



DEPARTMENT OF CHEMISTRY
EVALUATION SCHEME OF UG & PG PROGRAM AS PER NEP-2024-25

w.e.f. July, 2024-25

Certificate in Bioorganic and Chemical Analysis

1st Year / 2nd Semester



| S.No. | Course Code | Course Title | (T)Theory (P)Practical | Course Type | Periods per Week | | | Evaluation Scheme | | | End Semester | Subject Total | Total Credit | Attributes | | | | | | United Nations Sustainable Development Goals (SDGs) | | |
|--------------|---|--|---------------------------|------------------|------------------|-----------|-----------|-------------------|--------------------|------------|--------------|---------------|--------------|---------------|------------------|-------------------|-----------------|------------------------------|--------------|---|---------------------|---|
| | | | | | Lecture | Tutorial | Practical | Class Test | Teacher Assessment | Total | | | | Employability | Entrepreneurship | Skill Development | Gender Equality | Environment & Sustainability | Human Values | | Professional Ethics | |
| 1. | B020201T/CH155 | Bioorganic Chemistry | T | Core Major | 3 | 1 | - | 15 | 10 | 25 | 75 | 100 | 04 | √ | | √ | | | | | | |
| 2. | B020202T/CH156 | Material Science and Technology | T | | 3 | 1 | - | 15 | 10 | 25 | 75 | 100 | 04 | √ | | | | | | | | |
| 3. | B020203P/CH157 | Biochemical Testing | P | | - | - | 4 | 15 | 10 | 25 | 75 | 100 | 02 | √ | √ | √ | | √ | | | | |
| 4. | B020204P/CH158 | Material Analysis | P | | - | - | 4 | 15 | 10 | 25 | 75 | 100 | 02 | √ | √ | √ | | | | | | |
| 5. | <ul style="list-style-type: none"> • B030202T/MT148 • A040209T/LN109 • - | <ul style="list-style-type: none"> • Basic Mathematics & Statics • Basics of Communication • EVS/BS | T + P | Minor (Elective) | 3 | 1 | 4 | 15 | 10 | 25 | 75 | 100 | 06 | √ | √ | √ | | √ | | | | - |
| 6. | B000201V/CH144 | Laboratory Safety & Sample Handling | T + P | Vocational | 1 | - | 2 | - | - | - | 100 | 100 | 03 | √ | | √ | | √ | √ | √ | | |
| 7. | Z020201T/NS110 | First Aid and Health | T | Co-curricular | 2 | - | - | 15 | 10 | 25 | 75 | 100 | 02 | √ | | √ | | √ | √ | √ | | |
| 8. | B020205T/CH159 | Advanced Application of Artificial Intelligence in Chemical Sciences* | T | Audit Course | 2 | - | - | - | - | - | 100 | 100 | 00 | √ | √ | √ | | | | | | - |
| TOTAL | | | | | 14 | 03 | 14 | 90 | 60 | 150 | 650 | 800 | 23 | | | | | | | | | |

*Qualifying (Non-Credit Course)



Effective from Session: 2024-2025

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|--------------------------|---|----------------------------|----------------------|----------|----------|----------|----------|
| Course Code | B020101T/CH155 | Title of the Course | Bioorganic Chemistry | L | T | P | C |
| Year | First | Semester | Second | 3 | 1 | 0 | 4 |
| Pre-Requisite | 10+2 | Co-requisite | - | | | | |
| Course Objectives | This course aims to provide the students with a basic understanding of carbohydrates, amino acids, proteins, nucleic acids, and medicinal chemistry along with the synthesis, uses and mode of action of antibiotics and sulphha drugs, antipyretics analgesics, anesthetic drugs, cardiovascular drugs | | | | | | |

Course Outcomes

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|------------|---|
| CO1 | The students would be able to understand functioning of biomolecules essential for living organisms and the chemistry of carbohydrates. |
| CO2 | The students would be able to understand the physiological function that regulates the proper growth and development of a human body along with the chemistry of proteins and nucleic acids. |
| CO3 | The students would get an in-depth knowledge of medicinal chemistry and different classes of drugs like antibiotics, antipyretics, analgesics, antimalarial, and cardiovascular drugs. |
| CO4 | The students would be able to understand the classification, synthesis, and mode of action of inhalation of intravenous anaesthetics and basal anaesthetics. |
| CO5 | The students would be able to analyse different classes, structure, synthesis and mode of action of cardiac glycosides digoxin, and digitoxin; anti-hypertensive, hypotensive, and antiarrhythmic agents. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|----------------------------|---|--------------|-----------|
| 1 | Chemistry of Carbohydrates | Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Mechanism of mutarotation Determination of configuration of Glucose (Fischer's proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Inter conversions of sugars (ascending and descending of sugar series, conversion of aldoses to ketoses). Lobry de Bruyn-van Ekenstein rearrangement; stepping-up (Kiliani Fischer method) and stepping-down (Ruff's & Wohl's methods) of aldoses. end-group interchange of aldoses Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose.) | 8 | 1 |
| 2 | Chemistry of Proteins | Classification of amino acids, zwitter ion structure and isoelectric point. Overview of primary, secondary, tertiary, and quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C-terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection & C-activating groups and Merrifield solid phase synthesis. Protein denaturation/ renaturation. Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions). | 8 | 2 |
| 3 | Chemistry of Nucleic Acids | Constituents of Nucleic acids: Adenine, guanine, thymine, and Cytosine (Structure only), Nucleosides and nucleotides (nomenclature), Synthesis of nucleic acids, Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation | 8 | 2 |
| 4 | Medicinal Chemistry | Evaluation and study of introduction, examples and uses of various antibiotics, antipyretics and analgesics, antimalarial and cardiovascular drugs. | 8 | 3 |
| 5 | Anesthetic drugs | Introduction, Classification, synthesis, and mode of action of; Inhalation anaesthetics: Vinyl ether, Cyclopropane and Fluroxene; Intravenous anaesthetics: Thiopental Sodium Procaine hydrochloride, Tetracaine hydrochloride. | 8 | 4 |
| 6 | Cardiovascular drugs | Introduction, classification, structure, and mode of action of cardiac glycosides Digoxin, and Digitoxin; Anti-hypertensive and hypotensive drugs: structure, synthesis and Modeofaction of Losartan, lonidine, Antiarrhythmic agents: structure, synthesis and mode of action of Diisopyramide, Procainamide, Propranolol, Beritylium Tosilate | 6 | 4 |
| 7 | Antibiotics | Introduction and classification of antibiotics; beta lactam antibiotics: penicillins, its structure and mode of action, synthesis of Penicillin-v. Cephalosporin, Aminoglycoside: Streptomycin, Neomycin and Kenamycin. | 6 | 4 |
| 8 | Sulpha Drugs | Synthesis and uses of sulphathiazole, sulphaguanidine, sulphadiazine, sulphamethazine and sulphaacetamide. | 8 | 5 |

Reference Books:

Davis, B. G., Fairbanks, A. J., Carbohydrate Chemistry, Oxford Chemistry Primer, Oxford University Press.

Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).

Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.

e-Learning Source:

<http://heecontent.upsc.gov.in/Home.aspx>

<https://nptel.ac.in/courses/104/105/104105124/>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | 3 | 3 | - | - | - | - | - | 3 | - | - | 1 | 3 |
| CO2 | 3 | 2 | - | - | - | - | - | 2 | - | - | 2 | 2 |
| CO3 | 3 | 3 | - | - | - | - | - | 3 | - | - | 2 | 2 |
| CO4 | 2 | 1 | - | - | - | - | - | 1 | - | - | 1 | 3 |
| CO5 | 3 | 3 | - | - | - | - | - | 3 | - | - | 2 | 2 |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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|---|-------------------------------|
| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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|--|--|----------------------------|---------------------------------|----------|----------|----------|----------|
| Effective from Session: 2024-2025 | | | | | | | |
| Course Code | B02020T/CH156 | Title of the Course | Material Science and Technology | L | T | P | C |
| Year | First | Semester | Second | 3 | 1 | 0 | 4 |
| Pre-Requisite | 10+2 | Co-requisite | - | | | | |
| Course Objectives | The main aim of this course is to convey fundamental knowledge on materials and their applications in environmental protection, recycling and reuse of raw materials and treatment agents, economic benefits, and potential problems to our society. Upon completion of this theory course the students would gain knowledge of various materials, surface chemistry and interfacial phenomena, catalysis, metals and alloys, cement, ceramics and corrosion, polymer, glass, advanced materials and material balance, material balance without chemical reactions, material balance involving chemical reactions. | | | | | | |

| Course Outcomes | |
|------------------------|---|
| CO1 | The students would know about nanomaterials and their distinguished properties. They would also understand the concept of adsorption and micelles and their applications. |
| CO2 | The students would be able to understand the basic working principle of water, steam and air boilers and also understand nucleations, crystallization, and equipment tank crystallizer. |
| CO3 | The students would perceive a sound knowledge of crystals and also able to understand the nature of amorphous solids and their role in drug delivery. They would understand the importance of different separation techniques and their applications. |
| CO4 | The students would understand filtration and types of extraction such as liquid-liquid extraction, acid-base extraction |
| CO5 | The students would be able to know about the purification of organic compounds and their different types and their importance. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|--|---|---------------------|------------------|
| 1 | Basics of Materials synthesis | Advanced materials and Material balance: Nanomaterials, superconductors, biomaterials and fullerenes Material balance without chemical reactions: Flow diagram for material balance and material balance calculations for distillation, absorption, evaporation, extraction filtration, crystallization. Material balance involving chemical reactions: Concepts of stoichiometric equations, limiting reactant, excess reactant, percent excess, conversion, yield, selectivity and liquid phase reaction, gas phase reaction with or without recycle or bypass. | 9 | 1 |
| 2 | Surface chemistry and ceramics | Adsorption isotherm, sols, gels, emulsions, micro emulsions, micelles, aerosols, effect of surfactants. Introduction of ceramics, types, manufacturing processes and applications of ceramics. | 8 | 1 |
| 3 | Utilities in chemical industry | (i) A brief idea about water, steam and air boilers used in chemical industries (ii) A brief idea about fans, blowers, compressors and vacuum pumps, reciprocating pumps, gear pumps, centrifugal pumps, ejectors used in chemical industries. | 8 | 2 |
| 4 | Crystallization | Equilibrium solubility, super saturation, definition, nucleations, crystallization, equipment tank crystallizer and circulating liquid evaporator crystallizer. | 8 | 2 |
| 5 | X-ray powder diffraction and pharmaceuticals | Introduction, different solid forms and their role in drug development, salts, solvates, co-crystals, characterization of amorphous materials. | 9 | 3 |
| 6 | Distillation, evaporation and absorption | (i) Batch and continuous distillation, azeotropic and extractive distillation. (ii) Evaporator equipments; short tube evaporator and forced circulation evaporators. (iii) Equipments: Tray (Plate) towers for absorption, packed towers for absorption. | 6 | 3 |
| 7 | Filtration, extraction and drying | (i) Filter media and filter aids, filtration equipment- bed filters, plate and frame press filters, rotary drum filter and centrifuges. (ii) Extraction equipments: spray column and packed column extraction, rotating disc column extractors, liquid-liquid extraction, acid-base extraction. (iii) Purpose of drying, equipment- tray dryer, rotary dryer, flask dryer, fluid bed dryer, drum dryer, spray dryer. | 6 | 4 |
| 8 | Purification of organic compounds | Simple crystallization, fractional crystallization, sublimation, simple distillation, fractional distillation, distillation under reduced pressure, steam distillation, azeotropic distillation. | 6 | 5 |

Reference Books:

- W. D. Bowen, H. K. Kingery, D.R. Uhlmann, Introduction to Ceramics, Wiley Publishers, New Delhi (1976)
 J. A. Kent, J. A. (ed), Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.(1997)
 G. Cao, Nanostructures and Nanomaterials: Synthesis, Properties & Applications by Guozhong Cao, Imperial college Press, London (2004)
 W. D. Callister Jr., D. G. Rethwisch Materials Science and Engineering: An Introduction , John Wiley & Sons (2018) .
 W. L. Mc. Cabe, J. C. Smith & Parriet Unit Operators of Chemical Engineering, Mc. Graw Hill Book Company Singapore, 7th edition (2017)
 W.L.F. Armarego W.L.F. Armarego C. Chai, Purification of Laboratory Chemicals, Elsevier (2009)

e-Learning Source:

- <https://nptel.ac.in/courses/112106227>
<https://nptel.ac.in/courses/112/106/112106227/>
https://onlinecourses.nptel.ac.in/noc21_cy45/preview
<https://nptel.ac.in/content/storage2/courses/102103047/PDF/mod4.pdf>
https://onlinecourses.nptel.ac.in/noc19_ch31/preview
<https://nptel.ac.in/courses/113/105/113105015/>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | 2 | 1 | - | - | - | 1 | - | 3 | - | - | 3 | 2 |
| CO2 | 1 | 2 | - | - | - | 2 | - | 1 | - | - | 2 | 2 |
| CO3 | 1 | 3 | - | - | - | 1 | - | 2 | - | - | 1 | 3 |
| CO4 | 3 | 2 | - | - | - | 1 | - | 1 | - | - | 1 | 1 |
| CO5 | 2 | 1 | - | - | - | 1 | - | 2 | - | - | 2 | 3 |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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SDG: 4, 8



Effective from Session: 2024-2025

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|--------------------------|---|----------------------------|---------------------|----------|----------|----------|----------|
| Course Code | B020203P/CH57 | Title of the Course | Biochemical Testing | L | T | P | C |
| Year | First | Semester | Second | 0 | 0 | 4 | 2 |
| Pre-Requisite | 10+2 | Co-requisite | - | | | | |
| Course Objectives | The objective of this course is to acquaint the biomolecules, simple drug development and compounds made of carbohydrates, proteins, amino acids, and nucleic acids through qualitative and quantitative experiments. | | | | | | |
| Course Outcomes | | | | | | | |
| CO1 | The students would learn to perform qualitative and quantitative analyses of proteins, amino acids, and fats | | | | | | |
| CO2 | The students would be inculcated with the skills to perform qualitative and quantitative analyses of biomolecules such as carbohydrates, and nucleic acids. | | | | | | |
| CO3 | The students would be able to perform qualitative and quantitative analysis of carbohydrates | | | | | | |
| CO4 | The students would learn the synthesis of simple drug molecules. | | | | | | |
| CO5 | The students would be able to determine and identify nucleic acids and their strength components. | | | | | | |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|---|--|--------------|-----------|
| 1 | Qualitative and Quantitative Analysis of Proteins, Amino Acids and Fats | Isolation of protein. Determination of protein by the Biuret reaction. TLC separation of a mixture containing 2/3 amino acids Paper chromatographic separation of a mixture containing 2/3 amino acids 5. Action of salivary amylase on starch To determine the concentration of glycine solution by formylation method. To determine the saponification value of an oil/fat. To determine the iodine value of an oil/fat | 15 | 1,3 |
| 2 | Qualitative and Quantitative Analysis of Carbohydrates | Separation of a mixture of two sugars by ascending paper chromatography Application of TLC and PC for the identification of natural coloring materials such as Lycopene from Tomato and Chlorophyll from Spinach Differentiate between a reducing/ non reducing sugar Synthesis of Osazones. | 15 | 1,2 |
| 3 | Synthesis of Simple Drug Molecules | To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC. Synthesis of barbituric acid Synthesis of propranolol | 15 | 1,4 |
| 4 | Determination and Identification of Nucleic Acids | Determination of nucleic acids Extraction of DNA from onion/cauliflower | 15 | 1,5 |

Reference Books:

- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).
 Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education.
 G. Svehla, Vogel's Qualitative Inorganic Analysis, 7e Pearson (2008).
 Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, ELBS.
 Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009).
 9. Varley, H., Gowenlock, A.H & Bell, M.: Practical Clinical Biochemistry, Heinemann.

e-Learning Source:

- <https://www.labster.com/chemistry-virtual-labs/>
<https://www.vlab.co.in/broad-area-chemical-sciences>
<http://chemcollective.org/vlabs>
https://gtu.ge/Agro-Lib/Vogels_Textbook_Of_Quantitative_Chemical_Analysis_5th_ed_-_G_H_Jeffery.MsuCity.pdf

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | 1 | 3 | - | - | - | - | - | - | 3 | 1 | - | - |
| CO2 | 1 | 2 | - | - | - | - | - | - | 1 | 1 | - | - |
| CO3 | 3 | 1 | - | - | - | - | - | - | 1 | 2 | - | - |
| CO4 | 2 | 1 | - | - | - | - | - | - | 3 | 1 | - | - |
| CO5 | 3 | 3 | - | - | - | - | - | - | 2 | 2 | - | - |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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|--|--|----------------------------|-------------------|----------|----------|----------|----------|
| Effective from Session: 2024-2025 | | | | | | | |
| Course Code | B020204P/CH158 | Title of the Course | Material Analysis | L | T | P | C |
| Year | First | Semester | Second | 0 | 0 | 4 | 2 |
| Pre-Requisite | 10+2 | Co-requisite | - | | | | |
| Course Objectives | The chemistry lab program for this course is designed to give students the essential knowledge of preparing solutions of various concentrations, determination of concentrations, extraction of compounds from solutions, determination of refractive index of materials, molar refractivity and specific reactivity of solutions and chromatographic separations. These techniques and methods are very useful tools in various chemical industries such as pharmaceuticals, petroleum, food and materials. | | | | | | |

| Course Outcomes | |
|------------------------|--|
| CO1 | The students would gain knowledge and skills to understand the laboratory methods and tests related to the estimation of molecular weight by depression in freezing point and elevation in boiling points. |
| CO2 | The students would be able to understand and perform the extraction experiment. They would also learn to understand the phase diagram and separation of immiscible liquids. |
| CO3 | The students would be able to perform and measure the refractive Index of liquids and its variation with change of medium. |
| CO4 | The students would be able to understand the concept of chromatography and applications in industries. |
| CO5 | The students would be able to perform the separation of organic compounds using thin layer paper chromatography. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|--------------------------|--|---------------------|------------------|
| 1 | Analysis of solution | Molecular weight determination by depression in freezing point and elevation in boiling points. | 10 | 1,2 |
| 2 | Extraction process | Phase diagram, partition coefficient. To find out the partition coefficient of – Iodine between CCl ₄ and water Acetic acid between water and benzene | 10 | 2,3 |
| 3 | Refractometer | Determination of Refractive Index of a liquid by Abbe's refractometer. Determination of Molar refractivity and specific refractivity of a liquid by using Abbe's refractometer. | 20 | 2,4 |
| 4 | Chromatography | Column, paper, thin layer To separate and identify the amino acids by ascending paper chromatography. To separate and identify the organic compound by the use of thin layer chromatography. Separation of a mixture of organic compound by column chromatography | 20 | 2,5 |

Reference Books:

- Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.
Harris, D.C.Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.
Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.
Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning, India

e-Learning Source:

- <https://www.labster.com/chemistry-virtual-labs/>
<https://www.vlab.co.in/broad-area-chemical-sciences>
<http://chemcollective.org/vlabs>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | |
|---|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | 1 | 2 | - | - | - | - | - | - | 2 | 1 | - | - |
| CO2 | 2 | 3 | - | - | - | - | - | - | 1 | 2 | - | - |
| CO3 | 1 | 2 | - | - | - | - | - | - | 2 | 1 | - | - |
| CO4 | 1 | 1 | - | - | - | - | - | - | 1 | 2 | - | - |
| CO5 | 3 | 1 | - | - | - | - | - | - | 3 | 3 | - | - |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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Effective from Session: 2024-2025

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|--------------------------|--|----------------------------|-------------------------------------|----------|----------|----------|----------|
| Course Code | B000201V/CH144 | Title of the Course | Laboratory Safety & Sample Handling | L | T | P | C |
| Year | First | Semester | Second | 1 | 0 | 2 | 3 |
| Pre-Requisite | 10+2 | Co-requisite | - | | | | |
| Course Objectives | Main objective of the course is to impart the fundamental understanding of laboratory safety, managerial abilities for waste reduction, a basic understanding of chemistry, laboratory equipment, reagents, and solutions, as well as expertise in using high-tech equipment for any pharma/chemical company/testing lab, etc. | | | | | | |
| Course Outcomes | | | | | | | |
| CO1 | The students would learn the safety procedures and protocols to follow in a science laboratory. | | | | | | |
| CO2 | The students would learn waste management skills. | | | | | | |
| CO3 | The students would gain the elementary knowledge of chemistry. | | | | | | |
| CO4 | The students would learn to work in a chemistry lab and get familiarize with laboratory instruments, reagents, and solutions. | | | | | | |
| CO5 | The students would learn handling of sophisticated instruments for pharmaceutical/chemical company/testing labs, etc. | | | | | | |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|--|--|--------------|-----------|
| 1 | Safety In Science Laboratory | Theory: General Safety; Safe Handling of Chemicals and Glass wares; Working in Chemo-Safety/ Bio-Safety areas. Practical: Quantitative analysis; Determination of physical parameters of wastewater and solid waste. Temperature, Colour, Odour, pH, etc. | 10 | 1 |
| 2 | Managerial Skill in Minimizing Wastes | Theory: Four "Rs"- Reuse, Rework, Reduce, Recycle. Practical: Handling of different kinds of wastes and reuse. BOD, COD, & DO measurement. | 10 | 1,2 |
| 3 | Elementary Knowledge of Chemistry | Theory: Elementary knowledge of inorganic chemistry; Elementary knowledge of organic chemistry; Elementary knowledge physical chemistry. Practical: Study of Physico- chemical characteristics of e waste. | 10 | 3 |
| 4 | Laboratory Instruments | Theory: Principle and working of basic laboratory instruments Autoclave, Hot air oven, Incubator, pH meter, water bath, centrifuge, Refrigerator, colorimeter, Balance, Flame photometer, Microscope, Electrophoresis etc. Practical: Wastewater analysis and its treatment including primary, secondary, and tertiary treatment. | 10 | 1,4 |
| 5 | Reagents and Solutions | Theory: Molar solutions, normal solutions; Buffer solutions, solutions, saturated solutions, standard solutions. Dilution of the concentrated solution to desired concentration. Practical: Soil Sampling and its digestion; Physico-chemical characteristics of soil. | 10 | 1,4 |
| 6 | Expertise in Handling Sophisticated Instruments for Any Pharma/Chemical Companies/ Testing Labs etc. | Theory: Sustainability and the Chemical Industry; Chromatography and separation Techniques. Practical: TLC and Paper chromatographic techniques | 10 | 1,5 |

Reference Books:

- Industrial Chemistry by B.K Sharma, By Krishna Publications, GOEL Publishing House
- Environmental Chemistry by H. Kaur, Pragati Prakashan, Meerut.
- Environmental Chemistry by A. K.De , New Age International Publishers, (9th edition)
- Water Pollution by V.P. Kudesia, 4th edition, (latest) Pragati Prakashan, Meerut.
- Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education, sixth edition
- Hand book of solid waste management, second edition, McGraw-Hill education.

e-Learning Source:

- https://www.researchgate.net/publication/320360474_Metal_Recovery_from_Industrial_and_Mining_Wastewaters
- <https://www.routledge.com/Metal-Recovery-from-Industrial-Waste/Brooks/p/book/9781315895352>
- https://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf
- <https://www.epa.gov/sites/production/files/2016-03/documents/industrial-waste-guide.pdf>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| | CO1 | 3 | 3 | - | - | - | - | - | - | 3 | 2 | 1 |
| CO2 | 3 | 3 | - | - | - | - | - | - | 2 | 3 | 2 | 2 |
| CO3 | 2 | 3 | - | - | - | - | - | - | 3 | 2 | 2 | 1 |
| CO4 | 3 | 1 | - | - | - | - | - | - | 3 | 2 | 1 | 1 |
| CO5 | 3 | 3 | - | - | - | - | - | - | 3 | 3 | 1 | 1 |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| <p>Name & Sign of Program Coordinator</p> | <p>Sign & Seal of HoD</p> |
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|--|--|----------------------------|--|----------|----------|----------|----------|
| Effective from Session: 2024-2025 | | | | | | | |
| Course Code | B020205T/CH159 | Title of the Course | Advanced Application of Artificial Intelligence in Chemical Sciences | L | T | P | C |
| Year | First | Semester | Second | 3 | 1 | 0 | 4 |
| Pre-Requisite | 10+2 | Co-requisite | - | | | | |
| Course Objectives | The objective of this course is to acquaint the students with the origin of artificial intelligence, its evolution, scope, and significance. The idea is to know about the probable applications of AI in chemical sciences and how they can be implemented in reaction designing, synthesis, molecular prediction, reaction outcome prediction, template selection, molecular designing, and property prediction. | | | | | | |

| Course Outcomes | |
|------------------------|--|
| CO1 | The learner would gain basic knowledge of the history and evolution of AI, as well as its scope and significance. |
| CO2 | The learner would be taught problem solving through AI. |
| CO3 | The learner would be able to evaluate different types of neural networks and deep learning, supervised and unsupervised learning, feature selection and engineering, and learning from observation. |
| CO4 | The learner would be able to understand the machine learning applications and data analysis in chemistry, databases, and deep learning in chemistry. |
| CO5 | The learner would be able to understand the implementation of AI in chemical synthesis, molecular prediction, prediction of reaction outcomes and designing of new reactions, reactant and template selection, molecular designing, and property prediction. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|---|--|---------------------|------------------|
| 1 | Introduction to artificial intelligence and problem solving through AI | <i>Introduction:</i> History and evolution of AI, comparison of human and computer skill, Component of AI, Scope and significance in different domains, Ethical considerations in AI development and deployment, Intelligent Agent, logical agent. <i>Problem solving through AI:</i> Defining problem as a state space search, analyzing the problem, solving problem by searching, informed search and Uninformed Search. | 7 | 1, 2 |
| 2 | Machine Learning Basics and Natural Language Processing | <i>Machine Learning:</i> Neural networks and deep learning, Supervised and unsupervised learning, feature selection and engineering, learning from observation, knowledge in learning. <i>Natural Language Processing:</i> Brief history of NLP, Text processing, Sentiment analysis, language translation, Early NLP system, ELIZA system, LUNAR system, General NLP system. | 8 | 1 |
| 3 | AI in Chemistry | Concept of Artificial intelligence, machine learning, Machine learning applications to data analysis in chemistry, databases, deep learning in chemistry, cheminformatics, molecular dynamics and simulation, chemical representation of atoms and molecules with molecular graph representation and Simplified Molecular Input Line Entry System (SMILES) | 7 | 2 |
| 4 | Applications of AI in Synthetic and Medicinal Chemistry and ethical issues: | Artificial intelligence in synthesis, molecular prediction, prediction of reaction outcomes and designing of new reactions, reactant and template selection, molecular designing and property prediction, computer-assisted synthesis design and prediction of biochemical pathways and new drug targets. Regulatory science, ethical consideration related to use of AI in chemical sciences | 8 | 3 |

Reference Books:

Artificial Intelligence with Python: A Comprehensive Guide to Building Intelligent Apps for Python Beginners and Developers by Prateek Joshi
 Hands-On Artificial Intelligence for Beginners: An introduction to AI concepts, algorithms, and their implementation By Patrick D. Smith
 Machine Learning in Chemistry: The Impact of Artificial Intelligence Edited by Hugh M Cartwright
 Artificial Intelligence in Chemistry: Structure Elucidation and Simulation of Organic Reactions, Volume 73 Z. Hippe

e-Learning Source:

https://www.youtube.com/watch?v=Q_gWtkh5pEY
<https://www.youtube.com/watch?v=HbfFS7bA5M0>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | |
|---|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | 2 | 2 | - | - | - | - | - | 2 | - | - | 1 | 2 |
| CO2 | 1 | 1 | - | - | - | - | - | 1 | - | - | 2 | 3 |
| CO3 | 2 | 2 | - | - | - | - | - | 1 | - | - | 2 | 2 |
| CO4 | 1 | 1 | - | - | - | - | - | 2 | - | - | 1 | 2 |
| CO5 | 2 | 2 | - | - | - | - | - | 1 | - | - | 1 | 1 |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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Effective from Session: 2024-2025

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|--------------------------|---|----------------------------|-------------------------------|----------|----------|----------|----------|
| Course Code | B030202T/MT148 | Title of the Course | Basic Mathematics & Statistic | L | T | P | C |
| Year | First | Semester | Second | 3 | 1 | 0 | 4 |
| Pre-Requisite | | Co-requisite | | | | | |
| Course Objectives | The purpose of this undergraduate course is to impart basic and key knowledge of elementary mathematics. By using the principal of applied mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the student will able to explore subject into their respective dimensions | | | | | | |

Course Outcomes

| | |
|------------|---|
| CO1 | Students will be able to interpret limits and continuity of functions. Also, they can find differential coefficient, differentiation of functions including function of a function, differentiation of parametric form, simple and successive differentiation. |
| CO2 | Students will evaluate and interpret integration as an inverse of differentiation; They will be able to find indefinite integrals of standard form, integration by parts, by substitution and by partial fraction method. They can evaluate definite integrals. |
| CO3 | Students can describe the basic concepts of simple random sampling and stratified random sampling. They can understand and find measures of central tendency (mean, median and mode), measures of variation (mean deviation and standard deviation), measure of coefficient of variation. Student will be able to understand and evaluate covariance and correlations, Karl Pearson's Coefficient of correlation and Spearman's coefficient of rank correlation. They can also be able to find regression by method of least squares. |
| CO4 | Students can interpret the fundamental principle of counting. They will also be able to find permutations, permutations under certain conditions, combinations, combinatorial identities. They can also apply Binomial theorem (without proof) |
| CO5 | Students will be able to understand the random experiment and associated sample space, events. They can also find probability and can use addition and multiplication theorems for finding probability (without proof). They will be able to understand probability distributions, and will be able to find Binomial, Poisson, and Normal distributions. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|-------------------------------|--|--------------|-----------|
| 1 | Limit and Continuity | Set and functions, left hand limit and right-hand limit, limits of function, continuity of function. | 7 | 1 |
| 2 | Differentiability | Definition of differential coefficient, differentiation of function including function of a function, differentiation of parametric form, simple and successive differentiation, Leibnitz rule. | 8 | 1 |
| 3 | Integrations | Integration as inverse of differentiation, indefinite integrals of standard form, integration by parts, substitution method and partial fraction method, evaluation of definite integrals. | 8 | 2 |
| 4 | Univariate Statistics | Basic concepts of simple random sampling and stratified random sampling, measures of central tendency (mean, median and mode), measures of variation (mean deviation, quartile deviation and standard deviation), coefficient of variation. | 7 | 3 |
| 5 | Bivariate Statistics | Covariance, correlations, scatter diagram, Karl Pearson's coefficient of correlation, Spearman's coefficient of rank correlation, regression and its coefficient, estimation of regression lines by the method of least square. | 7 | 3 |
| 6 | Permutations and Combinations | Fundamental principle of counting, permutations, permutations under certain conditions, combinations, combinatorial identities, Binomial theorem (without proof), some applications of Binomial theorem. | 7 | 4 |
| 7 | Probability theory | Random experiment and associated sample space, events, definition of probability, algebra of events, addition and multiplication theorems on probability (without proof), conditional probability, Baye's theorem. | 8 | 5 |
| 8 | Probability Distributions | Probability distribution, probability mass function, probability distribution function, expectations, Binomial, Poisson, normal distributions and their mean and variance, fitting the expected frequency of Binomial and Poisson distributions. | 8 | 5 |

Reference Books:

- Murray R. Spiegel, 1980, Probability and Statistics, Schaum's (Outline Series) McGraw-Hill Book Co.
- Q. S. Ahmad, V. Ismail and S. A. Khan: Biostatistics, Laxmi Publications Pvt. Ltd.
- E. Kreyszig, "Advanced Engineering Mathematics", 5th Edition, Wiley Eastern, 1985.

e-Learning Source:

- NPTEL, MOOC

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3 | | | | 1 | | 3 | 2 | | 2 | 2 | |
| CO2 | 3 | | | | 1 | | 3 | 2 | | 2 | 1 | |
| CO3 | 3 | | | | 3 | | 3 | 2 | | 1 | 2 | |
| CO4 | 3 | | | | 1 | | 3 | 2 | | 2 | 3 | |
| CO5 | 3 | | | | 3 | | 3 | 2 | | 2 | 3 | |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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| Effective from Session: 2024-2025 | | | | | | | |
|-----------------------------------|---|---------------------|------------------------|---|---|---|---|
| Course Code | A040209- LN109 | Title of the Course | Basic of Communication | L | T | P | C |
| Year | First | Semester | Second | 3 | 1 | 0 | 4 |
| Pre-Requisite | | Co-requisite | | | | | |
| Course Objectives | To enhance basic communication skill among the students. Students will also learn about the fundamentals of linguistics and Grammars. | | | | | | |
| Course Outcomes | | | | | | | |
| CO1 | Basic understanding of Communication and professional communication | | | | | | |
| CO2 | Basic knowledge of structural and functional Grammar. Learning language through literature. | | | | | | |
| CO3 | Basic tools of communication and improvement in communicative competence. | | | | | | |
| CO4 | Understanding the basic grammar and basic structure of language. | | | | | | |
| CO5 | Students will gain a fundamental understanding of the nature, branches, and history of Linguistics. | | | | | | |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|-----------------------------|--|--------------|-----------|
| 1 | Professional Communication | Professional Communication: Its Meaning and Importance, Essentials of Effective Communication, Barriers to Effective Communication. | 8 | 1 |
| 2 | Language through Literature | A. Essays: 1. The Effect of Scientific Temper on Man by Bertrand Russell, 2. The Aim of Science and Humanities by Moody E Prior. B. 1. The Meeting Pool by Ruskin Bond, 2. The Portrait of a Lady by Khushwant Singh | 8 | 2 |
| 3 | Basic Vocabulary | Euphemism, One-word Substitution, Synonyms, Antonyms, Homophones, Idioms and Phrases, Common Mistakes, Confusable Words and Expressions. | 8 | 3 |
| 4 | Basic Grammar | Articles, Prepositions, Tenses, Concord, (Subject-Verb agreement), Modal Auxiliaries, Verbs: its Kinds and uses, Degrees of Comparison, Punctuation | 8 | 4 |
| 5 | Language and Linguistics | Language: Definition, characteristics and importance of Language Linguistics: Definition, nature, scope, branches, levels and types of Linguistics, Linguistics versus Traditional Grammar. | 8 | 5 |

Reference Books:

Effective Communication Skills

Improve Your Communication Skills

Communication Skills Training

e-Learning Source:

www.ignou.com

www.swayam.com

www.coursera.com

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | 3 | 3 | 2 | 3 | 3 | - | - | 2 | 3 | 3 | 2 | - |
| CO2 | 2 | 3 | 1 | 2 | 3 | - | - | 2 | 3 | 3 | 1 | - |
| CO3 | 1 | 3 | 1 | 2 | 3 | - | - | 3 | 3 | 2 | 2 | - |
| CO4 | 3 | 3 | 2 | 2 | 3 | - | - | 2 | 2 | 3 | 1 | - |
| CO5 | 2 | 3 | 2 | 3 | 3 | - | - | 3 | 3 | 2 | 3 | - |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
|------------------------------------|--------------------|