





**Modified Syllabus**  
**for**  
**M.Sc. Industrial Chemistry**

**(according to NEP)**



**Department of Chemistry**  
**CSJM UNIVERSITY, CAMPUS**  
**Kanpur**

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*Ratna*     
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# CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY, KANPUR

STRUCTURE OF SYLLABUS FOR THE

**PROGRAM: M.Sc., SUBJECT: Industrial Chemistry**

1 <sup>ST</sup> YEAR / 1 <sup>ST</sup> SEM						
COURSE CODE	TYPE	COURSE TITLE	MIN CREDITS	CIA	ESE	MAX. MARKS
B190701T	CORE	Analytical Techniques Part A	4	25	75	100
B190702T	CORE	Inorganic Chemistry	4	25	75	100
B190703T	CORE	Organic Chemistry	4	25	75	100
B190704T	CORE	Physical Chemistry	4	25	75	100
B190705P	PRACTICAL	LAB COURSE I	4	25	75	100
	PROJECT	RESEARCH PROJECT				-
TOTAL			20			500
1 <sup>ST</sup> YEAR / II <sup>ND</sup> SEM						
B190801T	CORE	Research Methodology	4	25	75	100
B190802T	CORE	Analytical Techniques Part B	4	25	75	100
B190803T	ANY TWO	1. Polymer Chemistry	4	25	75	100
B190804T	ELECTIVES TO BE CHOSEN	2. Soft Materials and Nano composites				
B190805T		3. Environmental Impact Assessment				
B190806P	PRACTICAL	LAB COURSE II	4	25	75	100
B190807R	PROJECT	RESEARCH PROJECT	8	25	75	100
	MINOR ELECTIVE FROM OTHER FACULTY (IN 1 <sup>ST</sup> YR- Ist/II <sup>nd</sup> SEM)*		4/5/6	25	75	100
TOTAL			32			700
II <sup>ND</sup> YEAR / III <sup>RD</sup> SEM						
B190901T	CORE	Sugar and Pulp Chemistry	4	25	75	100
B190902T	CORE	Chemistry of Life	4	25	75	100
B190903T	ANY TWO	1. Environmental Chemistry and Wastewater Management	4	25	75	100
B190904T	ELECTIVES TO BE CHOSEN	2. Natural Products, Cosmetics and Perfumery				
B190905T		3. Pharmaceutical Chemistry				
B190906P	PRACTICAL	LAB COURSE 3	4	25	75	100
	PROJECT	RESEARCH PROJECT				-
TOTAL			20			500
II <sup>ND</sup> YEAR / IV <sup>TH</sup> SEM						
B191001T	CORE	Food Technology and Agrochemicals	5	25	75	100
B191002T	ANY	1. Essential Oils, Dyes and Paints	5	25	75	100
B191003T	THREE	2. Chemistry of Materials, Petrochemicals And Fertilizers				
B191004T	ELECTIVES TO BE CHOSEN	3. Waste Management				
B191005T		4. Green Chemistry				
B191006T		5. Chemical Analysis In Agro, Food, Soap and Detergent Industries and Safety Measures				
B191007R	PROJECT	RESEARCH PROJECT				
TOTAL			28			500
<b>GRAND TOTAL</b>			<b>100</b>			<b>2200</b>
<b>Open elective course for other departments</b>						
B190808T		Industrial Applications in Chemistry	4	25	75	100

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# M.Sc. Industrial Chemistry

## Syllabus

### Semester I

#### Paper I (MSIC – 101) - Analytical Techniques Part A

Credits:4

Paper Code: B190701T

#### 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, Bassette and co-workers, Longman Group UK
2. Fundamentals of molecular spectroscopy, Bunwell, C.N.
3. Instrumental methods of analysis, Willard M.H., Merrit, L.L., Dean J.A., Settle, F.A.
4. Principles and practice of analytical chemistry, Fijield F.W., Kaley D., Blackie Academic and Professional, 4<sup>th</sup> Edition, 1995.

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**Paper II (MSIC – 102) Inorganic Chemistry**  
Paper Code: B190702T

Credits: 4

**Unit I**

**Chemical Bonding:** Walsh diagram; Evidence of MO pictures from spectra and reactivity; Molecular term symbols (ground & excited state).  $p\pi - d\pi$  bonding,  $3C-2e$  bonding,  $\mu$ -bond,  $\delta$ -bond.

**Unit II**

**Coordination Chemistry:** Crystal field theory, Splitting of d orbitals. Crystal field stabilization energies in weak field and strong field environments, spectrochemical series. and Jahn-Teller effects on energy levels.

**Unit III**

**Magnetochemistry:** Van Vleck equation and its applications, Curie and Curie-Weiss laws, zero-field splitting, spin-orbit coupling, quenching of orbital contribution, para and diamagnetism, ferromagnetic, ferrimagnetism & antiferromagnetic coupling.

**Unit IV**

**Metal Ligand Equilibrium:** Equilibria Stability of mononuclear, polynuclear mixed ligand complexes in solution, Stepwise and overall formation constants, trends in stepwise constants factors affecting the stability of metal complexes – chelate effect, determination of stability constants.

**Unit V**

**Reaction Mechanism:** Inert and labile complexes-Explanation of lability on the basis of CFSE. Substitution reactions (dissociative, associative, Id, & Ia mechanisms) in square planar, tetrahedral and octahedral geometries with special reference to  $d^n$  ion complexes.

**Recommended Text Books:**

1. D. F. Shriver, P. W. Atkins and C. H. Langford, *Inorganic Chemistry*, Oxford University Press, New York (1990.)
2. B. Douglas, D. McDaniel and J. Alexander, *Concepts and Models of Inorganic Chemistry*, 3rd Edn, John Wiley and Sons, Inc., New York (2001).
3. J. E. Huheey, E. A. Keiter and R. L. Keiter, *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th Edn, Harper Collins College Publishers, New York (1993).
4. T. P. Fehlner, J. -F. Halet and J. -Y. Saillard, *Molecular Clusters — A Bridge to Solid State Chemistry*, Cambridge University Press, Cambridge (2007).
5. M. Driess and H. Noth (Eds.), *Molecular Clusters of the Main Group Elements*, Wiley-VCH, Weinheim (2004).
6. O. Kahn, *Molecular Magnetism*, VCH, New York (1993).
7. P. Braunstein, L. A. Oro and P. R. Raithby (Eds.), *Metal Clusters in Chemistry*, Wiley-VCH, Weinheim (1999).
8. M. H. Chisholm (Ed.), *Early Transition Metal Clusters with  $\pi$ -Donor Ligands*, VCH, New York (1995).
9. J. D. Lee, *Concise Inorganic Chemistry*, Chapman and Hall, London (1991).

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## Paper III (MSIC – 103) - Organic Chemistry

Credits:4

Paper Code: B190703T

### Unit I

#### Heterocyclic synthesis & Pericyclic

Introduction, synthesis and properties of Thiophene, Furan, Pyridine, Pyrrole, Quinoline and Indole. Cycloaddition, Electrocyclic, Sigmatropic and Cheletropic reactions.

### Unit II

#### 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 III

#### Reagents in Organic synthesis

Grignard reagent,  $\text{NaBH}_4$ ,  $\text{LiAlH}_4$ , Gilman's reagents, Lithium dimethyl cuprate, DDQ, oxidising agents:  $\text{SeO}_2$ .

### Unit IV

#### Organic Synthesis

Disconnection approach (one and two group), C-C, C-X disconnection, 1, 3 and 1, 5-difunctional compounds.

#### Recommended Text Books:

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

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## Paper IV (MSIC – 104) - Physical Chemistry

Credits:4

Paper Code: B190704T

### 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, 3<sup>rd</sup> Edn. Harper International.*
2. *Electrochemistry, Bockris and Reddy, Vol. 1 & 2 Plenum.*
3. *Solid State Chemistry, H.V. Keer, Wiley Eastern.*
4. *Physical Chemistry, P.W. Atkins, Oxford Univ. Press.*
5. *Physical Chemistry of surfaces, A.W Adamson & A. Gast*
6. *Introduction Interfaces and Colloids, J.C. Berg.*
7. *Intermolecular and Surface Forces. J.N. Israclachvili.*

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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.

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## Semester II

Paper Code: B190801T

### Paper VI (MSIC- 201) Research Methodology, Statistical Techniques and Computer Applications

Credits:4

#### 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

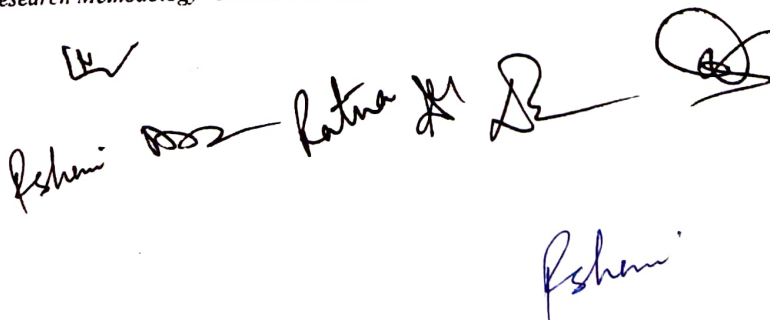
#### Unit V

##### 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*
2. *Research Methodology; Methods and Techniques- C.P.Kothari*
3. *Statistics (Theory and Practice) – B.N.Gupta*
4. *Research Methodology; Methods and statistical Techniques- Santosh Gupta*
5. *Research Methodology and statistical Measures- Reddy and Rao*
6. *Research Methodology- Sharma and Jain.*

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

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Paper VIII Elective Paper 1

Paper IX Elective Paper 2

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**Paper X (MSIC – 203)- Lab Course II**

**Credits:4**

**Paper Code: B190806P**

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<sub>2</sub> 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.

*Dr. Ratna Pishani*

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**Paper XI (MSIC- 204) –Research Project/ Industrial Training and Seminar**

**I**

*Credit 8*

Paper Code: B190807R

It includes industrial training, seminar and project work

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## Elective Papers

Elective 01- (MSIC- E201) Polymer Chemistry  
Paper Code: B190803T

Credits:4

### 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. Fried JR. *Polymer Science and Technology*. Prentice-Hall of India, (2000)
2. Billmeyer F.W., *Textbook of Polymer Science*, Wiley-Interscience: New York (1984)
3. DeGennes, P.G. *Scaling Concepts in Polymer Physics*, Cornell University Press (1979)
4. Young R.J. & Lovell. P.A., *Introduction to Polymers 2<sup>nd</sup> Ed.*, Chapman & Hall (1991)

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**Elective 02- (MSIC- E202) - Soft Materials and Nanocomposites**  
Paper Code: B190804T

Credit 4

**UNIT I:**

**Liquid Crystals:** Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientation, order nematic & smectic mesophases, nematic transition & clearing temperature-homotropic, planer & schlieren textures, twisted nematic, chiral nematic, molecular arrangement in smectic A & Smectic B phases, optical properties of liquid crystals, Dielectric susceptibility & dielectric constants, Lyotropic phases & their description or ordering in liquid crystals.

**UNIT II**

**Soft Materials:** Thin Films and Langmuir-Blodgett Films, Preparation techniques, vaporation/sputtering, chemical process, MOCVD, sol-gel etc. growth technique, photolithography, properties and applications of thin and L-B films.

**UNIT III**

**Organic Solids and Fullerenes:** Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes: doped fullerenes as superconductors.

**UNIT IV**

**Nanocomposites:** Introduction to Nanocomposites, Composite material, Mechanical properties of Nano composite material: stress - strain relationship, toughness, strength, plasticity. Synthetic methods for various nanocomposite materials: mechanical alloying, thermal spray synthesis etc. Nano composites for hard coatings; DLC coatings; Polymer nanocomposites; Thin film nanocomposites; Applications of nanocomposites in drug delivery.

**Recommended Text Books:**

1. *Material science and Engineering*, W D Callister, Wiley.
2. *Solid State Chemistry*, A R west.
3. *Modern Prospective in Solid State Chemistry*, C N R Rao and J Gopalakrishnan.
4. *Principles of Polymer Science*, Bahadur P and N.V Shastry, Narosa, New Delhi, 2000.
5. *Polymer Science and Engineering*, D.J.Williams, Prentice Hall Inc, New Jersey, 1971.
6. *Theory and Basics of Polymer Science*, F.W. Billmeyer, John Wiley & Sons, NY, 1984
7. P.M. Ajayan, L.S. Schadler and P.V. Braun, *Nanocomposite Science & Technology* - WileyVCH GmbH Co.
8. Chatopadhyaya.K.K, and Banerjee A.N. *Introduction to Nanoscience and Nanotechnology*
9. C.N.R. Rao, A. Muller and A.K. Cheetham. *The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Vol-I.*

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

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## Semester III

### Paper XII (MSIC – 301) –Sugar and Pulp Chemistry

Credits:4

Unit I Paper Code: B190901T

#### 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 spirit, denatured spirit.

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
2. *Cane Sugar Manufacture in India* – D.P. Kulkarni
3. *Handbook of Cane Sugar Engineering* – E. Heogot
4. *Cane Sugar Engineering* – Peter Rein
5. *Industrial Fermentations* by L.A. Under Koeffler, Chemical Pub. Co., Newyork
6. *Pulp and Paper chemistry and Technology*. Monika E. K, Goran Gellerstedt, Gunnar Heneriksson.

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**Paper XIII (MSIC – 302) – Chemistry of life**

**Credits:4**

Paper Code: B190902T

**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, thymine, 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.

**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 D. Robertis.
- 2 Molecular Biology of Cell by Albertis.
- 3 Biochemistry by Lehninger, Kalyani Publishers.
- 4 Biochemistry by U. Stayanarayana and U. Chakrapani, Books and Allied (P) ltd
- 5 Biochemistry by Stryer.
- 6 Outline of Biochemistry, Conn and Stumpf Biochemistry by J.H. Well.
- 7 Biochemistry by Zubey.
- 8 Peptide synthesis, Bondensky & Bondensky.
- 9 Fundamental of biochemistry by J L Jain, Sunjay Jain and Nitin Jain, S Chand & Co Ltd.

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Paper XIV Elective Paper 1

Paper XV Elective Paper 2

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1. Preparation of detergent and study of the properties.
2. To prepare liquid soap and study its properties.
3. Preparation of flower extracts in water (eg. Rose water)
4. Preparation of flower extracts in oil (Itar)
5. Preparation of Hand Sanitizer.
6. Preparation of disinfectant (Phenyle)
7. Preparation of cream (cosmetics i.e. cold and vanishing)
8. Saponification of edible oil
9. Qualitative analysis of soap by foaming
10. To determine the Iodine value of soap.

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## Elective Papers

**Elective 01- (MSIC- E301) – Environmental Chemistry and Wastewater Management** Paper Code: B190903T Credit 4

### 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 and Advanced Water Treatment Techniques

Chemical unit processes for Wastewater treatment

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

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*, Nazuroff W.W., Alvarez-Cohen L., Wiley India Pvt. Ltd., 2004.
4. *Wastewater Engineering: Treatment and Reuse*, Metcalf and Eddy, Fourth Edition, Tata McGraw Hill.

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**Elective 02- (MSIC- E302) –Natural Products, Cosmetics and Perfumery**

Paper Code: B190904T

**Credits:4**

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

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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

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.

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## Semester IV

**Paper XVII (MSIC – 401) – Food Technology and Agrochemicals** Credits: 5  
Paper Code: B191001T

### 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 Clostridium, Salmonella, Staphylococcus. Govt. Regulatory practices and policies, FDA, ISI. Application of microbial enzymes (proteases and lipases) in dairy industry (cheese 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*, 2<sup>nd</sup> edn., Adams.
2. *Fundamental of Dairy Microbiology*, Prajapati.
3. *Microbiology of Fermented Foods, Vol. I & II*, Brian J. Wood, Elsevier Applied Science Publication.
4. *Principles of Food Chemistry*, John M. DeMan, Springer 1976.
5. *Introduction to food Chemistry*, Richard Owusu –Apenten, CRC Press.
6. *Chemistry and Technology of Agrochemical Formulation*, Editor- A. Knowles, Springer.

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Paper XVIII Elective Paper 1

Paper XIX Elective Paper 2

Paper XX Elective Paper 3

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**Paper XXI (MSIC 402)- Research Project / Industrial Training and Seminar II**

Paper Code: B191007R

**Credits:8**

Minimum 2-3 weeks training at an industry

Presentation of work done and things learnt at training

Seminar on a relevant topic of interest

Or

Research project and submission of dissertation

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## Elective Papers

### Elective 01- (MSIC- E401) –Essential Oils, Dyes and Paints

Credits: 5

Paper Code: B191002T

#### 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 dyeing, 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-V*, Guenther.
2. *The Essential Oil Book*, Edited by Colleen, K. Dodt.
3. *Introduction to Paint Chemistry*, G.P.A. Turner, Chapman & Hall.
4. *Basics of Paint Technology, Part I & II*, V.C. Malshe and Meenal Sikchi.
5. *Chemistry and Application of Dyes*, Editors- Waring, R. David, Geoffery.
6. *Textbook of Dye Chemistry*, Georgievce, London Scott Greenwood.
7. *Industrial Dyes: Chemistry, Properties and applications*, Edited by Klaus Hunger.

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**Elective 02- (MSIC- E402) –Chemistry of Materials, Petrochemicals and Fertilizers**

**Credits: 5**

Paper Code: B191003T

**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. Oliver Kahn. *Molecular Magnetism*, VCH Publishers, (UK).
2. W. D. Callisters. *Materials Science and Engineering: An Introduction*, Wiley.
3. N. W. Aschcroft and N. D. Mermin. *Solid State Physics*,
4. J. C. Anderson, K. D. Leaver, J. M. Alexander and R. D. Rowlings. *Materials Science*. ELBS.
5. Kelker and Hatz. *Hand Book of Liquid Crystals*

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**Elective 03- (MSIC- E403) – Waste Management**  
Paper Code: B191004T

**Credits: 5**

**Unit I**

**Introduction and Types of Waste**

Introduction to environmental Science. Definition, Types and Categories of Waste. Collection, Sorting and Transfer of Waste ,The Five R's.

**Unit II**

**Solid and Liquid Waste Management**

Techniques in Solid and Liquid waste Management. Waste Disposal and Scientific Landfill Cultivation. Municipal waste management

**Unit III**

**Hazardous Waste Management**

Introduction to Hazardous Waste Management (Nuclear waste and e-waste), Management and disposal of hazardous waste, Impact of Biomedical waste on environment and human health. Treatment and disposal of Biomedical waste.

**Unit IV**

**Biomedical and Industrial Waste Management**

Infection control, prevention and patient safety. Waste management in food industry, Reuse and recycling Techniques.  
Entrepreneurship in waste management, Human Resource and Financial Management. Industry based case studies

**Recommended Text Books**

1. Frank Kreith, *Hand Book of Solid Waste Management*, Mc Graw Hills, Newyork , 2017.
2. Yung-Tse Hung, *Hand Book of Environment and Waste Management vol1*, World Scientific Publishing Company Pte Ltd. 2012.
3. John Pichtel, *Waste Management Practices; Municipal, Hazardous and Industria*, CRC Press, 2014

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**Elective 05 - (MSIC- E405) – Chemical Analysis in Agro, Food, Soap and Detergent Industries and Safety Measures**

Paper Code: B191006T

Credit: 5

**Unit I**

**Analysis of soil:** Moisture, pH, total nitrogen, phosphorous, silica, lime, Magnesia, Manganese, sulfur and alkali salts.

**Fuel analysis:** Solid, liquid and Gas, ultimate and proximate analysis heating values, grading of coal, liquid fuels, flash points, aniline point, octane number and carbon residue, gaseous fuels – producer gas and water gas – calorific value.

**Unit II**

**Oils, soaps and Detergents:** Refining of edible oils, manufacturing of soaps, detergents-classification-anionic, cationic, non-ionic and amphoteric detergents, detergent builders and additives, liquid soaps. Manufacturing of fatty acids and glycerol, greases from fatty acids, turpentine oil

**Unit III**

**Food analysis :** Moisture, ash, crude protein, fat, crude fiber, carbohydrate, calcium, potassium, sodium, and phosphates, food adulteration – common adulteration in food, contamination of food stuffs, microscopic examination of foods for adulterants, Pesticide analysis in food products, Extraction and purification of sample, HPLC, gas chromatography for organo – phosphates, thin layer chromatography for identification of chlorinated pesticides in food products.

**Unit IV**

**Safety:** Flammable material handling and firefighting equipment's, control measures for toxic chemicals, industrial hygiene, safety in laboratories & plant, safety in the transportation & storage of chemicals. OHSAS 18000.

**Chemical Warfare Convention:** Definitions and schedules. Toxic chemicals, remote control systems, tear gas, chemical weapons, ocean dumping of chemical weapons.

**Recommended Text Books**

1. *Statistical Quality Control, 2<sup>nd</sup> Edn., Manohar Mahajan Dampat Rai and Sons, 1995.*
2. *Quality management: a process improvement approach, Fryman Mark A, Cengage learning, 2002.*
3. *Quality Control, Paranthaman D. Tata, McGraw Hill, 1987.*
4. *Gupta R. N. Chemical warfare and casualty management 2011*
5. *Vyas M. N. Safety and hazards management in chemical industries 2013. Atlantic publication.*
6. *Dikshith T.S.S Safety evaluation of environmental chemicals. New Age International, 1996.*
7. *Chemical Safety Matters-IUPAC-IPCS. Cambridge univ. Press, 1992.*
8. *Environmental Chemistry: A K. Dey, Wiley Eastern.*

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9. *Environmental Chemistry*, S.K. Banerji, Prentice Hall India, 1993.
10. *Chemistry of Water Treatment*, S.D. Faust and O.M. Aly, Butterworths, 1983.
11. *Environmental chemistry*, Ahluwalia V K, Anne Books India, 2008.
12. *Chemistry for Environmental Engineering*, Sawyer and McCarty, McGraw Hill, 1978.
13. *Environmental Chemistry*, I. Williams, John Wiley, 2001
14. *Engineering Chemistry* by Jain and Jain.
15. *Industrial electrochemistry* by Peltcher
16. *Modern Electrochemistry: Vol I, IIA & IIB* (1998) J.O.M. Bockris and A.K.N. Reddy

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## Open elective course for other departments

**MCH 01 -Industrial applications in Chemistry**  
Paper Code: B190808T

Credits: 5

### Unit I

**Cement, Ceramic and Glass:** Composition of cement, mixing of cement clinker with Gypsum, Setting of cement. Composition, Physical and Chemical properties of Glass, Varieties of glass, Introduction to ceramics

### Unit II

**Polymeric Materials:** Introduction, classification, types of polymerisation, properties, Miscellaneous polymers ( Thermoplastic, Thermosetting, conducting, Biopolymers, polymers in medicine and surgery)and their applications.

### 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. Oliver Kahn. *Molecular Magnetism*, VCH Publishers, UK (1993)
2. W. D. Callisters, *Materials Science and Engineering: An Introduction*, Wiley (2006).
3. N. W. Aschcroft and N. D. Mermin *Solid State Physics*, Holt, Rinehart and Winston, New York (1976).
4. J. C. Anderson, K. D. Leaver, J. M. Alexander and R. D. Rowlings *Materials Science*. ELBS (2003).
5. Kelker and Hatz . *Hand Book of Liquid Crystals*, 2<sup>nd</sup> Ed. Wiley (2014)
6. Principles of Polymer Science, Bahadur P and N.V Shastry, Narosa, New Delhi, 2000.
7. Polymer Science and Engineering. D.J. Williams, Prentice Hall Inc, New Jersey, 1971.
8. Theory and Basics of Polymer Science, F.W. Billmeyer. John Wiley & Sons. NY, 1984.

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