छत्रपति शाहू जी महाराज विश्वविद्यालय, कानपुर

CHHATRAPATI SHAHU JI MAHRAJ UNIVERSITY, KANPUR

(पूर्ववर्ती कानपुर विश्वविद्यालय कानपुर)

Formerly Kanpur University, Kanpur – 208024

A Documentary Support

For

Metric No. – 1.1.1

Programme Outcomes & Course Outcomes

Under the

Criteria - I

(Curriculum Design and Development)

Key Indicator - 1.1

In

Metric No. – 1.1.1

M.Sc. Industrial Chemistry

Co-ordinator
Internal Quality Assurance Cell
CSJM University, Kanpur

(Registrar)
C.S.J.M.University
Kanpur

REGISTRAR
C.S.J.M. UNIVERSITY
KANPUR

Department of Chemistry

Vision

Vision of the department is to provide excellent knowledge of the chemistry for under graduate as well as post graduate students. The department provide experimental knowledge to the students and prepare as an industry professional person with sound knowledge of instruments and chemical analysis.

Mission

To prepare the student as a good researcher, smart and skilled person, entrepreneur with ethical values as well as a quick problem solver.

To provide the knowledge of implementation and importance of chemistry in the field of MSME, Electronics, CSE, Chemical engineering and Mechanical Engineering.

M.Sc. - Industrial Chemistry

Program Outcomes (POs)

PO1	Fundamental Knowledge of Basic principles
PO2	Applications of Various Aspect of Chemistry to Different Industries
PO3	Communication of Scientific Information in a clear and Concise Manner
PO4	Explain Environment Pollution Issues and remedies
PO5	To Develop the Sustainable and eco-friendly Technology
PO6	Knowledge and handling of Equipment
PO7	Hands on Experiment
PO8	Inculcate Logical Thinking to address the Problem with Solution
PO9	Individual and team work

Program Specific Outcomes (PSOs)

PSO1	Exposure to various industries at local and National Level
PSO2	Knowledge to Build up Small scale industry

Program Educational Outcomes (PEOs)

1. Student will be able to serve in various fields as scientist, analyst, quality controller, academics, research organizations and can work and set testing labs at local, national and international level.
2. Students will be able to analyse and investigate scientifically real life problems along with ethical attitude which works in multidisciplinary team.
3. To make them familiar with new skills and techniques to overcome the problem related with new technologies.
4. To develop the skills of students in the proper handling of various equipment, apparatus and chemicals.
5. To make the students explain why Chemistry is an integral course for addressing social, economic, and environmental problem**.**

Semester-wise Course Structure

1st Year Semester I

Sl. No.	Course Code	Course Title	Marks
1	MSIC 101	Analytical Techniques Part A	100
2	MSIC102	Research Methodology, Statistical Techniques and Computer applications	100
3	MSIC 103	Organic Chemistry	100
4	MSIC 104	Physical Chemistry	100
5	MSIC 105	Lab Course I	100
		Total	**500**

1st Year Semester II

Sl. No.	Course Code	Course Title	Marks
1	MSIC 201	Polymer Chemistry	100
2 2	MSIC 202 MSIC 202	Chemistry of materials, Petrochemicals and Fertilizers Chemistry of materials, Petrochemicals and Fertilizers	100
3	MSIC 203	Analytical techniques part –B	100
4	MSIC 204	Environmental Chemistry and waste water management	100
5	MSIC 205	Industrial training and seminar part-A	100
		Total	**500**

2nd Year Semester III

Sl. No.	Course Code	Course Title	Marks
1	MSIC 301	Natural products, Cosmetics and perfumery	100
2	MSIC 302	Pharmaceutical Chemistry	100
3	MSIC 303	Sugar and Pulp chemistry	100
4	MSIC 304	Essential oils, Dyes and Paints	100
5	MSIC 305	Lab Course -II	100
		Total	**500**

2nd Year Semester IV

Sl. No.	Course Code	Course Title	Marks
1 1	MSIC 401 MSIC 401	Environmental Impact Assessment Environmental Impact Assessment	100
2	MSIC 402	Food science and Agrochemicals	100
3	MSIC 403	Chemistry of life	100
4	MSIC 404	Industrial training and seminar part-B	200
		Total	**500**

Detailed syllabus

Semester I

Course Code: MSIC-101

Course Name: Analytical Techniques Part –I

Course outcomes: After completion of this course the students will be able to:

CO1	Purification, separation and identification of compounds need special techniques.
CO2	Knowledge of solvent extraction.
CO3	Basics and application of electron microscopies like SEM and TEM
CO4	Separation of mixtures using different chromatographic Techniques.

Course Details:

Unit I

Basics of Filtration processes

Introduction to unit processes and unit operations, Screening, Mixing, Coagulation and Flocculation, Sedimentation: Type of settling, Filtration for wastewater treatment. Type of filters - rapid sand filter, slow sand filter, high rate filter, pressure filter. Gravitational settling, Centrifugal impaction, Inertial impaction, Diffusion, Electrostatic precipitation,

Unit II

Electron Microscopy

Introduction, Principle and Instrumentation of SEM and TEM.

Unit III

Separation Techniques

Solvent extraction (liquid-liquid extraction), general principles, relationship between extraction and distribution coefficient, distribution ratio, multiple extractions, extraction of metal organic complexes and ion association complexes.

Unit IV

Chromatographic Techniques

Classification, basic principles, theory of chromatography, Ion-exchange chromatography: ion exchange process, synthesis and structure of ion-exchange resin, resolution, retention parameters, ion-exchange capacity and separation of lanthanides; Paper and thin-layer chromatography, various techniques of development, visualization and evaluation of chromatograms, Liquid-gas chromatography, HPLC: introduction, methodology, instrumentation and industrial application.

Recommended Text Books:

1. *Vogel's Textbook of Quantitative Chemical Analysis, 5th edition Bassette and co-workers, Longman Group UK (1989)*
2. *Fundamentals of molecular spectroscopy, Banwell, C.N., 3rd edition, McGRW- HILL COMPANY (1989)*
3. *Instrumental methods of analysis, Willard M.H., Merrit, L.L., Dean J.A., Settle, F.A.,7th edition, International Atomic Energy Agency(1988)*
4. *Principles and practice of analytical chemistry, Fifield F.W., Kaley D., Blackie Academic and Professional, 4th Edition(1995).*

Course Code: MSIC– 102

Course Name: Research Methodology, Statistical Techniques and Computer Applications

Course outcomes: After completion of this course the students will be able to:

CO1	Identify and discuss the issues.
CO2	Concepts salient to the research process .
CO3	The concept of data collection analysis
CO4	Reporting, selecting an appropriate research design and implementing research project.
CO5	To apply parametric and non-parametric Tests

Course Details:

Unit I

Basics of Research Methodology

Introduction to research methodology and design, research definition, selection and formulation of research problem, types of research, formulation of hypothesis, review of literature, types of data- primary, secondary and tertiary data, research process, survey and census

Unit II

Sampling Techniques

Population and sample, Sampling theory and techniques, advantages and limitations of sampling, data collection, coding and tabulation, probability and non probability sampling techniques, field research methodology

Unit III

Central Tendency

Measures of central tendency: mean, mode, median, data distribution, Chebyshev's theorem, variance, standard deviation, standard error, ratio and proportion, precision and accuracy, correlation, rank correlation, significance level, t-test, paired t-test

Unit IV

Statistical Tests

Non-parametric tests: Chi square test for goodness of fit and relationship between two variables, Analysis of variance, F-test, Data presentation: Charts, graphs

Unit V

Fundamentals of Computer Organization and Applications

Fundamentals of computers, Computer organization, binary numbers, flow chart, Use of data analysis tools and text editors, power point presentations, different templates for report writing and dissertations, use of computers in report preparation and presentation

Recommended Text Books:

1. *Statistical Methods- S.P.Gupta 46th edition, Sultan Chand & Sons (2021).*
2. *Research Methodology, Methods and Techniques- C.P.Kothari, 2nd edition, New Age International (P) Limited, Publishers (2004)*
3. *Statistics (Theory and Practice) – B.N.Gupta, SBPD Publication(2021).,*
4. *Research Methodology Methods and statistical Techniques- Santosh Gupta, Deep & Deep Publications Pvt. Ltd. New Delhi (2008).*
5. *Research Methodology and statistical Measures by T.S Reddy and P.B Aappa Rao, Reliance Publishing House, India (2012).*
6. *Research Methodology by Sharma and R.K. Jain, Vayu Education of India(2021).*

Course Code: MSIC– 103
Course Name: Organic Chemistry

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Learn the different types of heterocyclic molecule and their chemistry and biological property.
CO2	Learn modern synthetic methods for the preparation of heterocyclic compound and their structural elucidation.
CO3	Learn the properties & side effects of different heterocyclic compounds.
CO4	Learn the basic photochemistry & different types of photochemical reaction.
CO5	Learn the different types of organometallic compounds and their uses in organic synthesis.
CO6	Learn the different types rearrangement reaction in organic synthesis.

Course Details:

Unit I

Heterocyclic synthesis

Introduction, synthesis and properties of Thiophene, Furan, Pyridine, Pyrrole, Quinoline and Indole.

Unit II

Pericyclic

Cycloaddition, Electrocyclic, Sigmatropic and Cheletropic reactions.

Unit III

Rearrangement and Reactions

Pinacol/Pinacolone Rearrangement, Wagner-Meerwein Rearrangement, Wolff Rearrangement, Hofmann Rearrangement, Curtius Reaction, Lossen Rearrangement, Schmidt Reaction, Beckmann Rearrangement, Favorskii Rearrangement and Claisen Rearrangements, Aldol Reaction, Perkin Reaction, Stobbe Reaction, Reimer-Tiemann Reactions.

Unit IV

Reagents in Organic synthesis

Grignard reagent, $NaBH_4$, $LiAlH_4$, Gilman's reagents, Lithium dimethyl cuprate, DDQ, oxidising agents: SeO_2**.**

Unit V

Organic Synthesis

Disconnection approach (one and two group), C-C, C-X disconnection,

1, 3 and 1, 5-difuctional compounds.

***Recommended Text Books**:*

1. *Advanced Organic Chemistry, Parts A & B, Carey, F.A. & Sundberg, R.J. Plenum: U.S. (2004).*
2. *Modern methods of Organic Synthesis, Carruthers, W.Cambridge University Press (1971).*
3. *Organic Synthesis: The Disconnection Approach, Warren, S.John Wiley & Sons (1984).*
4. *Advanced Organic Chemistry, Reaction Mechanisms and Structure, J. March. John Wiley(2006).*
5. *WSome Modern Methods of Organic Synthesis, . Carruthers .Cambridge University Press(2016).*
6. *Organic Chemistry, I. L. Finar, ELBS, U.K(1973).*
7. *Organic Chemistry, Morrison R.T. & Boyd R. N.; Prentice Hall India(2010).*
8. *Organic Chemistry, Clayden, J., Oxford University Press(2014).*

Course code: MSIC – 104

Course name: Physical Chemistry

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Understand concept of kinetics of reaction and theories related to it
CO2	Gain knowledge about rate of reaction , chain reactions , catalysis and enzyme kinetics
CO3	Concept of electrochemistry and electrochemical reactions
CO4	Mechanism related to corrosion and corrosion preventive methods
CO5	Concept of Colloidal chemistry, surface chemistry and their various applications

Course Details:

Unit I

Colloids and Surfaces

Introduction, types of colloidal system, Characterization of colloidal particles, emulsions, application of colloids in different industries (agricultural, chemical, pharmaceutical, petroleum recovery, coating, painting, food and cosmetics etc.)

Unit II

Reaction dynamics

Molecularity and order of reaction, Integrated rate equations, temperature dependent of reaction rate, activation energy, methods of determining reaction rates, complex reactions- chain reactions , reversible and irreversible reactions, Catalysed and Enzyme catalysed reactions, Heat of reaction and Equilibrium constant from thermodynamics.

Unit III

Electrochemistry

Electrochemistry of solution ,electro catalysis, Deby- Huckel theory for activity coefficient of electrolytic solution, determination of activity coefficient, ionic strength, Donnan –membrane equilibrium, , Electrochemical and Concentration cells, Corrosion: classification, factors affecting corrosion and prevention , Polarization , Overvoltage , Decomposition voltage.

Unit IV

Chemical equilibrium

Introduction, Law of chemical equilibrium, Lechateliers principle, application, equilibrium constant from thermodynamics consideration, Concepts of acids and bases, pH and pOH of solutions, Buffer solution, Solubility product.

Recommended Text Books

1. *Chemical kinetics, K.J Laidler, 3rd Edn. Harper International(1987).*
2. *Electrochemistry, Bockris and Reddy, Vol. 1 & 2Plenum(2002).*
3. *Physical Chemistry, P.W. Atkins, Oxford Univ. Press(2018).*
4. *Physical Chemistry of surfaces, A.W Adamson & A. P.Gast, Wiley(1997).*
5. *Introduction Interfaces and Colloids, J.C. Berg, World Scientific Publishing Company(2009).*
6. *Intermolecular and Surface Forces, J.N. Israclachvili. 3rd edition, Elsevier(2011).*

Course code: MSIC- 105

Course name: Lab Course I

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Able to determine the hardness, alkalinity/acidity and inorganic ions in water
CO2	Purification and distillation of water
CO3	Chromatographic separations by TLC, Paper and Column
CO4	Conduct metric titrations and CMC determination using Conductivity meter
CO5	Physical parameter determination Like pH, Viscosity, Optical activity, Melting Point etc. using various equipment

Course Details:

1. Determination of total acidity/ alkalinity of given water sample.
2. To determine the total hardness of water.
3. Determination of chloride content of a water sample by Mohr`s method.
4. Purification and distillation of tap water / organic solvent.
5. Preparation of phenol formaldehyde resin.
6. To separate the given organic compounds mixture by TLC / Paper chromatography.
7. To separate the different organic compounds by column chromatography.
8. To Prepare 2, 4, 6 – tribromo aniline.
9. To prepare phthalamide from phthalic anhydride.
10. To determine the relative viscosities of given liquids by Ostwald viscometer.
11. Determination of brix, specific gravity and pH of molasses.
12. Determination of total reducing sugar in molasses by Lane & Eynon method.
13. Determination of RS Brix / Pol/ Purity and RS (reducing sugar) in sugar.
14. Conductometric titrations of different acid-base mixtures.
15. Determination of CMC (critical micelle concentration) of a surfactant in water by surface tension measurements at different concentrations.

Course Code: MSIC-106

Course Name: MOOCs Course Alternatives

The Student has the option to replace any one class room taught course with currently floated online MOOCs courses from UGC MOOCs website i.e. https://ugcmoocs.inflibnet.ac.in every semester. MSIC – 105, MSIC – 205, MSIC – 305 and MSIC - 404 are mandatory course which cannot be replaced by MOOCs courses.

Semester II

Course code: MSIC-201

Course name: Polymer Chemistry

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	The basics and different kind of polymers with their properties.
CO2	The concept of molecular weight and distribution
CO3	Difference between crystalline melting temperature and glass transition temperature with variation in properties of polymers
CO4	The effect of factors such as polymer structure, molecular weight, branching and diluents on crystallinity, mechanical properties.
CO5	Techniques of polymer processing

Course Details:

Unit I

Basic Concepts, Kinetics and Rheology

Polymers and their classification, nomenclature, Types of Polymerization: condensation, addition (free radical, cationic and anionic), copolymerization, Kinetics, Polydispersity and Molecular weight distribution, practical significance and measurement of molecular weight

Unit II

Thermodynamics and Transition properties of polymer

Glass transition temperature in polymers (T_g), Melt transition (T_m), factors influencing glass transition temperature, relationship between T_g and T_m.

Process of Polymer dissolution, The Flory –Higgins Theory of polymer dissolution

Unit III

Polymer Processing

Plastics, Elastomers and Fibres, Processing techniques: calendaring, casting, moulding, thermoforming, foaming, reinforcing and fiber spinning, film and laminates. Manufacturing of Thermocol.

Unit IV

Commercially Important Polymers and Applications

Commercially important Thermosetting and Thermoplastic polymers, Resins: Phenol- Formaldehyde resins, Urea- Formaldehyde resins, Epoxy resins, Melamine-Formaldehyde resins. Biomedical polymers, electrically conducting polymers, smart polymers

Recommended Text Books

1. Polymer Science and Technology, Fried JR, Prentice-Hall of India,(2000).

2. Textbook of Polymer Science, Billmeyer F.W., Wiley -Interscience: New York (1984).

3. Scaling Concepts in Polymer Physics, DeGennes, P.G. Cornell University Press (1979).

4. Introduction to Polymers., Young R.J. & Lovell, P.A., 2nd Ed ,Champan & Hall (1991).

Course code: MSIC-202

Course name: Chemistry of materials, Petrochemicals and Fertilizers

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	The chemical composition of cement, ceramics and glass and their industrial applications.
CO2	Learn the chemistry of magnetic materials and nano-materials and their new-age applications.
CO3	Understand the chemical composition of fertilizers and their application to society/agriculture
CO4	Understand the chemical composition of natural gas, crude petroleum, and lubricants and their application to daily life.

Course Details:

Unit I

Cement, Composites, Ceramic and Glass

Composition of cement, mixing of cement clinker with Gypsum, Setting of cement. Microscopic and Macroscopic Composites, Dispersion, Strengthened, Particle and Fiber- reinforced Composites. Composition, Physical and Chemical properties of Glass, Varieties of glass, Introduction to ceramics

Unit II

Magnetic and Nanomaterials

Ferromagnetism, Antiferromagnetism, Ferrimagnetism, Hysteresis, Remanence and Coercivity, Design of Molecular- based magnets: Three dimensional magnetic ordering. Preparation, Properties, Characterization and Applications of Nano materials (SEM, TEM).

Unit III

Fertilizers

N - Ammonia, Ammonium nitrate and Urea; P - Phosphoric acid, Single and Triple superphosphate, DAP; K- Potassium Nitrate and Muriate of potash.

Unit IV

Petrochemicals and Lubricants

Introduction, Occurrence, Composition of Petroleum, Natural gas, cracking, refining, octane rating, cetane number, flash and fire point determination.

Lubricating oils and additives, Naphtha crackers and Profile of their products, Synthetic and Blended oils.

Recommended Text Books

1. *Molecular Magnetism, Oliver Kahn ,VCH Publishers, UK(2021)*
2. *Materials Science and Engineering: An Introduction, W. D. Callisters., Wiley (2018).*

3. *Solid State Physics, N. W. Aschcroft and N. D. Mermin, Holt, Rinehart and Winston (1976).*
4. *Materials Science, J. C. Anderson, K. D. Leaver, J. M. Alexander and R. D. Rowlings,5th edition, ELBS(2003).*
5. *Hand Book of Liquid Crystals, Kelker and Hatz, Wiley(1998).*

Course code: MSIC-203

Course name: Analytical Techniques Part B

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Basic concepts of IR, UV-Visible, NMR and Mass Spectroscopy
CO2	Apply the learned concept of IR, UV-Visible, NMR and Mass Spectroscopy in various fields
CO3	Concept behind the Polarography and its application in analysis of various kinds of organic, inorganic and biological materials
CO4	The principal, Basic concept and application of Electron Spin Resonance Spectroscopy in various areas
CO5	Bragg's law, its relation to crystal structure , different methods on interpretation and application in various fields

Course Details:

Unit I

Spectroscopic Techniques

Introduction, Principles, Instrumentation and Application of IR, UV- Visible, NMR and Mass spectroscopy

Unit II

Electron Spin Resonance

Introduction, Technique, Instrumentation and Applications of ESR.

Unit III

Polarography

Origin of polarography, Current-voltage relationship, Theory of polarographic waves (DC and sampled D polarograms), Instrumentation, Qualitative and Quantitative applications.

Unit IV

X-ray Diffraction

Introduction, Bragg's law, Miller indices, Instrumentation and its applications.

Recommended Text Books

1. *Modern Spectroscopy, Hollas, J. M., 4th Ed., John Wiley & Sons (2004).*
2. *Organic Spectroscopy, Kemp, W. 3rd Ed., W. H. Freeman & Co.(1991).*
3. *Spectroscopic Identification of Organic Compound, Silverstein, R. M., Bassler, G. C. & Morrill, T. C. John Wiley & Sons (1981)*
4. *Structural Methods in Inorganic Chemistry, Ebsworth, E. A. O., Blackwell Scientific Publications (1991).*
5. *Physical Methods in Chemistry, Drago, R. S., W.B. Saunders Co., U.K. (1977)*

Course code: MSIC-204

Course name: Environmental Chemistry and Wastewater Management

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	About the environmental science, biodiversity and ecosystem.
CO2	Conventional and non-conventional energy resource, global warming, ozone layer depletion, water pollution and air pollution
CO3	BOD, COD, DO, TDS, concept of hard water and soft water.
CO4	Fundamentals of unit operations for waste water treatment and disinfection.
CO5	Advanced treatment operations, reverse osmosis, electro dialysis and ion exchange method

Course Details:

Unit I

Basics of Sustainable Development

Scope and Importance of environmental studies, Need for public awareness, Segments of environment, biodiversities: Genetic diversity, Species diversity, Ecosystem diversity, Landscape diversity, Causes of pollution and detrimental effects, Eco systems- Types of ecosystems, energy flow in an ecosystem, Balanced ecosystem, Basics of Environmental Impact Assessment, Sustainable Development

Unit II

Energy Resources and Air Pollution

Energy- Different types of energy (Renewable and Non-renewable), Conventional and non- conventional energy sources- Electromagnetic radiation, Hydro Electric, Fossil fuel based, Nuclear, Solar, Biomass and Bio-gas, Hydrogen as an alternative future source of energy.Environmental pollution and their effects, Water pollution , Land Pollution , Noise Pollution, Public Health aspects , Air pollution. Current environmental issues of importance and their impact on environment: Population Growth, Climate change and global warming effect, Urbanization, Automobile pollution. Acid rain , Ozone layer depletion.

Unit III

Water Quality Assessment and Treatment

Water quality assessment by DO, COD, BOD, TDS, TSS and dissolved ions determination. Hardness of water, softening of water, Reverse osmosis, Treatment of boiler feed water by Calgon process, Ion-exchange resins and Zeolites

Unit IV

Disinfection of Water

Chemical unit processes for Wastewater treatment

Disinfection: Objectives, Different Types - Bleaching Powder, Ozone Treatment, UV Irradiation, Chlorination – Types, Breakpoint chlorination, Dechlorination

Unit V

Advanced Water Treatment Techniques

Advanced treatment operations, Adsorption Isotherms, Advanced Oxidation Process, Membrane processes, Reverse osmosis, Electro dialysis, Desalination, Ion exchange: Removal of specific chemical contaminants as fluorides, arsenic, nitrates and organics.

Recommended Text Books

1. *Environment and Ecology, Gupta K.M., Umesh Publications, Delhi(2008).*
2. *Perspectives in Environmental Studies, Kaushik A, Kaushik CP, New Age International Publishers(2014).*
3. *Environmental Engineering Science, Nazaroff W.W., Alvarez-Cohen L., Wiley India Pvt. Ltd.(2004).*
4. *Wastewater Engineering: Treatment and Reuse, Metcalf and Eddy, Fourth Edition, Tata McGraw Hill(2003).*

Course code:MSIC-205

Course name: Industrial Training and Seminar Part A

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.
CO2	Enhance knowledge in one particular technology.
CO3	provide learners hands on practice within a real job situation.
CO4	Ability to communicate efficiently.

Course Details:

Minimum 2-3 weeks training at an industry during summer

Report to be submitted after training.

Presentation of work done and things learnt at training in the coming semester.

Course Code: MSIC-206

Course Name: MOOCs Course Alternatives

The Student has the option to replace any one class room taught course with currently floated online MOOCs courses from UGC MOOCs website i.e. https://ugcmoocs.inflibnet.ac.in every semester. MSIC – 105, MSIC – 205, MSIC – 305 and MSIC - 404 are mandatory course which cannot be replaced by MOOCs courses.

Semester III

Course code: MSIC-301

Course name: Natural Products, Cosmetics and Perfumery

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Learn the different types of alkaloids, terpenes & terpenoids etc. and their chemistry and biological importance and as lead molecules for new drug discovery
CO2	Learn the constituent present in natural products responsible for anti-diabetic, anti-malarial, activity.
CO3	Learn the constituent present in natural products used as pain killer, local anaesthetic, violent poison etc.
CO4	Learn advanced methods of structural elucidation of compounds of natural origin.
CO5	Understand isolation, purification and characterization of chemical constituents from the natural source.

Course Details:

Unit I

Carbohydrates

Disaccharides and Polysaccharides (Maltose, Cellulose, Lactose and Sucrose)

Unit II

Natural Products

A general introduction, isolation, synthesis and structure of

Alkaloids: Nicotine, Morphine.

Terpenoids: Camphor, Menthol,

Steroids: Cholesterol and Ergocalciferol

Flavonoids: Quercetin and Kaempferol.

Unit III

Cosmetics

Raw materials, Cosmetics for Skin (toners, cleansing agents, moisturizers, sunscreens, talcum powder, bleaching products) and Hair Cosmetics (shampoos, conditioner, colorants, herbs used in hair cosmetics).

Unit IV

Perfumes

Introduction, Composition and Extraction of Perfume (flowers, clove, heena and rice bran) and Identification of compounds used in perfumery.

Recommended Text Books:

1. *Advanced Organic Chemistry, Parts A & B, Carey, F.A. & Sundberg, R.J., Plenum: U.S. (2004).*
2. *Modern methods of Organic Synthesis, Carruthers, W., Cambridge University Press (1971).*
3. *Organic Synthesis: The Disconnection Approach, Warren, S., John Wiley & Sons (1984).*
4. *Advanced Organic Chemistry, Reaction Mechanisms and Structure, J. March., John Wiley (2007).*
5. *Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge University Press(2004).*
6. *Organic Chemistry, Vol.-II, I. L. Finar, ELBS, 5th edition(2000).*
7. *Organic Chemistry, Morrison R.T. & Boyd R. N.; Prentice Hall India (1994).*
8. *Organic Chemistry, Clayden, J.; Oxford University Press (2001).*

Course Code: MSIC-302

Course Name: Pharmaceutical Chemistry

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Fundamentals of Pharmaceutical Chemistry, structure and characteristics of drug
CO2	Pharmacokinetics , Pharmacodynamics, Natural and synthetic lead compounds
CO3	Structure –Activity Relationship and drug design
CO4	Synthesis of Antibiotics and knowledge of some important drug categories
CO5	Strategies in design of anticancer , anti- HIV drugs and drug delivery system

Course Details:

Unit I

Basics of Pharmaceutical Chemistry

Introduction: Characteristics of drug, Common drug targets, Efficacy, inhibitory concentration, lethal dose, therapeutic index, half life, pass time and frequency of dosing, agonists, antagonists, competitive and non competitive inhibitors

Unit II

Drug Synthesis and Testing Techniques

In vitro testing, Line-Weaver-Burk Plot, Pharmacokinetics and pharmacodynamics, ADME, biological testing, natural and synthetic lead compounds, combinatorial synthesis, stereochemistry considerations and optimizing reactions

Unit III

Structure - Activity Relationships

Quantitative structure-activity relationships, Pharmacophore: skeletal and non-skeletal, substrate based drug design and target based drug design, Case study

Unit IV

Antibiotics

Synthesis of selected antibiotics, Structure, activity, resistance issues,

Different classes of antibiotics: Cephalosporins, Penicillins and other beta lactam antibiotics, Fluoroquinolones and other synthetic antibiotics

Unit V

Advanced Therapeutics Techniques

Strategies in design of Anticancer and anti-HIV drugs, Cytotoxicity and bioavailability issues, Drug delivery systems, Gene therapy, Immunotherapy

Unit VI

Important Drug Categories

Psychoactive drugs and cardiovascular drugs

Recommended Text Books

1. *Foye's Principles of Medicinal Chemistry, Williams, D.A., Lemke, T.L., Lippincott Williams and Wilkins(2005).*
2. *Medicinal Chemistry, Kar, A., New Age International Publishers(2007).*
3. *Introduction to Medicinal Chemistry: How drugs act and why? Gringauz, A., John Wiley and Sons(1997).*

Course Code: MSIC-303

Course Name: Sugar and Pulp Chemistry

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	The basic chemistry of sugars and concepts of sugar industry
CO2	The techniques used for the sugar manufacturing like, extraction ,clarification, and concentration of sugarcane juice
CO3	Sugar extraction from alternate sources like sugarbeet
CO4	Industrial application of fermentation like production of alcohol from different sources
CO5	Basics of pulp and paper chemistry

Course Details:

Unit I

Sugar Manufacturing

General idea about sugar factory, Introduction to carbonation and sulphitation processes and their comparison.

Carbonation process: composition of juice, extraction, clarification, sedimentation, evaporation and crystallization in brief. Sulphitation process: single and double sulphitation

Unit II

Chemical Treatment of Byproducts

i. Molasses: composition of molasses, alcoholic fermentation of molasses - manufacture of industrial alcohol, power alcohol, absolute alcohol, rectified sprit, denatured sprit.

ii. Bagasse : characteristics of bagasse, pith and fibre, production of ferfural, production of bio-gas and bio-manure, use of bagasse as fuel and cattle food, production of pulp, paper, fibre board, card board, particle board from Bagasse,.

iii. Colour: measurement of colour of sugar solution by ICUMSA (International Commission for Uniform Methods of Sugar Analysis) protocol.

Unit III

Distillery Industry

Fermentation: Types of fermentation, role of microorganisms and other conditions, production of grain spirit, production of alcohol from alternate feedstock viz. sugarbeat, cassava and lignocellulose.

Unit IV

Pulp and Paper Industry:

Pulp and paper industry in India, raw materials, classification and properties of fibrous materials, mechanical and chemical (acid, neutral and alkaline) pulping process, Lignin as a chemical raw material.

Recommended Text Books

1. *Handbook of Cane Sugar Technology – R.B.L. Mathur, Oxford adn Ibh Pub. Co, New Delhi(1974).*
2. *Cane Sugar Manufacture in India – D.P. Kulkarni, The sugar technologists' association of India , New Delhi(1996).*
3. *Handbook of Cane Sugar Engineering – E. Heogot, IIIrd Edition, Elsevier, Newyork(1986).,*
4. *Cane Sugar Engineering – Peter Rein, Batens (2017).*
5. *Industrial Fermentations by L.A. Under Koeffler, Chemical Pub. Co., Newyork(2013)*
6. *Pulp and Paper chemistry and Technology, Monika E. K, Goran Gellerstedt, Gunnar Heneriksson, GmbH & Co. KG, Berlin* (2009).

Course Code: MSIC-304

Course Name: Essential Oils, Dyes and Paints

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Source and Chemistry of Essential oils
CO2	Various techniques used for the extraction of EOs, recognizing physical and chemical properties
CO3	Uses of Essential oils in various industries(national and International)
CO4	Basic concepts, composition and classification of dyes, process of dyeing and its application
CO5	Basic concept of paints, composition, classification , properties and applications in various fields

Course Details:

Unit I

Essential Oils

Sources, Classification, chemistry of essential oil bearing materials , Methods of production of some important essential oils(rose, jasmine, khus, sandal wood etc.), Grading and Standardization , Physico-chemical characteristics.

Unit II

Dyes

Introduction, General characteristics of colour and constitution, Classification, Basic operations in dying, some commercial dyes (azo dyes, acidic dyes, basic dyes, mordant, vat dyes, indigo dyes, dispersive dyes etc.)

Unit III

Paints

General characteristic, their function, Manufacture and Classification, Enamels, Emulsion paints, Water based paints.Formulation of paints: Function of vehicles , solvent, thinner, pigment, dyes, filler, resins, drier, insecticides, additives in paint formulation

Recommended Text Books

1. *Essential Oils, Vol. I, E.* Guenther, *D.Van Nostrand Company, Inc., Newyork(2007)*
2. *The Essential Oil Book,* Edited by Colleen, K. Dodt, *Storey publishing, North Adams (1996).*
3. *Introduction to Paint Chemistry, G.P.A. Turner, Chapman& Hall, London (1967).*
4. *Basics of Paint Technology, Part I & II,* V.C. Malshe and Meenal Sikchi, *Antar Prakash Center for Yoga, Mumbai, India, (2008).*
5. *Chemistry and Application of Dyes, Editors- Waring, R. David, Geoffery, Plenum Press, New York (1990).*

6. *Textbook of Dye Chemistry,* Georgievice, *London Scott and Greenwood,Toronto (1920).*
7. *Industrial Dyes: Chemistry, Properties and applications,* Edited by Klaus Hunger, *Wiley-VCH Verlag GmbH & Co. KGaA* (2002).

Course Code: MSIC-305

Course Name: Lab Course II

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Isolation of different compounds(Caffeine and Lycopene) from plants
CO2	Estimation of Casein , acidity of provided fruit, identification of DNA, acetic acid in vinegar
CO3	Able to determine the acid value of oil, argemone oil in mustard oil, non-volatile extract of spices, salt % in curry powder
CO4	Enzyme catalysis using UV-Visible spectrophotometer, CO2 determination in water sample
CO5	Physical parameter determination such as density, surface tension etc. with the help of various equipment

Course Details:

1. Isolation of caffeine from tea leaves.
2. Isolation of lycopene from tomato.
3. Estimation of casein in milk.
4. Determination of density of given liquid using pycnometer.
5. To determine the surface tension of given liquid by stalagmometer.
6. Determination of free CO_2 in given water.
7. Determination of dissolution of given Caplet or tablet.
8. To determine the amount of acetic acid present in a given sample of vinegar.
9. To prepare calcium stearate from stearic acid.
10. To determine the acidity of fruit provided.
11. To study the degradation of polymers through viscosity measurement (Ostwald viscometer).
12. To determine enzyme catalysis using UV-Visible spectrophotometer.
13. Extraction and identification of DNA from green peas and onions.
14. To determine the acid value of various vegetable oils.
15. To determine the non-volatile extracts of spices.
16. Determination of salt percentage in curry powder.
17. Determination of Argemone oil in mustard oil.

Course Code: MSIC-306

Course Name: MOOCs Course Alternatives

The Student has the option to replace any one class room taught course with currently floated online MOOCs courses from UGC MOOCs website i.e. https://ugcmoocs.inflibnet.ac.in every semester. MSIC – 105, MSIC – 205, MSIC – 305 and MSIC - 404 are mandatory course which cannot be replaced by MOOCs courses.

Semester IV

Course Code: MSIC-401

Course Name: Environmental Impact Assessment

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	The concepts of Environment Impact Assessment (EIA),
CO2	Environment law, aim and concept,
CO3	Necessity of EIA
CO4	Important plant or animal groups and preparation of EIA reports.
CO5	Methodologies used for EIA

Course Details:

Unit I

National Environmental Policy

The Environment Protection Act 1986. Objectives of Anti-pollution Acts.

National Policy on EIA and Regulatory Framework: Rule, regulations of central and State Government. Central and State pollution control boards for Safeguard for Environmental Protection. Rules, regulations and guidelines given for disposal of hazardous waste, municipal solid waste and bio-medical waste. Case study of current issue requirements of Rule 14 for Environmental Audit under Environmental protection Act 1986.

Unit II

Sustainable Development

Definition and concepts of sustainable development, Integration of (a) Economic, Social and Environmental sustainability (b) Biodiversity and (c) Availability of natural resources in development. Critical review of drawbacks in traditional (base on economics) evaluation of development, Cost benefit analysis. Introduction of ecological growth factor similar to economical growth factor for sustainable development.

Unit III

Methodologies for Impact Assessment

Baseline collection of data, Significant impacts, Assessment of impacts of physical, biological and socio- economic environment, Impact prediction tools / techniques such as adhoc method, checklist methods etc. Development of environment management plan – Post project monitoring, EIA report and EIS, Review process, EIA case studies / histories for industrial projects, water resources and irrigation projects, port and harbours, mining, transportation and other project sectors.

Recommended Text Books

1. *Environmental Impact Assessment, Larry W.Canter Tata McGraw Hill Co. Singapore(1996).*
2. *Environment Engineering and Management, Suresh K. Dhameja, S.K. Kataria & Sons Delhi(2004).*
3. *Relevant MoEF Notifications and CPCB / GPCB Acts & Rules, New Delhi, 2006.*
4. *Environmental Risk Assessment, Whylte, Anne, V. and Ian Burlon(eds), John Wilay and Sons(1980).*
5. *Pares Distn. Environmental Laws in India (Deep. Deep, Lated edn.)*
6. *The ISO 14000 Handbook: Joseph Casci(1999)*
7. *ISO 14004 – Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004: 1996 (E)(2004).*
8. *ISO 14001: Environmental management systems: Specification with guidance for use (ISO 14001: 1996b (E), International organization for standardization, Switzerland(2004).*

Course Code: MSIC-402

Course Name: Food Technology and Agrochemicals

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Nutrients of food like Proteins, carbohydrates, fats etc.
CO2	Structure, sources and importance of vitamins, minerals, pigments and flavor in food
CO3	Cause and prevention of food born bacterial diseases
CO4	Knowledge of food additives and food preservation
CO5	Importance, classification , mode of action, structure and properties of agrochemicals

Course Details:

Unit I

Food Chemistry

Introduction, Classification, Properties of sugar and polysaccharides

in foods, Proteins and amino acids, Vitamins and Minerals, Industrial application of enzymes, Water in food, Water activity and shelf life of food, Natural food flavours, Pigments in food and their industrial application.

Unit II

Food Microbiology

Food born infections and intoxications: bacterial with examples of infective and toxic Type Clostridiums, Salmonella, Staphylococcus. Govt. Regulatory practices and policies, FDA, ISI. Application of microbial enzymes (proteases and lipases) in dairy industry (cheese production) and beverages (beer production).

Unit III

Food Processing and Preservation

Food additives, Contaminants, Food Preservation methods, Food packaging and preservation methods of fruits, vegetables, cereals and grains.

Unit IV

Agrochemicals and their effects

Introduction, Importance and general classification of agrochemicals, mode of action, Public health issues related to agrochemicals.

Classification, Physical and Chemical Properties of Pesticides & Insecticides

(BHC, DDT, Parathion & from natural sources i.e neem seed etc.), Herbicides (2, 4-dichlorophenoxyacetic acid & atrazine).

Recommended Text Books

1. *Food Microbiology ,2nd edn.,* Adams M.R.,*2nd edition, Royal Society of Chemistry, Cambridge(2000).*
2. *Fundamental of Dairy Microbiology, Prajapati J.B.Indian Council of Agriculture Research, New Delhi(2018).*
3. *Microbiology of Fermented Foods, Vol. I & II, Brian J. Wood, Elsevier Applied Science Publication, New York (1998).*
4. *Principles of Food Chemistry, John M. DeMan, Springer (1976).*
5. *Introduction to food Chemistry, Richard Owusu –Apenten, CRC Press (2004).*
6. *Chemistry and Technology of Agrochemical Formulation, Editor- A. Knowles, Springer(1998).*

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Course Code: MSIC-403

Course Name: Chemistry of life

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	Basic concept related to cell biology. Describe biomolecules and their functions
CO2	Concepts of nuclei acid, synthesis, transmission and expressing hereditary information
CO3	Proteins, its synthesis and their function
CO4	Understand the nature of lipids, assembly in membranes and applications
CO5	Knowledge related to enzymes, classification and their various applications

Course Details:

Unit I

Molecules and Life

Introduction, History, Cell theory, Cell biology and their biological science,

Biomolecules, chemical and biological evolution, level of organization.

Unit II

Nucleic Acids

Introduction, Nucleic Acids: Nucleosides, Nucleotides, Biological importance of nucleotides and pentose sugar structure and properties of uracil, thyamine, guanine, cytosine, adenine. Structures of different forms of RNA, DNA (Watson and Crick Model), Concept of gene, Nucleic acid metabolism – central dogma, features of genetic code, A brief introduction of replication, transcription and translation.

Unit III

Proteins and peptides

Classification, Level of organization and biological functions.

Peptides: Structure, Nomenclature, Classification, sequencing of peptides and their function.

Unit IV

Lipids

Fatty acids, essential fatty acids, structure and function , Role of lipid aggregates – micelles ,bilayers, liposomes and their possible biological functions, Lipid metabolism - oxidation of fatty acids and its significance.

Unit V

Enzymes

History, nomenclature, classification, general characteristics, difference between inorganic catalyst and enzyme, Theories of enzyme action, Enzyme kinetics (Michael's Menton equation and its modification). Mechanism of action -factors contributing the catalytic efficiency, Enzyme Inhibition**:** Reversible and irreversible.

Recommended Text Books

1 *CELL and Molecular Biology by E. D.P. Robertis, CCH, a Wolters Kluwer Business (2017).*
2 *Molecular Biology of Cell by Bruce AlbertisW.W. Norton & Company, New York(1983).*
3 *Biochemistry by Lehninger, Kalyani Publishers,(9175).*
4 *Biochemistry by U. Stayanarayana and U. Chakrapani,4th edition, Elsvier India Pvt. Ltd. India(2013).*
5 *Biochemistry by Lubert Stryer,5th edition,(2019),*
6 *Outline of Biochemistry, Conn and Stumpf, Wiely India Pvt. Ltd(2011).*
7 *Biochemistry by J.H. Wel, 4th edition, New Age International Pvt Ltd.(2005)*
8 *Principles of Biochemistry by Zube G.L. Wm. C. Brown PublisherAustralia(1995).*
9 *Chemistry of Peptide synthesis, Bentoiton, N, Leo,Taylor & Francis, New York(2006)*
10 *Fundamental of biochemistry by J L Jain, Sunjay Jain and Nitin Jain, S Chand & Co Ltd, New Delhi(2016)*

Course Code: MSIC-404

Course Name: Industrial Training and Seminar Part B

Course outcomes (CO) : After completion of this course the students will be able to:

CO1	To provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.
CO2	To enhance students' knowledge in one particular technology.
CO3	To provide learners hands on practice within a real job situation
CO4	Ability to communicate efficiently.

Course Details:

Minimum 2-3 weeks training at an industry

Presentation of work done and things learnt at training

Seminar on a relevant topic of interest

Course Code: MSIC-405

Course Name: MOOCs Course Alternatives

The Student has the option to replace any one class room taught course with currently floated online MOOCs courses from UGC MOOCs website i.e. https://ugcmoocs.inflibnet.ac.in every semester. MSIC – 105, MSIC – 205, MSIC – 305 and MSIC - 404 are mandatory course which cannot be replaced by MOOCs courses.