stability of compounds.
- Application of Fajan's rules to explain properties of ionic compounds.
- Predict the shapes of molecules based on VSEPR theory.
- Summarize the different methods for the synthesis of alkanes, alkenes, dienes and alkynes
- Design synthesis of simple saturated and unsaturated hydrocarbons
- Write mechanisms for simple organic reactions of hydrocarbons.
- Explain electrophilic aromatic substitution reactions and their mechanism
- Predict the reactivity and outcome of electrophilic aromatic substitution reactions in substituted benzene
- Design synthesis of multifunctional aryl compounds based on the orienting effects of substituents.

Reference Books :

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press(2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India(2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa(2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP(2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson(2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
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8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill(2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series(2006).
10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP(2009).
11. Banwell C.N.,Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).
13. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
14. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
15. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
16. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.
17. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
18. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
19. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (PearsonEducation).
20. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London,1994.
21. Kalsi, P. S. Stereochemistry Conformation and Mechanism, NewAgeInternational, 2005.
22. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

PRACTICALS
SEMESTER : II

Paper- II

COURSE CODE: VGVUSMCHP201

CREDITS: 02

1. Qualitative analysis: (at least 6 mixtures to be analyzed)

Semi-micro inorganic qualitative analysis of a sample containing two cations and two anions.

Cations (from amongst):

Pb²⁺, Ba²⁺, Ca²⁺, Sr²⁺, Cu²⁺, Cd²⁺, Fe²⁺, Ni²⁺, Mn²⁺, Mg²⁺, Al³⁺, Cr³⁺, K⁺, NH⁴⁺

Anions (From amongst):

CO₃²⁻, S²⁻, SO₄²⁻, NO₂⁻, NO₃⁻, Cl⁻, Br⁻, I⁻, SO₄²⁻, PO₄³⁻

(Scheme of analysis should avoid use of sulphide ion in any form for precipitation / separation of cations.)

2. Titration using double indicator:

Analysis of solution of Na₂CO₃ and NaHCO₃.

3: Organic Chemistry

Characterization of organic compound containing C, H, (O), N, S, X elements.

(minimum 6 compounds only liquid compounds)

Reference Books :

1. A. I. Vogel's *Qualitative Chemical Analysis 6th Ed.*, Pearson, 2009.
 2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education(2009)
 3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry*, 5th Ed., Pearson(2012)
 4. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P. W. G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996
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Proposed Draft Syllabus for F.Y. B. Sc. Chemistry

Semester I and II

Choice Based Credit System (NEP 2020)

(To be implemented from the academic year, 2023-2024)

Vocational skill enhancement Courses (VSC)

Semester – I

Paper I

Course Code: VGVUSVS102

Credits: 2

F. Y. B. Sc. CHEMISTRY : Choice Based Credit System				
Semester I				
PAPER : Vocational Skill Enhancement Courses (VSC-I)				
Course Name: Introduction to Practical Chemistry ((30 lectures)		Course Code VGVUSVS102		
Periods per week (1 period 60 minutes)		02		
Credits		02		
Evaluation System			Hours	Marks
	Theory Examination		2.0	60
	Theory Internal			40
				No. of Period
Unit I	1.1 Chemistry Laboratory Safety 05 Hrs Fire Hazards: Causes of fires, classification of fires, fire prevention protocols and measures, fire alarms, fire escapes, fire Extinguishers and their uses. Chemical Hazards: Classification and handling of hazardous chemicals, storage of chemicals, transfer from large containers Gas Hazards: usage of LPG and CNG safer in the laboratory, detection and handling of Gas Leakage, health hazards of gases			15 Hrs
	1.2 Stoichiometry - I 10 Hrs 1.2.1 Mole concept and Avogadro's constant. 1.2.2 Expressing concentration of solutions: Normality, molality, molarity, formality, mole fractions, weight ratio, volume ratio, weight to volume ratio, ppm, ppb, millimoles, milliequivalents Concept of primary and secondary standard substances, Preparation of standard solution			

SEM-I
Course Code: VGVUSVSP102
Credits: 2
Introduction to Practical Chemistry (Practical)

60 Hrs

1. Calibration of Burettes, pipettes and Standard flask
2. To prepare 0.1 N succinic acid and standardize the NaOH of two different concentrations.
3. To standardize commercial sample of HCl using borax
4. Prepare Material Safety Data Sheet (MSDS) for commonly used Chemicals
5. Chromatography
 - a) Separation of a mixture of two sugars by ascending paper chromatography
 - b) Separation of a mixture of o- and p-nitrophenols by using thin layer chromatography (TLC)
6. Purification of any four organic compounds by recrystallization selecting suitable solvent. **(Provide 1 g.)**

Learners are expected to report

 - a) Solvent for recrystallization.
 - b) Mass and the melting points of purified compound.

References

1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels, 3rd Ed. ELBS (1964)
 2. Vogel's textbook of quantitative chemical analysis, Sixth Ed. Mendham, Denny, Barnes, Thomas, Pearson education
 3. Standard methods of chemical analysis, F. J. Welcher
 4. Experimental Physical Chemistry, V.D. Athawale and P. Mathur, New Age International Publishers, 2001.
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References

1. D. A. Skoog, D. M. West, F. J. Holler, and S. R. Crouch, Analytical Chemistry: An Introduction, 7th ed., Chapter 15, pp.345-381.
2. A.I. Vogel. "Textbook of Quantitative Inorganic Analysis," Longman, London (1961).
3. Some Experiments for B. Tech in Chemistry & Chemical Technology compiled by Prof. J.B.BARUAH, Mrs. Abhilasha Mohan Baruah and Mr. Parikshit Gogoi.

Course Outcomes:

Upon completion of the course:

The learner shall be able to:

1. Learners will develop a practical hand in titrations
2. Learners will understand the important aspects of acid–base and redox titrations.
3. Learners will gain expertise in handling colorimetry and Ph-metry
4. Learners will be able to identify all the apparatus and instruments used in chemical analysis
5. Learners will gain expertise in gravimetric analysis.

SEM-II

Course Code: VGVUSSEP202

Credits: 2

Practical

Skill Enhancement Courses (SEC)

1. To determine the percentage of copper (II) present in a given sample by titration against a standard aqueous solution of sodium thiosulfate (iodometry titration)
2. To determine amount of Fe(II) in given sample by redox titration using KMnO_4
3. To determine amount of oxalic acid in given sample by redox titration using KMnO_4
4. To determine amount of barium ion in the given solution gravimetrically
5. To determine amount of Fe (II) in the given solution Gravimetrically
6. To verify Beer-Lambert's law, using KMnO_4 solution by colorimetric method
7. To determine dissociation constant of weak acid (K_a) using Henderson's equation and the method of incomplete titration pH metrically.

References

1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels, 3rd Ed. ELBS (1964)
 2. Vogel's textbook of quantitative chemical analysis, Sixth Ed. Mendham, Denny, Barnes, Thomas, Pearson education
 3. Standard methods of chemical analysis, F. J. Welcher
 4. Experimental Physical Chemistry, V.D. Athawale and P. Mathur, New Age International Publishers, 2001
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Syllabus for F.Y. BA/B.Com. Students
Semester I and II
Choice Based Credit System (NEP 2020)
(To be implemented from the academic year, 2023-2024)

Open Elective Courses (OE)

Semester – I

Paper I

Course Code: VGVUOE103

Credits: 3

(Open Elective Paper - 1) : Chemistry in Daily Life -I

Unit 1	<p>Cosmetics</p> <p>1.1 Definition and Importance of Cosmetics</p> <ul style="list-style-type: none">• Introduction to cosmetics and their significance in everyday life.• Explanation of the purpose and benefits of using cosmetic products. <p>1.2 Chemistry in Cosmetics</p> <ul style="list-style-type: none">• Overview of the chemistry involved in cosmetic products.• Discussion of the interaction between cosmetic ingredients and the human body.• Highlighting the role of chemical formulation in achieving desired cosmetic effects. <p>Application of Cosmetics</p> <p>Face Powder</p> <p>Introduction to Face Powder</p> <ul style="list-style-type: none">• Explanation of the purpose and usage of face powder in cosmetics.• Overview of different types and forms of face powder available in the market. <p>Introduction to Sunscreen</p> <ul style="list-style-type: none">• Importance of sunscreen in protecting the skin from harmful UV radiation.• Explanation of the different types of UV radiation and their effects on the skin. <p>Introduction to Perfumes</p> <ul style="list-style-type: none">• Significance of perfumes in the cosmetic industry and personal grooming.• Explanation of how perfumes can evoke emotions and enhance individuality.	15 Hrs
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Unit 2	<p>Safety and Regulations in the Cosmetic Industry</p> <ul style="list-style-type: none"> • Introduction to the regulations and safety considerations in the cosmetic industry. • Explanation of the role of regulatory agencies in ensuring product safety. • Discussion of labeling requirements, product testing, and quality control measures. <p>Introduction to Cosmetic Safety and Regulations</p> <p>Common Cosmetic Allergens and Sensitizers</p> <ul style="list-style-type: none"> • Discussion of common allergens and sensitizers found in cosmetics. • Explanation of how certain ingredients can trigger allergic reactions in sensitive individuals. <p>Testing and Labeling Requirements</p> <ul style="list-style-type: none"> • Elaboration on the importance of testing cosmetic products for safety and efficacy. • Overview of labeling requirements, including ingredient lists, warnings, and usage instructions. <p>Product Claims and Consumer Education</p> <ul style="list-style-type: none"> • Discussion of the importance of accurate product claims and the prevention of misleading advertising. • Highlighting the role of consumer education in making informed choices about cosmetic products. 	15 Hrs
Unit 3	<p>Pharmaceutical Products</p> <p>3.1 Introduction to Pharmaceuticals and Drugs</p> <ul style="list-style-type: none"> • Definition & Importance of Pharmaceuticals in Healthcare • Commonly Used Pharmaceuticals and Drugs <p>3.2 Drug Abuse & Addiction</p> <ul style="list-style-type: none"> • Types of drugs abused • Action against drug abuse • Understanding tolerance of drug abuse <p>3.3 Advantages & Disadvantages</p> <ul style="list-style-type: none"> • Effect on life • Effect on finance • Impact on environment 	15 Hrs

Learning Outcomes:

On studying the syllabi, the learner will be able to

1. Define the cosmetics,
2. Distinguish between various types of cosmetic, identify various formulations in cosmetics.
3. Understand side effects of cosmetics.

4. Learn application of cosmetics
5. Awareness on safety and regulations.
6. Learn labeling and efficacy.
7. Get educated on claims about the products.
8. Consumer education.
9. Describe importance of drugs and pharmaceutical products.
10. Understand the process of drug abuse and addiction.
11. Determine the advantages and disadvantages of pharmaceutical products.

Reference Books :

1. Article: Gruber, J. V., &Schlossman, M. L. (Eds.). (2015). Introduction to Cosmetic Formulation and Technology. Wiley.
 2. Article: Gruber, J. V., Schlossman, M. L., &Rosoff, A. L. (2018). The Chemistry and Manufacture of Cosmetics. Volume II. Formulating. CRC Press.
 3. Book: Shaath, N. A. (2005). Sunscreens: Regulations and Commercial Development (3rd ed.). Taylor & Francis.
 4. Book: Edwards, D. (1997). The Chemistry of Fragrances: From Perfumer to Consumer. Royal Society of Chemistry
 5. Book: Barel, A. O., Paye, M., &Maibach, H. I. (Eds.). (2009). Handbook of Cosmetic Science and Technology (3rd ed.). CRC Press.
 6. Book: Schlossman, M. L., Gruber, J. V., &Kanerva, L. (2015). Safety Evaluation of Cosmetics and Personal Care Products: Handbook of Experimental Pharmacology (Vol. 226). Springer.
 7. The Chemistry of Pharmaceuticals and Drugs" by David E. Newton - This book provides an introduction to the chemistry of pharmaceuticals and their development.
 8. The Drug Book: From Arsenic to Xanax, 250 Milestones in the History of Drugs" by Michael C. Gerald - This book presents a historical overview of drugs and their impact on society.
 9. The Essential Guide to Prescription Drugs" by James J. Rybacki and James W. Long - A comprehensive guide to understanding prescription drugs, their uses, and potential side effects.
 10. Drugs: From Discovery to Approval" by Rick Ng - This book explains the process of drug discovery, development, and regulatory approval.
 11. The Science of Drugs" by Leslie A. Mertz - A book that explores the science behind drugs and their effects on the human body.
 12. Pharmaceutical Sciences" by Remington, Paul Beringer - While this is a more advanced textbook, it covers various aspects of pharmaceutical sciences and drug development.
 13. Pharmaceutical Calculations" by Howard C. Ansel - This book introduces students to the calculations involved in pharmacy practice.
 14. Drugs and the Human Body: With Implications for Society" by Ken Liska - An informative book that examines how drugs interact with the human body and their societal implications.
 15. Drugs and Medicines" by Tom Jackson - A visually engaging book that covers various drugs and medicines used in healthcare.
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Semester – I

Paper I

Course Code: VGVUOE103

Credits: 2

Practical

(Open Elective: Chemistry in Daily Life -I)

1. To Prepare aloevera gel
2. To Prepare hair oil
3. To Prepare face pack
4. To Prepare lip balm
5. To Prepare hand sanitizer
6. To Prepare talcum powder
7. To detect presence of iron filings in tea powder
8. To determine the pH of different shampoos and check the stability of the foam
9. To detect impurities in asafoetida (hing)
10. To analyze presence of Vitamin C in supplied fruit juice sample

Reference

1. Harry Cosmetology
 2. New Cosmetic Science
 3. Cosmetology by P.P. Sharma
 2. Hand book of Zoology, V.G.Vaze College
 3. Facts on file science experiments by Pamela Walker and Elaine Wood.
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Semester – II

Paper I

Course Code: VGVUOE202

Credits: 3

(Open Elective Paper - 1) : Chemistry in Daily Life-II

Unit 1	Introduction to Chemistry in Food Overview of the Importance of Chemistry in Our Daily Lives <ul style="list-style-type: none">• Explain the relevance of chemistry in our everyday lives, with a focus on the role of chemistry in food. Chemical Components of Food <ul style="list-style-type: none">• Provide an overview of the major chemical components of food:• Carbohydrates: Discuss their role as a source of energy and structural components in food.• Proteins: Explain their importance in building and repairing tissues, as well as their role as enzymes and hormones (General Explanation).• Lipids: Discuss the functions of lipids as a concentrated source of energy, insulation, and cell membrane components (General Explanation).• Vitamins and Minerals: Highlight the importance of these micronutrients for various physiological processes (General Explanation). The Role of Chemistry in Food Processing and Preservation <ul style="list-style-type: none">• Explain how chemistry is involved in food processing and preservation techniques:• Heat-based methods: Discuss the chemical changes that occur during cooking, such as denaturation and caramelization.• Chemical additives: Introduce common food additives and their functions, such as antioxidants, stabilizers, and flavor enhancers.• Food preservation methods: Explore chemical processes involved in canning, freezing, and drying, and their impact on food quality and safety. Chemical Reactions in Food <ul style="list-style-type: none">• Discuss key chemical reactions that occur in food:• Maillard reaction: Explain the interaction between proteins and reducing sugars during cooking, leading to flavor and color formation.• Oxidation reactions: Explore the role of oxygen in food spoilage and discuss methods to prevent oxidative deterioration.• Fermentation: Introduce the process of fermentation and its role in the production of various foods, such as bread, yogurt, and cheese.	15 Hrs
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Unit 2	<p>Beverages</p> <p>Introduction to Beverages</p> <ul style="list-style-type: none"> • Define beverages and their significance in our daily lives. • Discuss the different types of beverages and their cultural and social importance. <p>Juices and Nectars</p> <ul style="list-style-type: none"> • Explore the chemistry of fruit and vegetable juices. • Discuss the extraction processes, including pressing, pulping, and enzymatic methods. • Highlight the nutritional value, and health benefits of juices and nectars. <p>Soft Drinks: Carbonation and Flavor</p> <ul style="list-style-type: none"> • Explain the process of carbonation and its role in creating effervescence and refreshing mouthfeel in soft drinks. • Discuss the chemistry behind different flavors and additives used in soft drinks. • Address the impact of excessive soft drink consumption on health, including dental issues and obesity. <p>Coffee Chemistry: From Beans to Brew</p> <ul style="list-style-type: none"> • Explore the chemical compounds present in coffee beans, such as caffeine, chlorogenic acids, and melanoidins. • Discuss the roasting process and its impact on coffee flavor and aroma. <p>Tea Chemistry: The Art of Infusion</p> <ul style="list-style-type: none"> • Discuss the chemical components of tea leaves, including catechins, theaflavins, and caffeine. • Explain the process of tea infusion and the factors influencing tea strength and flavor. • Highlight the health benefits associated with tea consumption, including antioxidant properties and potential disease prevention. <p>Alcoholic Beverages: Fermentation and Distillation</p> <ul style="list-style-type: none"> • Explain the fermentation process and the role of yeast in alcohol production. • Discuss the chemical reactions involved in the conversion of sugars to ethanol during fermentation. • Address the distillation process and its impact on alcohol content and flavor. <p>Wine Chemistry: Grapes and Aging</p> <ul style="list-style-type: none"> • Explore the chemical composition of grapes and their influence on wine flavor and aroma. • Discuss the role of fermentation, yeast strains, and aging techniques in wine production. • Address the chemistry behind wine aging and the development of desirable characteristics. 	15 Hrs
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<p>Unit 3</p>	<p>Food Additives and Preservatives and Food Adulteration</p> <p>Introduction to Food Additives</p> <ul style="list-style-type: none"> • Define food additives • Discuss the reasons for using food additives, such as enhancing flavor, improving texture, and extending shelf life. <p>Common Food Additives and Their Functions</p> <ul style="list-style-type: none"> • Colorants: Explore natural and synthetic colorants used in food products and their role in enhancing visual appeal. • Flavorings: Discuss natural and artificial flavorings used to impart specific tastes and aromas to food. • Preservatives: Explain the role of preservatives in inhibiting microbial growth and extending the shelf life of food. • Emulsifiers: Introduce emulsifiers and their function in stabilizing mixtures of immiscible substances, such as oil and water. • Stabilizers and thickeners: Discuss the use of stabilizers and thickeners to improve the texture, consistency, and mouthfeel of food products. <p>Food Preservation Methods</p> <ul style="list-style-type: none"> • Canning: Explain the principles of canning as a food preservation method, including sterilization, sealing, and the use of heat-resistant containers. • Freezing: Discuss the effects of low temperatures on microbial growth and enzymatic activity, leading to food preservation. • Drying: Explore different drying methods (e.g., sun drying, freeze-drying) and their impact on moisture removal and food preservation. • Chemical preservatives: Address commonly used chemical preservatives, such as sulfites and nitrites, and their role in preventing spoilage and food borne illnesses. <p>Understanding Food Adulteration</p> <ol style="list-style-type: none"> a. Define food adulteration and its implications on food safety and consumer health. <p>Common Types of Food Adulterants</p> <ol style="list-style-type: none"> a. Filling agents: Explain the use of fillers and extenders to increase the quantity of food products while reducing costs. b. Synthetic additives: Discuss the inclusion of artificial substances, such as flavorings and colorants, to mimic natural ingredients. c. Mislabeling: Address the practice of misleading labeling, where inferior or cheaper ingredients are presented as higher quality or more expensive ones. d. Contamination: Explore issues of microbial contamination, pesticide residues, and presence of heavy metals in food. <p>Health Implications of Adulteration</p> <ol style="list-style-type: none"> a. Discuss the potential health risks associated with consuming adulterated fast food, such as foodborne illnesses, allergic reactions, and long-term health effects. 	<p>15 Hrs</p>
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Learning Outcomes:

On studying the syllabi, the learner will be able to

- Relate chemistry in everyday life
 - Identify different composition of food products
 - Learn the Role of Chemistry in Food Processing and Preservation
 - Identify the chemical Reactions in Food
 - Understand the beverages and their significance in daily life
 - Classify different type of juices
 - Understand the process of fermentation and distillation
 - Learn industrial application of grapes and aging process for beverages
 - Understand the process of food additives, preservatives and adulteration
 - Identify the common food additives and their functions
 - Learn different food preservation methods
 - Learn different food adulteration and their implications
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Reference

1. Book: Tanford, C., & Reynolds, J. A. (2001). Nature's Robots: A History of Proteins. Oxford University Press
 2. Book: Asmus, K. D., & Sheldon, R. A. (Eds.). (2007). Click Chemistry in Glycoscience: New Developments and Strategies. John Wiley & Sons
 3. Food Chemistry" (5th Edition) Author: Owen R. Fennema, Fidel Toldra, Michael D. Guisti, Y.H. Hui Publisher: CRC Press Year: 2016 ISBN-13: 978-1498744867
 4. Chemistry of Beverages" Author: James F. Parcher, James R. Casey Publisher: Wiley-Interscience Year: 2008 ISBN-13: 978-0470074731
 5. Beverage Quality and Safety" (2nd Edition) Author: Ted Wilson, Paul J. Brereton, David Kilcast Publisher: Woodhead Publishing Year: 2011 ISBN-13: 978-1845696760
 6. Beverage Science and Technology" Author: S. Suzanne Nielsen Publisher: Springer Year: 2016 ISBN-13: 978-1493936972
 7. Handbook of Alcoholic Beverages: Technical, Analytical, and Nutritional Aspects" (2nd Edition) Editor: Alan J. Buglass Publisher: John Wiley & Sons Year: 2011 ISBN-13: 978-0470512023
 8. Food Additives" (2nd Edition) Author: A.M. Smith, A.B. Hocking Publisher: Springer Year: 2017 ISBN-13: 978-1493932554
 9. Handbook of Food Additives" (3rd Edition) Editor: Michael Ash Publisher: CRC Press Year: 2008 ISBN-13: 978-1847350386
 10. Food Additives Data Book" Author: Jim Smith, Lily Hong-Shum Publisher: Wiley-Blackwell Year: 2011 ISBN-13: 978-1405172328
 11. Food Additives: A Shopper's Guide to What's Safe & What's Not" Author: Christine Hoza Farlow Publisher: Square One Publishers Year: 2017 ISBN-13: 978-0757004132
 12. Handbook of Food Additives: Revised and Expanded" (2nd Edition) Editors: Michael Ash, Irene Ash Publisher: CRC Press Year: 2008 ISBN-13: 978-0849319851
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Semester – I

Paper I

Course Code: VGVUOE202

Credits: 2

Practical

(Open Elective: Chemistry in Daily Life -II)

1. To identify the adulterants in the given sample of milk
2. To check the presence of casein in the milk
3. To identify the adulterants in cheese, butter and ghee
4. To identify the adulterants in jaggery and honey
5. To detect sulphates in shampoo samples
6. To detect presence of ammonia in hair dye
7. To test the physical barrier (water resistance) of sunscreen
8. To check the gas content in deodorant
9. To analyse and process the hard water into soft water
10. Preparation of soap

References

1. Manual of Methods of analysis of foods, food additives – 2016 (fssai).
2. Facts on file science experiments by Pamela Walker and Elaine Wood.

