

**Shri Rawatpura Sarkar University,
Raipur**



**Examination Scheme & Syllabus
for
MASTER OF SCIENCE IN CHEMISTRY
SEMESTER-III**

(Effective from the session: 2021-2022)



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Teaching and Examination Scheme

SN	Course Code	Th/Pr	Subject	Type of Course	Credit				Examination Scheme				Total Marks
					L	T	P	TC	Theory		Practical		
									EX	IN	EX	IN	
1.	SMS04301	Th	Natural Product and Medicinal Chemistry	Core	4	-	-	4	70	30	-	-	100
2.	SMS04302	Th	Biochemistry and Environmental chemistry	Core	4	-	-	4	70	30	-	-	100
3.	SMS04331	Th	Green Chemistry	Elective I	4	-	-	4	70	30	-	-	100
	SMS04332		Materials / Nuclear and Radiochemistry										
4.	SMS04333	Th	Pharmaceutical Techniques Technologies Development	Elective II	4	-	-	4	70	30	-	-	100
	SMS04334		Newer Synthetic Reactions and Reagents / Heterocyclic Chemistry										
5.	SMS04335	Th	Industrial Chemistry	Elective III	4	-	-	4	70	30	-	-	100
	SMS04336		Polymers										
6.	SMS04381	Pr	Chemistry Lab course: V	Core/Elective	-	-	4	2	-	-	35	15	50
7.	SMS04382	Pr	Chemistry Lab Course: VI	Core/Elective	-	-	4	2	-	-	35	15	50
Total					24								600



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Title	NATURAL PRODUCT AND MEDICINAL CHEMISTRY				
Course Code	SMS04301				
Course Credit	L	T	P	TC	
	4	-	-	4	
Prerequisite	Basic knowledge of chemistry				
Course Objective	<ul style="list-style-type: none"> Natural Product and Medicinal Chemistry in advance and establish foundation to research in the respective domain. 				
Course Content	<p>UNIT I</p> <p>Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination of Citral, Geraniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β – Carotene, Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on Nitrogen heterocyclic ring, role of alkaloids in plant. Synthesis and biosynthesis of the following: Ephedrine, (+)-Coline, Nicotine, Atropine, Quinine and Morphine.</p> <p>UNIT II</p> <p>Steroids: Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Esterone, Progesterone, Aldosterone and Biosynthesis of cholesterol, Plant Pigments: Occurrence, nomenclature and general method of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myricetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-O-galactoside, Cyanidin, Hirsutidin, Pyrethroids and Rotenones: Synthesis and reaction of Pyrethroids and Rotenones.</p> <p>UNIT III</p> <p>Drug Design: Development of new drugs procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, Structure-Activity Relationship (SAR), Factors affecting bioactivity, resonance, inductive effect. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative Structure Activity Relationship (QSAR). Physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Steric and surface activity parameters and redox potentials, General introduction of pharmacokinetics and pharmacodynamics.</p> <p>UNIT IV</p> <p>Antineoplastic Agents: Introduction cancer chemotherapy, special problems, role of alkylating agents and anti metabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards and 6-mercaptopurine. Recent development in cancer chemotherapy Hormone and natural Products, Cardio vascular Drug: Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function central intervention of cardiovascular output, Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, melhydopa, atenolol, nifedipine.</p>				



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

	<p>UNIT V</p> <p>Local Antiinfective Drugs: Introduction and general mode of action, Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapson, aminosalicylic acid, isoniazid, ethionamide, ethambutol, fluconazole, econazole, griseofulvin, chloroquin and primaquine, Psychoactive Drugs -The Chemotherapy of Mind: mode of action of hypnotics, sedatives, anti-anxiety drugs, synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximide, trimethadione, barbiturates, thiopental sodium, glutethimide, Antibiotics: Constitution and synthesis of penicillins, chloramphenicol, tetracycline and streptomycin.</p>
Course Outcome	<ul style="list-style-type: none">On the completion of this course successfully student will be able to understand the development of the inorganic chemistry.
Text Books	<ol style="list-style-type: none">Natural Products: Chemistry and Biological Significance, J. Mann, R. S. Davidson, J. B. Hobbs. Harlow, Essex, England : Longman Scientific & Technical ; New York : Wiley, 1994D. V. Banthorpe and J. B. Harbrone, Longman, Essex., Organic Chemistry, Vol. 2, I. L. Finar, ELBS.Chemistry, Biological and Pharmacological properties of Medicinal Plants from the Americans, Ed. Kurt Hostettmann, M. P. Gupta and A. Marston, Harwood Academic Publishers.
Reference Books	<ol style="list-style-type: none">Introduction to Flavonoids, B. A. Bhom, Harwood Academic Publishers.New Trends in Natural Product Chemistry, Att-ur-Rahman and M. I. Choudhary, Harwood, Academic Publishers.Insecticides of Natural Origin, SukhDev, Harwood Academic Publishers.Introduction to medicinal Chemistry, A Gringuage, Wiley-VCH. <p>Burger's Medicinal Chemistry-1 (Chapter-9 and Ch- 14), Drug Ed. M. E. Discovery, Wolff, John Wiley.</p>



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Course Title	BIOCHEMISTRY AND ENVIRONMENTAL CHEMISTRY				
Course Code	SMS04302				
Course Credit	L	T	P	TC	
	4	-	-	4	
Prerequisite	Knowledge of chemistry				
Course Objective	<ul style="list-style-type: none"> To study Biochemistry and Environmental chemistry in advance and establish foundation to research in the respective domain. 				
Course Content	<p>UNIT I</p> <p>Bioenergetics: Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP, Electron transfer in biology: Structure and function of metalloproteins in electron transport processes –cytochromes and ion-sulphur proteins, synthetic models, Transport and storage of dioxygen: Heme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, haemocyanins and haemerythrin, model synthetic complexes of iron, cobalt and copper.</p> <p>UNIT II</p> <p>Enzymes: Nomenclature and classification of induced Enzyme. fit hypothesis, concept and identification of active site by the use of inhibitors, Co-enzyme chemistry: Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD⁺, NADP⁺, FMN, FAD, lipoic acid, vitamin B12, Enzyme models: Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry, Cyclodextrin-based enzyme models, calixarenes, ionophores, synthetic enzymes or synzymes.</p> <p>UNIT III</p> <p>Metalloenzymes: Zinc enzymes –carboxypeptidase and carbonic anhydrase. Iron enzymes – catalase, peroxidase and cytochrome P-450. copper enzymes- superoxide dismutase. Molybdenum oxatransferase enzymes –xanthine oxidase, Biopolymer Interaction: forces involved in biopolymer interaction. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves, Thermodynamics of biopolymers solutions: Thermodynamics of biopolymer solution, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical system</p> <p>UNIT IV</p> <p>Environment:- Introduction, Composition of atmosphere, vertical temperature, heat budget of earth atmospheric system, Biogeochemical cycle of C, N, P, S and O. Atmosphere:- Chemical composition of atmosphere- particles, ions and radicals and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N,C,S and their effect, pollution by chemicals, petroleum, chlorofluoro, hydrocarbons. Green house effect, acid rain, air. Hydrosphere: Chemical composition of water bodies-lakes, streams, rivers and wet lands etc. Hydrological cycle. Aquatic pollution- inorganic, organic,</p>				



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

	<p>agricultural, industrial and sewage, detergents, oil spills and oil pollutants.</p> <p>UNIT V</p> <p>Analysis of Water:Water quality parameter - dissolved oxygen biochemical oxygen demand, solids metals, sulphate, phosphate, nitrate, microorganism, Water Quality standard. analytical methods for measuring BOD, DO, COD, F, oils metals (As, Cd, Hg, Pb) Residual chloride and chloride demands, Heavy metal pollution - public health significance of cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic. General survey of instrumental technique for the analysis of heavy metals in aqueoussystem. Industrial Pollution:-Cement, Sugar, distillery, paper and pulp, Thermal power plants, Nuclear power plants, Radio Nuclide analysis disposal of waste and their managementChemical solutions to environmental problems, biodegradability, principles of decomposition better industrial processes. Bhopal gas tragedy, Chernobyl, Three Mile Island and Minamata disasters.</p>
Course Outcome	<ul style="list-style-type: none">• On the completion of this course successfully student will be able to understand the development of the Bio Chemistry andEnvironmental chemistry
Text Books	<ol style="list-style-type: none">1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.L. Lippard and J.S. Valentine, University Science Books.3. Inorganic Biochemistry vols II and I.Ed G.L. Eichhorn, Elsevier.
Reference Books	<ol style="list-style-type: none">1. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-verlag.2. Understanding Enzymes, Trevor palmer, Prentice Hall.3. Enzyme Chemistry : Impact and Applications, Ed. Collin J Suckling, Chapman and Hall4. Biochemistry, L. Stryer, W.H. Freeman.



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Course Title	GREEN CHEMISTRY				
Course Code	SMS04331				
Course Credit	L	T	P	TC	
	4	-	-	4	
Prerequisite	Knowledge of chemistry				
Course Objective	<ul style="list-style-type: none"> Green Chemistry in advance and establish foundation to research in the respective domain. 				
Course Content	<p>UNIT I</p> <p>Introduction to Green Chemistry:Green chemistry - Anastas' twelve principles of green chemistry -Principle of atomeconomy. Examples of reactions following the principles of green chemistry and atomeconomy.A. Green Preparation of propene B. Green synthesis of Ibuprofen</p> <p>UNIT I</p> <p>Green Reactions:Acetylation of primary amine, base catalyzedaldol condensation (synthesis of dibenzalpropanone)- halogen addition to C=C bond (bromination of trans-stilbene)- [4+2] cycloaddition reaction (Diels-Alder reaction between furan and maleic acid). Rearrangement reaction (benzyl-benzilic acid rearrangement)- coenzyme catalyzed benzoin condensation (thiamine hydrochloride catalyzed synthesis of benzoin.</p> <p>UNIT III</p> <p>Green solvents: Introduction –classification of ionic liquids- synthesis of ionic liquids – Ionic liquids: simple preparation – types – properties and application – ionic liquids in organic reactions (Heck reaction, Suzuki reactions and epoxidation)- Analytical chemistry - gas chromatography stationary phases – advantages and disadvantages. Reactions in water and supercritical water and carbon dioxide. Green Catalyst: Supported metal catalysts – mesoporous silica. Phase transfer catalyst - Synthesis –applications. Magnetically recoverable catalysts.</p> <p>UNIT IV</p> <p>Alternative Synthesis, Reagents and Reaction Conditions: Photo reduction of benzophenone to benzopinacol using sunlight. Photochemicalalternative to Friedel-Crafts reaction and use of dimethyl carbonate as a methylatingagent. Reaction in water - furan and maleic acid. Supercritical liquids – water andCO₂.Extraction of D-limonene from orange peel. Green chemistry examples based onsonochemistry and mechanochemistry and photochemical principles in greenchemistry.</p> <p>UNIT V</p> <p>Application of Green Chemistry in real world cases: Wealth from waste, Industrial case studies Green Nanotechnology, Greener approaches for nanoparticle synthesisPharmaceutical industries: The largest waste producer problems and solutions through Green Chemistry benefits of greening industries, Need for Academia-Industry collaborations,Innovations stemming from Academia-Industry collaborationsEmerging Green Technologies. Green solvents, Next generation catalyst design, Microwave assisted</p>				



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

	synthesis etc.
Course Outcome	<ul style="list-style-type: none">On the completion of this course successfully student will be able to understand the green solvents and green catalysts
Text Books	<ol style="list-style-type: none">V.K. Ahluwalia, Green Chemistry – Environmentally benign reactions. Ane Books, India, 2006.Paul T. Anastas & Tracy C., Williamson, Green Chemistry – Designing Chemistry for the Environment, 2nd edition, 1998.Paul T. Anastas & Tracy C., Williamson Green Chemistry – Frontiers in benign chemical synthesis and processes, Oxford University Press, New York, 1998.
Reference Books	<ol style="list-style-type: none">Rashmi Sanghi, & M. M. Srivastava, Green Chemistry – Environment friendly alternatives, Narosa Publishing House, 2003.M.C. Cann & M. E Connelly, Real world cases in Green Chemistry, American Chemical Society, 2008.P. Tundo, A. Perosa and F. Zechini, Methods and Reagents for Green Chemistry, John Wiley & Sons Inc. New Jersey, 2007.



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Course Title	MATERIALS / NUCLEAR AND RADIOCHEMISTRY				
Course Code	SMS04332				
Course Credit	L	T	P	TC	
	4	-	-	4	
Prerequisite	Basic knowledge of material and nuclear chemistry				
Course Objective	<ul style="list-style-type: none"> Materials / Nuclear and Radiochemistry in advance and establish foundation to research in the respective domain. 				
Course Content	<p>UNIT I Introduction to the solid state, metallic bond, Band theory (Zone model, Brillouin Zones, Limitations of the Zone model); Defects in solids, <i>p</i>-type and <i>n</i>-type; Inorganic semiconductors (use in transistors, IC, etc.); Electrical, optical, magnetic and thermal properties of inorganic materials. Superconductors, with special emphasis on the synthesis and structure of high temperature superconductors.</p> <p>UNIT II Solid State Lasers (Ruby, YAG and tunable lasers): Inorganic phosphor materials; Synthesis and advantages of optical fibres over conducting fibres. Diffusion in solids, catalysis and Zone refining of metals.</p> <p>UNIT III Preparation of nanomaterials and their characteristic differences over bulk materials. Principles of Electron Microscopy, Dynamic Light Scattering, Atomic Force Microscopy and characterization of nanomaterials.</p> <p>UNIT IV Nuclear structure and nuclear stability, Nuclear models, Radioactivity and nuclear reactions (including nuclear fission and fusion reactions). Hot atom chemistry, Nuclear fission and fusion reactors. The interaction of nuclear radiations with matter. Radiation hazards and therapeutics. Detectors and their principles.</p> <p>UNIT V The direction of radioactivity. The counting errors and their corrections. Tracer techniques and their applications. Isotope dilution and radio-activation methods of analysis. Fission product analysis (e.g., the technique of isolating two or three different fission products of U or Th and determining the yields).</p>				
Course Outcome	<ul style="list-style-type: none"> On the completion of this course successfully student will be able to understand the green solvents and green catalysts 				
Text Books	<ol style="list-style-type: none"> West, A.R. Solid State Chemistry & its Applications, John Wiley & Sons(1987). West, A.R. Basic Solid State Chemistry, 2nd Edition, John Wiley & Sons(2000). Smart, L.E. & Moore, E.A. Solid State Chemistry - An Introduction, 3rd Edition, CRC Press(2005). 				



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

	4. Rodgers, G.E. Descriptive Inorganic, Coordination & Solid-State Chemistry, 3 rd Edition, Brooks/Cole, Cengage learning(2002).
Reference Books	<ol style="list-style-type: none">1. Tilley, R.J.D. Understanding Solids: The science of materials, 2nd Edition, John Wiley & Sons(2004).2. Harvey, B. C. Introduction to Nuclear Chemistry Prentice-Hall(1969).3. Friedlander,G.Kennedy,J.W.,Marcus,E.S. &Miller,J.M.Nuclear&Radiochemistry,JohnWiley& Sons (1981).4. Timp, G., Ed. Nanotechnology Springer-Verlag: N. Y.(1999).



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Course Title	PHARMACEUTICAL TECHNIQUES TECHNOLOGIES DEVELOPMENT				
Course Code	SMS04333				
Course Credit	L	T	P	TC	
	4	-	-	4	
Prerequisite	Knowledge of pharmaceutical chemistry				
Course Objective	<ul style="list-style-type: none"> To acquire knowledge of drug design, and development, pharmacokinetics, and pharmacodynamics. 				
Course Content	<p>UNIT I</p> <p>Importance of Targeted Drug Delivery, Efficacy, Safety and Toxicity Issues. Molecular basis of targeted drug delivery. Drug Release and Uptake Phenomenon. Drug Encapsulation Technologies. Different Carriers for Drug Encapsulation: Nanomaterials (metal-based, metal oxide based and polymeric) in drug encapsulation and drug delivery: their characterization, generation, efficacy, toxicity and release profile. Factors affecting drug loading and drug release.</p> <p>UNIT II</p> <p>Techniques to measure degree of loading and release efficiency. Metabolism and excretion of drug delivery carriers. General considerations; Methods of preparations, characterization and applications of liposomes, ionosomes, resealed erythrocytes, nanoparticulate systems, solid-liquid nanoparticles, dendrimers, organogels, multiple emulsions and nanoemulsions.</p> <p>UNIT III</p> <p>Overview and application of aquasomes, pharmacosomes, liquid crystalline systems, protein and peptide-based drug delivery systems. Polymers in drug encapsulation and drug delivery: Classification, synthesis and applications of biodegradable and natural polymers in formulation of controlled drug delivery systems.</p> <p>UNIT III</p> <p>Drug discovery, lead identification and lead optimization, Chemical, pharmaceutical and clinical technology development. Investigational New Drug (IND) and its Applications: criteria, contents, categories, submission, regulation, noteworthy examples. Clinical trials: Phase I, II and III clinical trials.</p> <p>UNIT V</p> <p>Pilot Plant Scale-Up Techniques: Primary function of the pharmaceutical pilot plant, factors to be considered during development, reporting responsibilities, personnel requirements, space requirements, review of the formula, raw materials, relevant processing equipments, production rates, process evaluation, master manufacturing procedures, GMP consideration, pilot plant design for tablet development.</p>				
Course Outcome	<ul style="list-style-type: none"> On the completion of this course successfully student will acquire knowledge of drug designing and development, their SAR and QSAR, mode of action of different drugs, role of drugs to inhibit the particular enzymes and treatment of disease, drug delivery 				



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

	and pharmaceutical technologies development
Text Books	<ol style="list-style-type: none">1. Mathiowitz, E., Ed. Encyclopaedia of controlled delivery(1999).2. Joseph R. Robinson and Vincent H. L. Lee Controlled Drug Delivery – Fundamentals and Applications.3. Saltzman, W. Mark Drug Delivery: Engineering Principles and Drug Therapy (OxfordPress)
Reference Books	<ol style="list-style-type: none">1. Loyd V. Allen, Jr., Nicolas G. Popovich and Howard C. ArselAnsel’s Pharmaceutical Dosage Forms and Drug DeliverySystems.2. The Art, Science and Technology of Pharmaceutical Compounding – Loyd V. AlenJr.3. Theory and Practice of Industrial Pharmacy –LachmannPharmaceutics –Aulto



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Course Title	NEWER SYNTHETIC REACTIONS AND REAGENTS AND HETEROCYCLIC CHEMISTRY				
Course Code	SMS04334				
Course Credit	L	T	P	TC	
	4	-	-	4	
Prerequisite	Knowledge of reactions and reagents				
Course Objective	<ul style="list-style-type: none"> to acquire the knowledge of enolates, umpolung and hetrocyclic chemistry 				
Course Content	<p>UNIT I Enolates, Thermodynamic versus Kinetic enolates, enonate equivalents and enamines: Applications in carbon-carbon bond formation and related reactions. Applications in chiral synthesis. Phosphorus, Sulphur and nitrogen ylides: Preparation, applications in organic synthesis and mechanism.</p> <p>UNIT II Umpolung reactions (sulphur compounds, nitro compounds, lithiated ethers and related compounds). Principles and applications of phase transfer catalysis, crown ethers and polymer- supported reagents in organic synthesis.</p> <p>UNIT III Introduction to heterocycles: Nomenclature, spectral characteristics, reactivity and aromaticity Synthesis and reactions of three and four membered heterocycles, e.g., aziridine, azirine, azetidene, oxiranes, thiarines, oxetenes and thietanes.</p> <p>UNIT IV Five membered rings with two heteroatoms: pyrazole, imidazole, oxazole, thiazole, isothiazole and benzofused analogs. Benzofused five membered heterocycles with one heteroatom, e.g. indole, benzofuran, benzothiophene. Chemistry of bicyclic compounds containing one or more heteroatoms</p> <p>UNIT V Benzofused six membered rings with one, two and three heteroatoms: benzopyrans, quinolines, isoquinolines, quinoxalines, acridines, phenoxazines, phenothiazines, benzotriazines, pteridines. Seven and large membered heterocycles: azepines, oxepines, thiepinines. Chemistry of porphyrins and spiroheterocycles.</p>				
Course Outcome	<ul style="list-style-type: none"> On the completion of this course successfully student will be acquire knowledge of Application of modern synthetic reactions and reagents in organic synthesis (including Ylides and Umpolung reaction). Nomenclature and reactivity and synthesis of different heterocyclic compounds. 				
Text Books	1. Carey, F.A. & Sundberg, R. J. Advanced Organic Chemistry, Parts A & B,				



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

	<p>Plenum: U.S.(2004).</p> <ol style="list-style-type: none">2. Carruthers, W. Modern Methods of Organic Synthesis Cambridge University Press(1971).3. Acheson, R. M. Introduction to the Chemistry of Heterocyclic Compounds John Wiley & Sons(1976).4. Anastas , Paul and Warner , John C.,Green Chemistry- Theory and Practical,(2005).
Reference Books	<ol style="list-style-type: none">1. Alhuwalia, VK and Kidwai, M. New trends in Green Chemistry. Anamaya Publishers, New Delhi (2003).2. Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), The Chemistry of Heterocycles (Nomenclature and Chemistry of three to five membered Heterocycles), Elsevier publication.3. Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), The Chemistry of Heterocycles (Chemistry of six to eight membered N, O, S, P and Se heterocycles), Elsevier publication



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Course Title	INDUSTRIAL CHEMISTRY				
Course Code	SMS04335				
Course Credit	L	T	P	TC	
	4			4	
Prerequisite	Basic knowledge of Chemistry				
Course Objective	<ul style="list-style-type: none"> Industrial Chemistry in advance and establish foundation to research in the respective domain. 				
Course Content	<p>UNIT I</p> <p>Industrial Fuels:Energy sources- Classification of fuels –solid- liquid and gaseous.Calorific value of fuels and its determination.Solid fuels – coal- lignite- sub-bituminous coal- bituminous coal and anthracite.Coking and non-coking coal. Liquid fuels – petroleum refining and uses. Hydrodesulphurisation and cracking (thermal and catalytic - fixed bed and fluidised bed).Octane number.Production and uses of tetraethyl lead- ETBE and MTBE. Gaseous fuels - natural gas and gobar gas –production-composition and uses-gobar electric cell.</p> <p>UNIT II</p> <p>Chemistry in Agriculture:Fertilizers- NPK- superphosphate- triple superphosphate- uses of mixed fertilizers. Micronutrients and their role, biofertilizers- plant growth hormones. Pesticides- classification of pesticides with examples. Insecticides - stomach poisons contact insecticides- fumigants. Manufacture and uses of insecticides. DDT- BHC (gammexane: Conformation of gamma isomer) pyrethrin, banned pesticides. Herbicides - manufacture of 2,4-D and 2,4,5-T. Fungicides -preparation of Bordeauxmixture-lime-sulphur creosote oil (formula only).Sugar industry - double sulphitation process. Refining and grading of sugar. Saccharin - use as a sugar substitute-aspartame.</p> <p>UNIT III</p> <p>Water Treatment:-Introduction-sources of water. Hardness of water- temporary and permanent hardness - units of hardness- disadvantages of hard water. Effect of iron and manganese in water.Estimation of hardness – EDTA method and alkali titration method. Water softening methods - Zeolite process- ion-exchange demineralisation mixed- bed deionisation. Domestic waste water treatment. Purification methods –chlorination- break point chlorination. Reverse osmosis - Desalination.</p> <p>UNIT IV</p> <p>Food Analysis: Moisture, ash, crude protein, fat, crude fibre, carbohydrates, calcium, potassium, sodium and phosphate. Food adulteration-common adulterants 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 organophosphates. Thin-layer chromatography for identification of chlorinated pesticides in food products</p>				



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

	<p>UNIT V</p> <p>Cement, Glass and Ceramics: Cement: Manufacturing – Wet Process and Dry process- types- analysis of major constituents- setting of cement- reinforced concrete. Cement industries in India. Glass: Composition and manufacture of glass. Types of glasses- optical glass coloured glasses and lead glass. Ceramics: Types- raw materials- white wares manufacture and uses.</p>
Course Outcome	<ul style="list-style-type: none">• On the completion of this course successfully student will be able to understand the development of the manufacture of cement and glass, water, fuel and food analysis.
Text Books	<ol style="list-style-type: none">1. R. Norris Shreve and Joseph A. Brink, Jr., Chemical process industries, 4th edition, McGraw – Hill, Kogakusha, Ltd, New York, 1977.2. T. George Austin, Shreve’s Chemical Process industries, 5th edition, McGraw – Hill, New York, 1984.3. P. C. Jain and M.C. Jain, Engineering Chemistry, 10th edition, Dhanpat Rai and Sons, New Delhi, 1993.
Reference Books	<ol style="list-style-type: none">1. A. K. De, Environmental Chemistry, 2nd edition, Wiley Eastern Ltd., Delhi, 1986.2. E. S Manahan, Fundamentals of Environmental Chemistry, 2nd edition, CRC Press, Florida, 2000.3. N. S. Subba Rao, Biofertilizers in Agriculture, Oxford and IBH Publishing Co Pvt Ltd, New Delhi, 1982.



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Course Title	POLYMERS				
Course Code	SMS04336				
Course Credit	L	T	P	TC	
	4	-	-	4	
Prerequisite	Knowledge of chemistry				
Course Objective	<ul style="list-style-type: none"> • Polymers in advance and establish foundation to research in the respective domain. 				
Course Content	<p>UNIT I</p> <p>Basics:Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.</p> <p>UNIT II</p> <p>Polymer Characterization:Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.</p> <p>UNIT III</p> <p>Structure and Properties:Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point T_m - melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, T_g-Relationship between T_m and T_g, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.</p> <p>UNIT IV</p> <p>Polymer Processing: Plastics, elastomers and fibres. Compounding. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.</p> <p>UNIT V</p> <p>Properties of Commercial Polymers :Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers - Fire retarding polymers and electrically conducting polymers. Biomedical polymers -</p>				



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

	contact lens, dental polymers, artificial heart, kidney, skin and blood cells.
Course Outcome	<ul style="list-style-type: none">On the completion of this course successfully student will be able to understand the polymer processing and its applications.
Text Books	<ol style="list-style-type: none">Textbook of Polymer Science, F.W. Billmeyer Jr, Wiley.Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Wiley-Eastern.Functional Monomers and Polymers, K. Takemoto, Y. Inaki and RM. Ottanbrite.
Reference Books	<ol style="list-style-type: none">Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.Physics and Chemistry of Polymers, J.M.G. Cowie, Blackie Academic and Professional.



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Course Title	CHEMISTRY LAB COURSE:V				
Course Code	SMS04381				
Course Credits	L	T	P	TC	
	-	-	2	2	
Prerequisites	Chemistry III				
Course Objectives	<ul style="list-style-type: none"> • To impart practical knowledge hands-on experience • To train the students to pursue further education. • Become familiar with chemical tools. 				
Course Contents	<p>1. Extraction of Organic Compounds from Natural Sources</p> <ol style="list-style-type: none"> a. Isolation of caffeine from tea leaves. b. Isolation of casein from milk: perform colour reaction of protein. c. Isolation of lactose from milk: purity of sugar should be checked by TLC and PC and R_f value reported. d. Isolation of nicotine dipicrate from tobacco. e. Isolation of cinchonine from cinchona bark. f. Isolation of piperine from black pepper. g. Isolation of lycopene from tomatoes. h. Isolation of β-carotene from carrots. i. Isolation of limonene from citrus rinds. j. Isolation of protein and carbohydrates from seeds – colour test. k. Extraction of fatty oil from seeds and determination of refractive index of the oil. l. Isolation of protein and carbohydrate (as reducing sugars) from seed-colour test. <p>2. Analysis of soil</p> <ol style="list-style-type: none"> a. Determination of pH of soil samples. b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration c. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry. <p>3. Analysis of food products:</p> <ol style="list-style-type: none"> a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. 				



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

	<p>b. Analysis of preservatives and colouring matter.</p> <p>c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drinks</p> <p>d. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.</p> <p>4. Clinical chemistry: A diagnostic approach by blood/ urine analysis.</p> <p>a. Carbohydrates – qualitative and quantitative.</p> <p>b. Lipids –qualitative.</p> <p>c. Determination of cholesterol using Liebermann- Burchardreaction.</p> <p>d. Proteins –qualitative.</p> <p>e. Isolation of protein.</p> <p>f. Determination of protein by the Biuret reaction.</p> <p>g. Determination of nucleic acids</p> <p>5. Drug Analysis:</p> <p>a. Detection of illegal drugs or steroids in athletes</p> <p>6. Fuel analysis</p> <p>a. To determine moisture, volatile matter and ash content of a given sample of coal.</p>
Course Outcomes	<ul style="list-style-type: none">• Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.• Ability to dissect a problem in to its key features.• Ability to design experiments and understand the limitations of the experimental approach
Text Books	<ol style="list-style-type: none">1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.5. Cooper, T.G. Tool of Biochemistry. Wiley-Blackwell (1977).
Reference Books	<ol style="list-style-type: none">1. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009).2. Varley, H., Gowenlock, A.H & Bell, M.: Practical Clinical Biochemistry, Heinemann, London (1980).3. Devlin, T.M., Textbook of Biochemistry with Clinical Correlations, John Wiley & Sons, 2010.



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

Course Title	CHEMISTRY LAB COURSE:VI				
Course Code	SMS04382				
Course Credits	L	T	P	TC	
	-	-	2	2	
Prerequisites	Chemistry IV				
Course Objectives	<ul style="list-style-type: none"> • To impart practical knowledge hands-on experience • To train the students to pursue further education. • Become familiar with chemical tools. 				
Course Contents	<p>1. Error Analysis and statistical data analysis. Errors, types of errors, minimization of errors, statistical treatment for error analysis, standard deviation, method of least squares. Calibration of volumetric apparatus, burettes, pipettes, standard flask, weight box etc.</p> <p>2. Volumetric Analysis</p> <ol style="list-style-type: none"> a. Determination of dissolved oxygen in water. b. Determination of Chemical Oxygen Demand (COD) c. Determination of Biological Oxygen Demand (BOD) d. Percentage of available chlorine in bleaching powder. e. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO_3 and potassium chromate). f. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method. g. Measurement of dissolved CO_2. h. Study of some of the common bio-indicators of pollution. i. Estimation of SPM in air samples. <p>3. Bio-Inorganic Chemistry:</p> <ol style="list-style-type: none"> (I) Extraction of chlorophyll from green leaves of student's of choice. Separation of chlorophylls and their electronic spectral study. (II) Complexation study of Cu (II) ion with biologically important amino acids. <p>4. Green Chemistry:</p> <ol style="list-style-type: none"> a. Preparation and characterization of biodiesel from vegetable oil. b. Extraction of D-limonene from orange peel using liquid CO_2 prepared from dry ice. 				



MASTER OF SCIENCE IN CHEMISTRY
SEMESTER- III
Examination Scheme
(Effective from the session: 2021-2022)

	<p>c. Mechano chemical solvent free synthesis of azomethine.</p> <p>d. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).</p> <p>e. Photoreduction of benzophenone to benzopinacol in the presence of sunlight</p> <p>f. Preparation of propene by two methods can be studied</p> <p>(I) $\text{Triethylamine ion} + \text{OH}^- \xrightarrow{\text{H}_2\text{SO}_4/\Delta} \text{propene} + \text{trimethylpropene} + \text{water}$</p> <p>(II) $1\text{-propanol} \longrightarrow \text{propene} + \text{water}$</p>
Course Outcomes	<ul style="list-style-type: none">• Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.• Ability to dissect a problem in to its key features.• Ability to design experiments and understand the limitations of the experimental approach
Text Books	<ol style="list-style-type: none">1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th Edition, 1996.2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
Reference Books	<ol style="list-style-type: none">1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).2. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.