BHAKTA KAVI NARSINH MEHTA UNIVERSITY

JUNAGADH 362263

SYLLABUS

Faculty of Science

M.Sc.- Chemistry

(Organic Chemistry)

Semester III and IV

Under Choice Based Credit System (CBCS)

Effective from June - 2019

Bhakta Kavi Narsinh Mehta University
Scheme of Instruction and Examinations
M. Sc. Chemistry (Organic Chemistry)
SEMESTER -III

Sr. No.	Level	SEM	Course Group	Course (Paper) Title	Paper No.	Credit	Teaching Hours/ Week	Internal Marks	External Marks	Practical Internal Marks	Practical External Marks	Total Marks/ Passing
								Total/ Passing	Total /Passing	Total/ Passing	Total/ Passing	
1	PG	3	Core	Stereochemistry	M18CHOC301	4	4	30/12	70/28	--	-	100/40
2	PG	3	Core	Advanced Organic Chemistry	M18CHOC302	4	4	30/12	70/28	-	-	100/40
3	PG	3	Core	Separation Techniques	M18CHOC303	4	4	30/12	70/28	-	-	100/40
4	PG	3	Elective-I	Medicinal Chemistry	M18CHE1304	4	4	30/12	70/28	-	-	100/40
5	PG	3	Elective-II	Phytochemistry	M18CHE2304							
6	PG	3	Practical	Practical	M18CHOP305	6	12	-	-	-	150/60	150/60
7	PG	3	Self study	Viva Voce	M18CHOV306	2	-	-	50/20	-	-	50/20
8	PG	3	Skill Enhancement Course	Research Writing and Presentation	M18CHOS307	2	2	-	50/20	-	-	50/20
Total						**26**	**30**					**650**

Bhakta Kavi Narsinh Mehta University
Scheme of Instruction and Examinations
M. Sc. Chemistry (Organic Chemistry)
SEMESTER -IV

Sr. No.	Level	SEM	Course Group	Course (Paper) Title	Paper No.	Credit	Teaching Hours/ Week	Internal Marks	External Marks	Practical Internal Marks	Practical External Marks	Total Marks/ Passing
								Total/ Passing	Total/ Passing	Total/ Passing	Total/ Passing	
1	PG	4	Core	Organic Synthesis: A Disconnection Approach	M18CHOC401	4	4	30/12	70/28	--	-	100/40
2	PG	4	Core	Chemistry of Synthetic Drugs	M18CHOC402	4	4	30/12	70/28	-	-	100/40
3	PG	4	Core	Heterocyclic Chemistry	M18CHOC403	4	4	30/12	70/28	-	-	100/40
4	PG	4	Elective-I	Modern Spectroscopy	M18CHE1404	4	4	30/12	70/28	-	-	100/40
5	PG	4	Elective-II	Chemistry of Biomolecules	M18CHE2404							
6	PG	4	Practical	Practical	M18CHOP405	6	14	-	-	-	150/60	150/60
7	PG	4	Self study	Viva Voce	M18CHOV406	2	-	-	100/40	-	-	100/40
Total						**26**	**30**					**650**

M.Sc. (Organic Chemistry) SEMESTER-III			
M18CHOC301	**Stereochemistry**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs.
Unit.1	**(a) Fundamental of stereochemistry and chirality** Isomerism, tetrahedron geometry and concept of chirality, Isomers, Classification of stereoisomerism, Optical isomerism, Projection formulae and their interconversion. Classification of stereosiomers based on energy and symmetry criterion. Various types of configurational nomenclature of stereocenters (one, two similar and two dissimilar stereocenters). Ring and π and diastereoisomerism-Various methods of nomenclature for acyclic and cyclic systems-cis-trans, E-Z, syn and anti. Stereoisomerism Without a stereogenic carbon: Axial chirality (bi-phenyl, allenes, spiranes, trans-cyclooctene), planar chirality (ansa compounds, paracyclophanes), helicity (hexahelicene). **(b) Racemic mixtures and modification** Theories of racemization, resolution of racemic mixtures, optical purity & enantiomeric excess.	**12**
Unit.2	**(a) Prochirality and prostereoisomerism** prostereoisomerism and prochirality-introductioin Topicity: Examples of homotopic & heterotopic ligands, pro-R and pro-S nomenclature. Examples of Homotopic & Heterotopic faces, Re-Si nomenclature system. **(b) Conformations and stereoisomerism in acyclic system** Conformations, klyne-prelog terminology for tortional angle. Physical methods of conformational analysis. Conformations and reactivity of acyclic molecules like butane, n-pentane, halogeno alkanes, acetaldehyde, propionaldehyde 1,3-butadiene and C-Hetero bond.	**12**
Unit.3	**Conformational analysis and reactivity of cyclic system** • Conformations of cyclohexane, mono and di-substituted cyclohexane ring systems. Effect of conformation on reactivity of cyclohexanes • Conformations of fused ring systems-decalin and decalones and its diastereoisomerism. • Conformation of bridge systems-Bicyclo[2,2,1] heptane and Bicyclo[2,2,2]octane. Exo. Endo nomenclature, bredt's rule. • Conformation Heterocycles -piperidines-pyramidal inversion and ring inversion. • Conformation of sugar (Fisher, haworth and chair), epimers, anomers, Epimerization, anomeric effect and mutarotation.	**12**
Unit.4	**Stereospecific and Stereoselective reactions-I** Stereospecific and stereoselective reactions, general methods of synthesis and asymmetric induction. **(a) Aliphatic nucleophilic substitution reactions** Introduction, Stereochemistry of S_N1 & S_N2 reaction mechanism, The S_Ni mechanism, Mixed S_N1 & S_N2 reaction, ambient nucleophile, Regioselectivity, Neighboring group participation. **(b) Elimination Reactions**	**12**

	Introduction, Mechanism E1, E2 and E1cB, Stereochemistry of E2-anti-ellimination reaction, E2-syn-elimination.	
Unit.5	**Stereospecific and Stereoselective reactions-II** **(a) Addition Reaction of Carbonyl** Stereochemistry addition of carbonyl compounds (Cram's rule and Felkin Anh models), Stereochemistry of metal hydride reduction of carbonyl. Stereoselective aldol reactions **(b) Addition Reaction of Olefins** Stereochemistry of addition of olefins: dihydroxylatioin (manganese, osmium based), Hydroboration & oxymercuration, Woodward & Prevost reagent.	**12**

Reference Books

1. Kalsi, P. S. (2011, Seventh edition) Stereochemistry Confirmation and Mechanism. New Delhi: New Age International (P) Limited. (ISBN: 81-224-2356-6).
2. Subrata Sen Gupta (2014), Basic Stereochemistry of organic molecules. New Delhi: Oxford University press. (ISBN: 978-0-19-945163-0).
3. Finar, I. L. (1989, Fifth edition) Organic Chemistry: Vol -2: Stereochemistry and the Chemistry of Natural Products. Harlow: Longman. (ISBN: 0-582-05916-X).
4. Clayden Jonathan; Greeves Nick, Warren Stuart (2012, Second edition) Organic Chemistry. Oxford: Oxford University Press (ISBN: 0199270295).
5. Eliel, Ernest L., Wilen, Samuel H. (1994) Stereochemistry of Organic Compounds. Hoboken: Wiley-Blackwell (ISBN: 0471016705).
6. Nogradi, M. (2008, Second revised and updated edition) Stereoselective synthesis: A practical approach. Weinheim: Wiley VCH. (ISBN: 978-3-527-61568-1).
7. Kalsi, P. S. (2012, Fourth edition) Organic Reactions Stereochemistry and Mechanism (Through Solved Problems). New Delhi: New Age International (P) Limited. (ISBN: 9788122417661).

M.Sc. (Organic Chemistry) SEMESTER-III			
M18CHOC302	**Advanced Organic Chemistry**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs.
Unit.1	**Pericyclic reactions and concerted mechanism-I** • General introduction and classification of pericyclic reaction, symmetry properties of molecular orbitals - ethylene, 1,3 – butadiene, 1,3,5–hexatriene and allylic systems. Concept of frontier molecular orbital (HOMO and LUMO) under thermal and photochemical conditional. • **Electrocyclic reaction**: Conrotatory and disrotatory motions of orbitals, prediction about feasibility of electrocyclic reaction: FMO approach, conservation of orbital symmetry-correlation diagram approach and perturbational molecular orbital (PMO) or Huckel-Mobius (H-M)approach. • Selection rule for electrocyclic ring-closing & ring-opening reaction (thermal or photochemical) for 4nπ system and (4n+2)π system. Examples of different electrocyclic reactions and their stereochemistry.	**14**
Unit.2	**Pericyclic Reactions and Concerted Mechanism-II** • **Cycloaddition reactions**: (2+2) cycloaddition through antarafacial and suprafacial modes, selection rules for cycloaddition by FMO & correlation diagram approach Diels-alder reaction: (4+2) exo and endo-addition, reactivity and regioselectivity. 1,3-Dipolar cycloaddition reactions, cheletropic reactions & selection rule for thermal condition. • **Sigmatropic rearrangements**: Suprafacial and Antarafacial shifts of hydrogen, selection rule for thermal and photochemical conditions, [1,3] & 1,5-sigmatropic shift of Hydrogen, [3,3] and [5,5] sigmatropic rearrangements, Claisen and Cope rearrangements, aza-Cope rearrangements, Sommelet–Hauser rearrangement.	**14**
Unit.3	**Asymmetric synthesis** Methods of asymmetric induction, substrate, reagent and catalyst controlled reaction: • Asymmetric oxidation from: mCPBA & Henbest effect, halo-hydrine, wittig ylide, Sharpless, Jacobsen and Shi reagents. • Asymmetric ring opening of expoxide from: Grignard reagent, super-Grignard reagent, dialkylcuprates, LAH, $NaBH_4$, DIBAL, OH^-/H_2O and HBr. • Asymmetric reduction: Noyori, Corey, Pfaltz transformations. • Chiral-auxillary controlled stereoselection: Evans oxazolidones, asymmetric synthesis of amino acids from chiral auxillary.	**12**
Unit.4	**Synthesis of natural products-I** Introduction, definition, classification, importance and total synthesis of following alkaloids: • Phenanthrene group: Morphine, Heroin, Codeine • Indole group: Reserpine • Quinoline group: Quinine • Pyridine groups: Ricinine • Pyrolidine group: Nicotine • Tropane alkaloids: Atropine, Cocaine • Phenylethylamine: Adrenaline	**10**

Unit.5	**Synthesis of natural products-II** Introduction, importance and total synthesis of: • Purines bases: Uric acid, Purine, Adenine, Guanine • Xanthine bases: Xanthine, Hypoxanthine, Caffeine, Theobromine, Theophylline • Pyrimidines: Uracil, Thymine and Cytosine • Nucleic acids: Introduction, structure of nucleic acid, structure difference between DNA & RNA. Synthesis of Nucleosides and Nucleotides	**10**

Reference Books

1. Vinay P. Sharma & Rakesh Kumar. Pericylic reactions and organic photochemistry, Pragati Prakashan, 2008, Meerut- (ISBN-978-81-8398-632-8)
2. Finar, I. L. (1989, Fifth edition) Organic Chemistry: Vol -2: Stereochemistry and the Chemistry of Natural Products. Harlow: Longman. (ISBN: 0-582-05916-X).
3. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, 1st Ed., Oxford University Press, 2001.
4. László Kürtip; Barbara Czakó (2004, First edition) Strategic Applications of Named Reaction in Organic Synthesis. Philadelphia: Elsevier Publishing company (ISBN: 9780124297852).
5. M.B. Smith & J. March, March's Advanced Organic Chemistry, 5th Ed., John Wiley & Sons, New York, 2001.
6. Peter Sykes, A Guide book to Mechanism in Organic Chemistry, 6th Ed., Orient Longman, Ltd., New Delhi, 1997.

M.Sc. (Organic Chemistry) SEMESTER-III			
M18CHOC303	**Separation Techniques**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs.
Unit.1	**Adsorption and Partition Chromatography** History, introduction, classification, principles, experimental, factors affecting adsorption & partition chromatography	**12**
Unit.2	**Planar Chromatography** Principle, basic theory, technique & applications of : Paper chromatography, thin layer chromatography and high performance thin layer chromatography	**12**
Unit.3	**Gas Chromatography** Basic theory, instrumentation, working and applications of GC, GC-MS &HS-GC	**12**
Unit.4	**Liquid Chromatography** Basic theory, instrumentation, working and applications of HPLC & LC-MS.	**12**
Unit.5	**Extraction Techniques** Introduction, types of extraction (LLE, SSE, LSE), extraction methods (maceration, infusion, digestion, decoction, percolation, solvent extraction, soxhlet extraction, counter current extraction, sonication, supercritical fluid extraction, steam distillation) and application.	**12**

Reference Books

1. Sethi, P. D. (2013) Sethi HPTLC: High Performance Thin Layer Chromatography: Quantitative Analysis of Pharmaceutical Formulations 3 Volume Set. New Delhi: CBS Publishers & Distributors Pvt. Ltd. (ISBN: 9788123922799).
2. Stahl, E. (1969, Second edition) Thin-Layer Chromatography: A Laboratory Handbook. New Berlin: Springer. (ISBN: 978-3-642-88488-7).
3. Heftmann, E. (2004, Sixth edition) Fundamentals and applications of chromatography and related differential migration methods - Part A (Journal of Chromatography Library). Philadelphia: Elsevier Publishing Company. (ISBN: 0444511075).
4. Skoog, D. A., West D. M., Holler, F. J., Crouch, Stanley R. (2013, Ninth edition) Fundamentals of Analytical Chemistry. Boston: Cengage Learning. (ISBN: 0495558281)
5. Instrumental Methods of Analysis by B. K. Sharma, Goel Publisher, Meerut.

M.Sc. (Organic Chemistry) SEMESTER-III			
M18CHE1304	**Medicinal Chemistry**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs
Unit.1	**Drug design and development** History and development of medicinal chemistry, drugs and their important, drug discovery, clinical trials, lead discovery, lead discovery from natural sources, lead discovery through: Random screening, non-random (or targeted or focused) screening, drug metabolism studies, clinical observations, rational approaches to drug discovery	**12**
Unit.2	**(a) Lead modification** Identification of the active part: The pharmacophore, functional group modification. structure–activity relationships, privileged structures and drug-like molecules, structure modifications to increase potency and the therapeutic index, homologation, chain branching, ring-chain transformations and bioisosterism. **(b) QSAR** Introduction to quantitative structure–activity relationships (QSARs), lipophilicity, partition coefficients (P), lipophilic substitution constants (p), electronic effects, the hammett constant (s), steric effects, the taft steric parameter (Es), molar refractivity (MR), other parameters. hansch analysis, craig plots, the topliss decision tree.	**12**
Unit.3	**Pharmacokinetics** Introduction, route of drug absorption, distributions of the drug and factor affecting. Drug metabolism, concept of drug excretion.	**12**
Unit.4	**Pharmacodynamics** Receptors and drug action**:** Types of receptors, theories of drug-Receptor interactions, biotransformation of the drug, phase I & II reactions, concept of bioassay and definition of IC_{50}, LD_{50}, ED_{50}, MIC and EC_{50}, $GI_{50.}$	**12**
Unit.5	**(a)Prodrug** Concept, structure and classification of prodrug. Use of prodrugs: Masking taste or odour, minimizing pain at site of injection, alteration of drug solubility, overcome absorption problems, prevention of pre-systemic metabolism, longer duration of action diminish local and systemic toxicity. **(b) Combinatorial chemistry**	**12**

	The Principle and design of combinatorial chemistry, Pool and split method for peptide synthesis, Parallel synthesis, Furka's mix and split technique, Solid support method.	

Reference Books

1. Fundamentals of Medicinal Chemistry by Gareth Thomus, Wiley-VCH- 2003, (ISBN 0-470-84306-3)
2. The practice of Medicinal Chemistry by Camille G. Wermurth, Third edition-Academic Press-(ISBN-0-12-744481-5).
3. Medicinal Chemistry by Ashutosh Kar, New age international-4th edition (ISBN:978-81-224-2305-7).
4. Principles of Medicinal Chemistry by S. S. Kadam, Mahadik, Bothera, Nirali Publication, 11th edition.
5. Drugs from Discovery to approval by Rick N.G., Wiley-Blackwell-second edition.
6. An Introduction to Drug Design, S. S. Pandey and J.R. Dimmock, New Age International.
7. Burger's Medicinal Chemistry and Drug Discovery, Sixth Edition, Ed.M.E.vWolff, John Wiley.
8. The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press.

M.Sc. (Organic Chemistry) SEMESTER-III			
M18CHE2304	**Phytochemistry**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs
Unit.1	**Phytochemistry** Introduction, classification, source, types of extraction, primary and secondary metabolite, extraction and isolation methods of metabolite.	**12**
Unit.2	**Phytochemical methods** Qualitative and quantative phytochemical methods for the structure determination of natural products.	**12**
Unit.3	**Phytochemical analysis** Quality control of crude drugs: proximate analysis including ash and extractive values, crude fiber content, U.V. and fluorescence analysis of powdered drugs. Qualitative & quantitative microscopy and microchemical tests.	**12**
Unit.4	**Phytochemical & quality control** Detection of common adulterants and insects infestation in whole and powdered drugs. Analysis of official formulations derived from crude drugs including some Ayurvedic preparations. Brief study of quality control of plant-products and their high-throughput screening. Microbiological screening methods for antimicrobial activity.	**12**
Unit.5	**Quality control guidelines** WHO guidelines for the quality control of raw materials used in herbal formulations.	**12**

Reference Books

1. Phytopharmaceutical Analysis by Ramadoss Karthikeyan Oruganti Sai Koushik, 2016; LAP Lambert Academic Publishing, ISBN-10: 3659886009.
2. Phytopharmaceutical Technology by List and Schmidt, 1990; CRC press, ISBN 9780849377099.
3. Chemistry of Natural Products by Gurdeep Chatwal, 1992.
1. Natural Product-A new source of drug discovery by J. D. Newman and G. M. Cragg

M.Sc. (Organic Chemistry) SEMESTER-III			
M18CHOP305	**Practical**	**12 hrs./Wk**	**6 Credits**

SR. No.	Practical Detail	Lab Hours
Unit-1	**Organic Synthesis** **Multi-step synthesis / Synthesis of Medicinally important moieties (with TLC monitoring of Reaction):** 1. Benzophenone to Benzanilide 2. 4-Bromoaniline from Acetanilide 3. 4-Iodonitrobenzene from 4-Amino-nitrobenzene 4. o-Iodobenzoic acid from Phthalic anhydride 5. Acridone from o-Chlorobenzoic acid 6. Hydantoin from Glycine 7. 5-Hydroxy-1, 3-benzoxathiol-2-one from hydroquinone 8. Benzimidazole from o-Phenylenediamine 9. Dibenzylacetone from Acetone 10. Barbituric acid from Urea 11. β-D-Glucopyranose penta-acetate from alpha-D-Glucose 12. 3-Carbethoxycoumarin from Salicyldehyde	**9**
Unit-2	**Separation Technique** **Extraction, isolation and TLC analysis of natural products:** 1. Eugenol from clove 2. Caffeine from Tea 3. Cinnamaldehyde from Cinnamon 4. Nicotine from Tobacco 5. Curcumin from Turmeric powder 6. Carotenoids from Tomato	**3**

Reference Books

1. Brian S. Furniss (1989, Fifth edition) Vogel's Textbook of Practical Organic Chemistry. Hoboken: John Willey & Sons (ISBN: 0-582-462363).
2. Arthur I. Vogel. (second edition) Elementary practical organic chemistry: Small scale preparations. Pearson (ISBN: 978-81-317-5686-7).
3. V.K. Ahluwalia and Renu Aggarwal (University Press),Comprehensive practical organic chemistry: Preparations and qualitative analysis (ISBN: 978-81-7371-273-9)
4. Raj K. Bansal (new age international-5th edition). Laboratory manual of organic chemistry (ISBN:978-81-224-2930-5**)**

M.Sc. (Organic Chemistry) SEMESTER-III			
M18CHOV306	**Viva Voce**	**-**	**2 Credits**
• Comprehensive viva voce based on core & elective courses			

M.Sc. (Organic Chemistry) SEMESTER-III			
M18CHOS307	**Research Writing & Presentation**	**2 hrs./Wk**	**1 Credits**

Research proposal Writing preparation (Minimum 5000 words):

- Explanation of various research funding agencies(UGC, DBT, DST, CSIR, SERB, GUJCOST) & their research support schemes.
- Training on how to write various aspects of research proposal in given format with one example (Title, description of problem, review of related work, national & international status, rationale for taking up project, objective of proposal, methodology, references, year-wise work plan, budget estimation etc.)
- Assign organic chemistry based research problems and its literature review.
- Preparation and submission of one research proposal for any one funding agency
- Presentation (ppt) of the prepared research proposal including all aspects.

M.Sc. (Organic Chemistry) SEMESTER-IV			
M18CHOC401	**Organic Synthesis: A Disconnection Approach**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs
Unit.1	**Retrosynthesis-A Disconnection Approach-** Introduction of disconnection analysis, Common terminology and explanation, representation of disconnection analysis, Concept of synthon (Acceptor and donor, umpolung) and synthetic equivalents (Reagent). Planning a synthesis- convergent vs linear synthesis, criteria of good disconnection. • Disconnection of aromatic compounds: Functional group based strategies- functional group addition (FGA), order of events, functional group interconversion (FGI), Functional group removal (FGR) and dummy groups.	**12**
Unit.2	**Functional groups relationships & scaffold construction** • One group C-C & C-X disconnection: Retrosynthesis of alcohols, olefins and carbonyl compounds. • Two group C-C disconnection: Disconnections in 1,3-dioxygenated skeletons, preparation of β-hydroxy carbonyl compounds, α,β-unsaturated carbonyl compounds, 1,3-dicarbonyls, 1,5-dicarbonyls and application of Mannich reaction.	**12**
Unit.3	**Illogical Two Group Disconnections (Umpolung)** • Disconnection and synthesis 1-hydroxy carbonyl, 1,2-diol, 1,2-dicarbonyl, 1,4-dicarbonyl and 1,6-dicarbonyl compounds	**12**
Unit.4	**Disconnection & Synthesis of Acyclic, Cyclic Hetero-Compounds** • Ring synthesis-application of Diels-alder cycloaddition reaction • Synthesis of saturated oxygen and nitrogen containing ring system • Disconnection strategies for 5 & 6 member heterocycles with two or three heteroatoms.	**12**
Unit.5	**Chemoselectivity & Protecting Groups** Introduction, three types of control, chemoselectivity examples and rules, chemoselectivity by (i) reactivity (ii) reagent, examples of chemoselectivity in synthesis. Protection of organic functional groups, protecting reagents and removal of protecting groups.	**12**

Reference Books

1. Warren, S.; Wyatt, P. (2008, Second edition) Organic Synthesis: The Disconnection Approach. Weinheim: Wiley. (ISBN: 978-0-470-71236-8).
2. Warren, S. (1978) Designing Organic Syntheses: A Programmed Introduction to the Synthon Approach. Weinheim: Wiley. (ISBN: 978-0-471-99612-5).
3. Carruthers, W.; Coldham, Iain (2004, Fourth Edition) Modern Methods of Organic Synthesis. Cambridge: Cambridge University Press. (ISBN: 9780521778305).
4. Jurgen Fuhrhop, Gustav Penzlin (2008) Organic synthesis-concept methods-starting materials-Weinheim: Wiley. (ISBN: 3-527-29074-5).

M.Sc. (Organic Chemistry) SEMESTER-IV			
M18CHOC402	**Chemistry of Synthetic Drugs**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs.
Unit.1	**Drugs acting on cancer** Introduction to diseases, classification of anticancer drugs and synthesis of the following classes of the drugs: (1) DNA alkylating agents: Estramustine, Cisplatin (2) Enzyme Inhibitors: Anastrozole, Sorafenib, sunitinib **Drugs acting on infectious diseases** Introduction to diseases, classification of acting on infectious diseases and synthesis of the following classes of the drugs: (1) Quinolone Antibiotics: Levofloxacin, Moxifloxacin. (2) Triazole Antifungals: Itraconazole, Fluconazole. (3) Non-Nucleoside HIV Reverse Transcriptase Inhibitors: Nevirapine, Delavirdine Mesylate (4) Neuraminidase Inhibitors For Influenza: Oseltamivir Phosphate (Tamiflu), Zanamivir. (5) Antimycobacterial (TB)drugs: Isoniazid, Ethambutol	**14**
Unit.2	**Drugs acting on cardiovascular disorder** Introduction to diseases, classification of drugs acting on Cardiovascular disorder and synthesis of the following classes of the drugs: (1) Hypertension: Losartan Potassium, Telmisartan. (2) Calcium Channel Blockers For Hypertension: Nifedipine, Amlodipine (3) Second-Generation Hmg-Coa Reductase Inhibitors: Rosuvastatin, Atorvastatin. **Diuretics drugs** Introduction to diseases, classification of drugs acting as diuretic drugs and synthesis of the following class of the drugs: (1) Thiazides(Benzothiadiazines): Chlorothiazide, Hydrochlorothiazide (2) Carbonic-Anhydrase Inhibitors: Acetazolamide, Ethoxzolamide (3) Miscellaneous Sulphonamide Diuretics: Indapamide (4) Miscellaneous Diuretics- Triamterene	**12**
Unit.3	**Drugs acting central nervous system** Introduction to diseases, classification of drugs acting on Central Nervous System, synthesis of the following classes of the drugs: (1) Antidepressant: Venlafaxine, Duloxetine. (2) Insomnia: Zolpidem, Zaleplon, Indiplon. (3) Antiepileptic: Gabapentin. (4) Attention Deficit Hyperactivity Disorder: Amphetamine. **Non-sedeting antihistamines** (1) Histamine blocker: Citrizine, fexofenadine	**10**
Unit.4	**Analgesic and Non-steroidal anti-Inflammatory dugs (NSAIDs):**	**12**

	Introduction to diseases, classification of anti-inflammatory drugs and synthesis of the following classes of the drugs: (1) Heteroarylacetic acid analogues: Indomethacin, Sulindac, (2) Arylacetic acid analogues: Ibuprofen, Diclofenac sodium. (3) Arylpropionic acid analogues: Ketoprofen, Indoprofen. (4) Naphthalene acetic acid analogues: Naproxen. (5) Salicylic acid analogues: Aspirin, Benorilate. (6) Pyrazolones and pyrazolodiones: Phenazone (Antipyrine), Phenylbutazone.	
Unit.5	**Anaesthetic drugs** Introduction to diseases, classification of anasthetic and synthesis of the following classes of the drugs: **General Anaesthetics:** (1) Inhalation Anaesthetics: Halothane, Chloroform. (2) Intravenous Anaesthetics: Ketamine Hydrochloride. (3) Basal Anaesthetics: Tribromoethanol, Paraldehyde. **Local Anasthetic** (1) The Esters: Benzocaine, Cyclomethycaine (2) Piperidine or Tropane Derivatives: α-Eucaine, Benzamine (3) The Amides: Lignocaine (4) Miscellaneous Type: Pramoxine **Anti-diabetic drugs:** Introduction to diseases, classification of hypoglycemic drugs acting and synthesis of the following class of the drugs: (1) Type 2 Diabetes: Rosiglitazone, Pioglitazone (2) Sulphonamide-Hypoglycemic agents: Tolbutamide, Glyburide (3) Guanidine: Metformin	**12**

Reference Books

1. The Art of Drug Synthesis by Douglas S. Johnson and Jie Jack Li, John Wiley & Sons, Inc., Hoboken, New Jersey, ISBN 978-0-471-75215-8.
2. Synthesis of Essential Drugs by R.S. Vardanyan and V.J. Hruby, Elsevier, ISBN: 978-0-444-52166-8.
3. Medicinal Chemistry by Ashutosh Kar, New Age International (P) Ltd, ISBN : 978-81-224-2305-7.
4. Burger's Medicinal chemistry and drug discovery, Sixth edition by Donald J. Abraham, John Wiley and Sons, Inc.

M.Sc. (Organic Chemistry) SEMESTER-IV			
M18CHOC403	**Heterocyclic Chemistry**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs.
Unit.1	**1. Nomenclature of heterocyclic compounds** **2. Heterocyclic analogues of cyclopropane and cyclobutane** **a.** Preparation and properties of aziridine, oxirane, thiirane, Azetidine. **b.** Preparation of 1,2-diazetidine, 1,2-dioxetane, 1,3-dithietane.	**12**
Unit.2	**Heterocyclic analogues of cyclopentane and its fused ring system** **a.** Preparation and properties of pyrrole, furan, thiophene. **b.** Preparation and properties of indole, benzofuran, benzothiophene. **c.** Preparation of isoindole, indolizine, isatin.	**12**
Unit.3	**1. Heterocyclic analogues of benzene** • Preparation and properties of pyridine and pyran. **2. Compounds with two heteroatoms in a six membered ring and its fused ring system** • Preparation of pyridazine, pyrimidine, pyrazine, thiazine, dioxane, Morpholine, phthalazine, quinazoline, quinaxoline, phenothiazine.	**12**
Unit.4	**Heterocyclic analogues of naphthalene and its fused ring system** **a.** Preparation and properties of quinoline, isoquinoline, acridine. **b.** Preparation of benzopyran, benzopyran-2-one and benzopyran-4-one.	**12**
Unit.5	**1. Compounds with two heteroatoms in a five membered ring** **a.** Preparation & properties of pyrazole, oxazole, thiazole **b.** Preparation of, imidazole, isoxazole, isothiazole. **2. Compounds containing more than two heteroatoms** • Preparation of triazole, oxadiazole, thiadiazole, triazenes.	**12**

Reference Books

1. Heterocyclic Chemistry by R.K. Bansal, New age international (ISBN-13: 978-8122412123)
2. Heterocyclic chemistry by J.A. Joule, K. Mills (2010, First ediction) John Wiley & Sons, Inc., Hoboken, New Jersey, (ISBN 978-1-405-13300-5).
3. Modern Heterocyclic Chemistry by Julio Alvarez-Builla, Juan Jose Vaquero, and Jose´ Barluenga, Wiley-VCH publication (ISBN 978-3-527-33201-4)
4. Name reaction in Heterocyclic chemistry by Jie Jack Li, Willey-interscience (ISBN 0-471-30215-5).
5. The Chemistry of Heterocycles by Theophil Eicher and Siegfried Hauptmann, Wiley-VCH publication (ISBN 3-527-30720-6).
6. Handbook of Heterocyclic chemistry by A. R. Katritzky, Pergamon-Elsevier (ISBN 0-08-042998-2)

M.Sc. (Organic Chemistry) SEMESTER-IV			
M18CHE1404	**Modern Spectroscopy**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs.
Unit.1	**Introduction to spectroscopic techniques** Types of analytical techniques, introduction of instrumental methods and its classification, overview of spectroscopic methods based on wave length regions of electromagnetic radiation, properties of electromagnetic radiation. **UV Spectroscopy** Introduction, theory of ultra violate spectra, instrumentation, type of transition in organic molecules; auxochrome, chromophore; explanation of bathochromic shift and hypsochromic shift, hyper chromic effects, types of bands, effect of solvent, application of UV spectra. Calculation of λ-max (1) dienes and conjugated dienes (2) enones and dienones (ie.unsaturated carbonyl compounds) (3) aromatic carbonyl system.	**10**
Unit.2	**Infrared Spectroscopy:** Introduction to IR and FTIR, principle & theory of Infrared absorption spectrometry, infrared sources and transducers, sample handling, instrumentation, interpretation of IR spectra, applications and limitations of IR spectroscopy.	**08**
Unit.3	**Mass Spectroscopy** Introduction, principle, theory and components of mass spectrometers, different ionization and detection techniques, recording and resolution of mass spectrometer, types of ions produced in mass spectrometer, interpretation of mass spectra of selected compounds /API, Applications of Mass spectrometry, Introduction to ICP-MS.	**08**
Unit.4	**Nuclear Magnetic Resonance Spectroscopy-I** Introduction, NMR active nuclei, Basic Theory, NMR Spectrometer, internal Standard & solvent. **^{1}H NMR (PMR):** Principle, Chemical shift, Magnetic anisotropy, spin-spin coupling (multiplicity), applications & problems of Nuclear magnetic resonance spectroscopy.	**14**
Unit.5	**Nuclear Magnetic Resonance Spectroscopy-II** **^{13}C NMR**: Introduction, Principle, chemical shift, application and problems of ^{13}C – NMR. **Introduction to 2D NMR, Application of COSY, NOESY, HSQC, HMBC** **Structure Elucidation**: Structure determination and distinction of various isomeric compounds through spectroscopic techniques (UV, IR, Mass, NMR &2D-NMR)	**20**

Reference Books

1. Martin, M. L., Delpuech, J. J. and Martin, G. J. (1980) Martin *Practical* Nmr Spectroscopy. Weinheim: John Wiley & Sons Ltd. (ISBN: 0471258652).
2. Silverstein, Robert M., Webster, Francis X., Kiemle, David J., Bryce, David L. (2014, Eighth edition) Spectrometric identification of Organic Compounds. Weinheim: John Wiley & Sons Ltd. (ISBN: 978-0-470-91401-4).
3. Abraham, R. J., Fisher, J. and Loftus, P. (1988) Introduction to NMR Spectroscopy. Weinheim: John Wiley & Sons Ltd. (ISBN: 0471918946).
4. Dyer, J. R. (1965) Application of absorption Spectroscopy of Organic Compounds. Upper Saddle River: Prentice Hall.
5. Williams, D. H., Fleming, I. (2007, Sixth edition) Spectroscopic Methods in Organic Chemistry. New Delhi: Tata McGraw-Hill. (ISBN: 007711812X).
6. Kalsi, P. S. (2006, Sixth edition) Spectroscopy of Organic Compounds. New Delhi: New Age International Pvt. Ltd. (ISBN: 8122415431).
7. Breitmaier E. (2002, Third edition) Structure elucidation by NMR in Organic Chemistry-A Practical approach. Weinheim: John Wiley & Sons Ltd. (ISBN: 978-0-470-85007-7).

M.Sc. (Organic Chemistry) SEMESTER-IV			
M18CHE2404	**Chemistry of Biomolecules**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs
Unit.1	**Amino acids and proteins** Classification and structure of amino acids, configuration of amino acids, acid-base properties and isoelectric point, separation of amino acids, peptide bonds, disulfide linkages, proteins classification based on solubility, shape, composition and function, structure of proteins, determination of the primary structure of a protein, secondary, tertiary and quaternary structures, protein denaturation.	**12**
Unit.2	**Enzymes, co-enzymes and their mechanism of action** Enzymes, Classification, kinetics, inhibition, mechanisms of enzyme action, cofactors as derived from vitamins, co-enzymes, prosthetic, prosthetic group and apoenzymes, structure and biological functions of coenzyme-A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FAD, lipoic acid, overview of reactions catalysed by the above cofactors.	**12**
Unit.3	**Nucleic acids** Nature of genetic material, structure of purine and pyrimidine, nucleotides and nucleosides, types of nucleic acids, structure of DNA, properties of nucleic acids, - Tm, denaturation and renaturation, hypo and hyperchromicity, basic ideas on replication, transcription and translation, determination of the base sequence of DNA.	**12**
Unit.4	**Lipids** Fatty acids classification, nomenclature, structure and properties of fatty acids - structure and function of prostaglandins, tri-acyl glycerol, structure and functions of phospholipids, spingomyelin, plasmologens, structure and function of glycolipids, cholesterol.	**12**
Unit.5	**Carbohydrates** Classification of carbohydrates, stereo isomerism and optical isomerism of sugars, mutarotation, occurrence, structure and biological importance of mono, di and polysaccharides, an introduction to mucopolysaccharides, reactions of carbohydrates due to the presence of hydroxyl, aldehyde and ketone groups.	**12**

Reference Books

1. D. L. Nelson, M. M. Cox, Lehninger Principles of Biochemistry, 5thEd., W. H. Freeman; New York, USA, 2005.
2. R. K. Murray, D. K. Grammer, Harper's Biochemistry, 29th Ed., McGraw Hill, Lange Medical Books, United Kingdom, 2009.
3. J.L. Jain, S. Jain, N. Jain, Fundamentals of Biochemistry, S. Chand & Company. India, 2013.
4. P. Y. Bruice, Organic Chemistry, 5th Ed., Pearson, 2014.

M.Sc. (Organic Chemistry) SEMESTER-IV			
M18CHOP405	**Practical**	**14 hrs./Wk**	**6 Credits**

SR. No.	Practical Detail	Lab Hours
	OR	
1	**(a) Synthesis of Medicinally important privileged scaffolds (with TLC monitoring of Reaction)** 1. 2-Phenylindole from acetophenone 2. 2,3-biphenylbenzopyrine 3. 2,4,5-Triphenyl-1H-imidazole 4. Benzilidene 2- methyloxazol 5- one. 5. 3-Methyl-5-pyrazolone 6. 2-hydroxy-4-methyl quinoline 7. 7-hydroxy-2-methylchromone 8. 5,5-diphenyl hydantoin 9. 2,2'-(4-nitrophenylazanediyl)diethanol 10. Dihydropyrimidine (DHPM) derivative **(b) Synthesis of Drug(TLC monitoring of Reaction):** 1. Sulphanilamide 2. Benzocaine 3. Paracetamol 4. Methylsalicylate **(C) Estimation of Drugs:** • Drug estimations by titrimetric method (3 Practicals) • Drug estimations by colorimetry (3 Practicals) • Drug estimations by spectrophotometry (3 Practicals)	**14**

Reference Books

5. Brian S. Furniss (1989, Fifth edition) Vogel's Textbook of Practical Organic Chemistry. Hoboken: John Willey & Sons (ISBN: 0-582-462363).
6. Arthur I. Vogel. (second edition) Elementary practical organic chemistry: Small scale preparations. Pearson (ISBN: 978-81-317-5686-7).
7. V.K. Ahluwalia and Renu Aggarwal (University Press),Comprehensive practical organic chemistry: Preparations and qualitative analysis (ISBN: 978-81-7371-273-9)
8. Raj K. Bansal (new age international-5th edition). Laboratory manual of organic chemistry (ISBN:978-81-224-2930-5**)**

M.Sc. (Organic Chemistry) SEMESTER-IV			
M18CHOV406	**Viva Voce**	**-**	**2 Credits**
• Comprehensive viva voce based on core & elective courses			

Bhakta Kavi Narsinh Mehta University Junagadh

M.Sc. Chemistry, SEM-3 and SEM-4

Question Paper Pattern

(Effective from June 2019)

Unit-1 [14 marks]

Answer **ALL** questions

Q.1 (a)	**1 Question of 4 Marks OR 2 Questions of 2 Marks Each.**	**4 Marks**
Q.1 (b)	**Answer any two question out of three.**	**10 Marks**
(1)		5
(2)		5
(3)		5

Unit-2 [14 marks]

Answer **ALL** questions

Q.2 (a)	**1 Question of 4 Marks OR 2 Questions of 2 Marks Each.**	**4 Marks**
Q.2 (b)	**Answer any two question out of three.**	**10 Marks**
(1)		5
(2)		5
(3)		5

Unit-3 [14 marks]

Answer **ALL** questions

Q.3 (a)	**1Question of 4 Marks OR 2 Questions of 2 Marks Each.**	**4 Marks**
Q.3 (b)	**Answer any two question out of three.**	**10 Marks**
(1)		5
(2)		5
(3)		5

Unit-4 [14 marks]

Answer **ALL** questions

Q.4 (a)	**1 Question of 4 Marks OR 2 Questions of 2 Marks Each.**	**4 Marks**
Q.4 (b)	**Answer any two question out of three.**	**10 Marks**
(1)		5
(2)		5
(3)		5

Unit-5 [14 marks]

Answer **ALL** questions

Q.5 (a)	**1 Question of 4 Marks OR 2 Questions of 2 Marks Each.**	**4 Marks**
Q.5 (b)	**Answer any two question out of three.**	**10 Marks**
(1)		5
(2)		5
(3)		5