**UGC CBCS**

**UG COURSE CURRICULUM**

**AND**

**SYLLABI**

**(As per UGC’s Draft Model**

**Syllabi)**

**(PROPOSED SCHEME)**

**CHEMISTRY**

**UGC’s Draft Model Syllabi)**

**(PROPOSED SC**

**HEME)**

***NORTH LAKHIMPUR COLLEGE***

***(AUTONOMOUS)***

SYLLABUS

FOR

UNDER GRADUATE (UG) COURSE

IN

CHEMISTRY

(HONOUR S & PASS)

UND ER

CHOICE BASED CREDIT SYSTEM

NORTH LAKHIMPUR COLLEGE

2019

**CBCS**

**UG - SY LLABI**

**CHEMISTRY**

**(DSE)**

CBCS: B. Sc. (Honours) with CHEMISTRY

**Discipline Specific Elective (DSE) Course**

CHEMISTRY

(Honours)

**(5th Semester)**

**Course Code: CHE-DS-T4-501**

 *(Analytical Methods in Chemistry)*

**Contact Hours: 60**

**Full Marks = 70 [** End Semester Exam (56) Internal Assessment (14)**]**

**Objective of the Course:** To develop a strong knowledge on spectroscopy, qualitative and

quantitative aspects of analysis and thermal analysis.

**Expected Learner Outcome: Students will gain an understanding of**

i. The principles and applications of modern chemical instrumentation, experimental design and data analysis.

ii. The composition of written laboratory reports that summarize experimental procedures and the accurately present and interprete data

iii. Qualitative and quantitave aspect of solvent extraction, chromatographic method of analysis -TLC & HPLC

**Unit I: Qualitative and quantitative aspects of analysis**

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals**.**

**5 Lectures, Marks - 4**

**Unit II: UV-Visible and IR Spectrometry**

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert’s law.

*UV-Visible Spectrometry*: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job’s method of continuous variation and mole ratio method.

*Infrared Spectrometry*: Basic principles of instrumentation (choice of source, monochromator

& detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, effect and importance of isotope substitution.

*Flame Atomic Absorption and Emission Spectrometry:* Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

**25 Lectures, Marks - 25**

**Unit III: Thermal Methods of analysis:**

Theory of thermo-gravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

**5 Lectures, Marks - 4**

**Unit IV:Electro-analytical methods**

Classification of electro-analytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points.Techniques used for the determination of pKa values.

**10 Lectures, Marks - 8**

**Unit V: Separation techniques**

*Solvent extraction*: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aueous solution, extraction of organic species from the aqueous and non-aqueous media.

*Chromatography*: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: TLC and HPLC.

**15 Lectures, Marks - 15**

**Reference Books:**

**1.** Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed., The English Language Book Society of Longman.

**2.** Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed., Wardsworth Publishing Company, Belmont, California, USA, 1988.

**3.** Christian, Gary D; Analytical Chemistry, 6th Ed., John Wiley & Sons, New York, 2004.

**4.** Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W. H. Freeman, 2001.

**5.** Khopkar, S. M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

**6.** Skoog, D. A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.

**7.** Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.

**8.** Ditts, R.V. Analytical Chemistry - Methods of separation.

**9.** Skoog, Douglas A., West, Donald M., Holler, F. James and Crouch, Stanley R. Fundamentals of Analytical Chemistry, 9th Edition.

CBCS: B. Sc. (Honours) with CHEMISTRY

**Discipline Specific Elective (DSE) Course**

CHEMISTRY

(Honours)

**(5th Semester)**

**Course Code: CHE-DS-P2-501**

*Analytical Methods in Chemistry*

**Contact Hours: 60**

**Full Marks = 30 [** End Semester Exam (24) Internal Assessment (6)**]**

***Time: 6 hours***

**A. *Any 2 (two) experiments to be set in examination* Marks - 10×2=20**

i) Paper chromatographic separation of Fe3+, Al3+, Cr3+, Ag+, Hg22+, and Pb2+

ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.

iii) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.

iv) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

v) Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

vi) Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

vii) Analysis of soil: determination of pH of soil, total soluble salt, estimation of calcium, magnesium, phosphate, nitrate

viii) Separation of metal ions from their binary mixture.

ix) Separation of amino acids from organic acids by ion exchange chromatography.

x) Determination of dissolved oxygen in water.

xi) Determination of chemical oxygen demand (COD).

xii) Determination of Biological oxygen demand (BOD).

**B. Viva - voce Marks - 4**

**Reference Books:**

**1.** Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G. H. Jeffery and others) 5th Ed., The English Language Book Society of Longman.

**2.** Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed., Wardsworth Publishing Company, Belmont, California, USA, 1988.

**3.** Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

CBCS: B. Sc. (Honours) with CHEMISTRY

**Discipline Specific Elective (DSE) Course**

CHEMISTRY

(Honours)

**(5th Semester)**

**Course Code: CHE-DS-T4-502**

*(Inorganic Materials of Industrial Importance)*

**Contact Hours: 60**

**Full Marks = 70 [**End Semester Exam (56) Internal Assessment (14)**]**

**Objective of the Course:** To learn about fertilizers, surface coating, silicate industries, batteries etc.

**Expected Learner Outcome: Students will gain an understanding of**

i. Properties and the types of different glasses, ceramics and cements

ii. Different types and manufacture of fertilizers, composition of paint pigments.

iii. Working principle of different batteries, elements present in alloys, different types of steel etc.

**Unit I: Silicate Industries**

*Glass*: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

*Ceramics*: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

*Cements*: Classification of cement, ingredients and their role, Manufacture of cement and the

setting process, quick setting cements.

**16 Lectures, Marks - 15**

**Unit II: Fertilizers**

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.

**8 Lectures, Marks - 8**

**Unit III: Surface Coatings**

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings, metal spraying and anodizing.

**10 Lectures, Marks - 8**

**Unit IV: Batteries**

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

**6 Lectures, Marks - 5**

**Unit V: Alloys**

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon, decarbonization, demanganization, desulphurization, dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

**10 Lectures, Marks - 10**

**Reference Books:**

**1.** E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.

**2.** R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.

**3.** W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.

**4.** J. A. Kent: Riegel’s Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

**5.** P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.

**6.** R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.

**7.** B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meerut.

CBCS: B. Sc. (Honours) with CHEMISTRY

**Discipline Specific Elective (DSE) Course**

CHEMISTRY

(Honours)

**(6th Semester)**

**Course Code: CHE-DS-P2-502**

 *(Inorganic Materials of Industrial Importance)*

**Contact Hours: 60**

**Full Marks = 30 [** End Semester Exam (24) Internal Assessment (6)**]**

***Time: 6 hours***

**A. *Any 2 (two) experiment to be set in examination* Marks - 10x2=20**

*a.* Determination of free acidity in ammonium sulphate fertilizer.

*b.* Estimation of Calcium in Calcium ammonium nitrate fertilizer.

*c.* Estimation of phosphoric acid in superphosphate fertilizer.

*d.* Electroless metallic coatings on ceramic and plastic material.

*e.* Determination of composition of dolomite (by complexometric titration).

*f.* Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.

*g.* Analysis of Cement.

*h.* Preparation of pigment (zinc oxide).

**B. Viva – voce Marks - 4**

**Reference Books:**

**1.** E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.

**2.** R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.

**3.** W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.

**4.** J. A. Kent: Riegel’s Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

**5.** P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.

**6.** R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.

**7.** B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meerut.

CBCS: B. Sc. (Honours) with CHEMISTRY

**Discipline Specific Elective (DSE) Course**

CHEMISTRY

(Honours)

**(6th Semester)**

**Course Code: CHE-DS-T4-601**

 *(Industrial Chemicals and Environment)*

**Contact Hours: 60**

**Full Marks = 70 [** End Semester Exam (56) Internal Assessment (14)**]**

**Objective of the Course:** To impart knowledge about nuclear pollution, ecosystem, handling of industrial gases, semi conductor technology etc.

**Expected Learner Outcome: Students will gain an understanding of**

i. Stored and handle different types of industrial gases and chemicals

ii. Semiconductor technology

iii. The effect of hazardous chemicals, purification method of water and industrial waste management.

**Unit I: Industrial Gases and Inorganic Chemicals**

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: Oxygen, nitrogen, argon, neon,helium, hydrogen, acetylene, crbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene. Inorganic materials: Manufacture, application, analysis, and hazards in handling of the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

**10 Lectures, Marks - 10**

**Unit II: Industrial Metallurgy**

Preparation of metals (ferrous and non ferrous) and ultrapure metals for semiconductor technology.

**4 Lectures, Marks - 4**

**Unit III: Environment and its segments**

Ecosystem, Biogeochemical cycles of carbon, nitrogen and sulphur.

*Air Pollution*: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources,particle size and chemical nature. Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, major sources of air pollution. Pollution by SO2, CO2, CO, NOx, H2S and other foul smeling gases, Methods of estimation of CO, NOx, SOx and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone Letion by oxides of nitrogen, chlorofluorocarbons and halogens, removal of sulphur from coal. Control of particulates.

*Water pollution*: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature

of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on

hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile. Tannery, diary, petroleum and petrochemicals, agro, fertilizers etc. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (Reverse osmosis, electro dialysis, ion-exchange). Water quality parameters for waste watter, industrial water and domestic water.

**30 Lectures, Marks - 30**

**Unit IV: Energy & Environment**

*Sources of energy*: Coal, petrol and natural gas. Nuclear Fusion/ Fission, Solar energy, Hydrogen, Geothermal, Tidal and Hydel etc.

*Nuclear pollution*: Disposal of nuclear waste, nuclear disaster and its management.

**10 Lectures, Marks - 8**

**Unit V: Biocataysis**

*Introduction to biocatalysis*: Importance in “ Green Chemistry” and “ Chemical Industry”

**6 Lectures, Marks - 4**

**Reference Books:**

**1.** E. Stocchi: *Industrial Chemistry*, Vol-1, Ellis Horwood Ltd, UK.

**2.** R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi

**3.** J. A. Kent: Riegel’s *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi

**4.** S.S.Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd, New Delhi

**5.** K.De, *Environmental Chemistry*: New Age International Pvt. Ltd., New Delhi

**6.** S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi

**7.** S.E. Manahan, *Environmental Chemistry*, CRC Press (2005)

**8.** G. T. Miller, *Environmental Science*, 11th Ed. Brooks/ Cole(2006)

**9.** A. Mishra, *Environmental Studies*. Selective and Scientific Books, New Delhi (2005)

CBCS: B. Sc. (Honours) with CHEMISTRY

**Discipline Specific Elective (DSE) Course**

CHEMISTRY

(Honours)

**(6th Semester)**

**Course Code: CHE-DS-P2-601**

 *(Industrial Chemicals and Environment)*

**Contact Hours: 60**

**Full Marks = 30 [** End Semester Exam (24) Internal Assessment (6)**]**

***Time: 6hours***

**A. *Any 2 (two) experiment to be set in examination* Marks - 10×2=20**

i) Determination of dissolved oxygen in water.

ii) Determination of Chemical Oxygen Demand (COD)

iii)Determination of Biological Oxygen Demand (BOD)

iv) Percentage of available chlorine in bleaching powder.

v)Estimation of total alkalinity of water samples (CO3-2, HCO3-) using double titration method.

vi) Measurement of dissolved CO2

**B. Viva-Voce Marks - 4**

**Reference Books:**

**1.** E. Stocchi: *Industrial Chemistry*, Vol-1, Ellis Horwood Ltd, UK.

**2.** R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi

**3.** J. A. Kent: Riegel’s *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi

**4.** S.S.Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd, New Delhi

**5.** K.De, *Environmental Chemistry*: New Age International Pvt. Ltd., New Delhi

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CBCS: B. Sc. (Honours) with CHEMISTRY

**Discipline Specific Elective (DSE) Course**

CHEMISTRY

(Honours)

**(6th Semester)**

**Course Code: CHE-DS-T6-602**

**Dissertation**

(*Project Work*)

**Full Marks-100 [**Dissertation (70) Viva (30)]

**(Credit-6)**

**Objective of the Course:** To develop the written and verbal communication. To present information in a clear an effective manner, to write report in a scientific style and to solve scientific problems.

**Expected Learner Outcome: Students will gain an understanding of: ---**

i. Communication effectively, verbally and written for the purpose of conveying chemical information to both professional scientist and to the public.

**ii.** Availability of instrument for conducting specific, scientific research

In this paper students have to carry out project work (Laboratory experiments or Comprehensive Review work on a specified topic) either at their respective colleges or any other R&D laboratory and UGC recognized University under guidance of a faculty member. The student may start their project work during the semester break between fifth and sixth semester.

The area of work is to be decided by the advisor.

On completion of the project work students have to submit the work in the form of a dissertation followed by oral presentation in the presence of faculty member and an external expert.

[Mark Distribution for evaluation of the Project Work

A. Laboratory Experiment

1. Literature Review 5 Marks

2. Objectives 5 Marks

3. Experimental work 25 Marks

4. Results & Discussions 25 Marks

5. Presentation and Viva 20 Marks

6. IA 20 Marks

B. Comprehensive Review

1. Objective 5 Marks

2. Review 35 Marks

3.References 10 Marks

4. Future prospects 10 Marks

5. Presentation and Viva 20 Marks

6. IA 20 Marks

Note: Students are encouraged to carry out laboratory experiment individually (However in

case of infrastructural issues a maximum of 4 students can perform experiments together).

Comprehensive review must be carried out individually. Students are encouraged to submit

Antiplagiarism certificate for the report/review.