BHAKTA KAVI NARSINH MEHTA UNIVERSITY

JUNAGADH 362263

SYLLABUS

Faculty of Science

M.Sc. - Chemistry

(Analytical 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 (Analytical 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	Instrumental Methods of Analysis	M18CHAC301	4	4	30/12	70/28	--	-	100/40
2	PG	3	Core	Pharma Regulatory Affairs	M18CHAC302	4	4	30/12	70/28	-	-	100/40
3	PG	3	Core	Separation Techniques	M18CHAC303	4	4	30/12	70/28	-	-	100/40
4	PG	3	Elective-I	Medicinal Chemistry	M18CHOE1304	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 (Analytical 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	Analysis of Selected Materials	M18CHOC401	4	4	30/12	70/28	--	-	100/40
2	PG	4	Core	Regulatory Affairs- II	M18CHOC402	4	4	30/12	70/28	-	-	100/40
3	PG	4	Core	Pharmaceutical Technology	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 Forensic Science	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. (Analytical Chemistry) SEMESTER-III			
M18CHOC301	**Instrumental Methods of Analysis**	**4 hrs./Wk.**	**4 Credits**

SR No.	Course Detail	Inst. Hrs.
Unit.1	**X-ray diffractions** Introduction, generation of X-rays, X-ray diffraction, Bragg's law, X-ray powder diffraction, X-ray single crystal diffraction interpretation of diffraction pattern, applications of XRD and numerical.	**12**
Unit.2	**MRI Imaging Technique** Magnetic resonance imaging (MRI) - principle, instrumentation, magnetic resonance angiography, 1H nmr of relevant diamagnetic and paramagnetic compounds, contrast agents and clinical applications.	**12**
Unit.3	**Thermal Methods of Analysis** Principle, theory and instrumentation of TGA, DTA and DSC. Factors affecting thermal analysis. Applications of thermal methods in various field of science. Various theories of thermal analysis for evaluation of kinetic parameters and analysis of simple and polymeric compounds.	**12**
Unit.4	**Atomic Absorption and Emission Technique** **Atomic absorption spectroscopy (AAS):** principle, classification of atomic spectroscopic method, measurement of atomic absorption, instrumentation, sensitivity, detection limits, application, advantages and disadvantages **Atomic Emission spectroscopy (AES)**: Introduction, principle, theory of emission,instrumentation,applications, advantages and disadvantages	**14**
Unit.5	**Flame Photometry** Introduction, principle, instrumentation, types of flame photometers, limitations of flame photometry, applications.	**10**

Reference Books

1. Fundamentals of Analytical Chemistry – Skoog, Harcourt College Publishers.
2. Quantitative chemical analysis – Vogel A. I., Pearson Education.
3. Text Book of Pharmaceutical Analsys – K. A. Connor, John Willey & Sons, New York.
4. Quantitative Chemical Analysis – Ayer by Harper & Row, New York.
5. Instrumental Methods of Analysis by B. K. Sharma, Goel Publisher, Meerut
6. Modern Analytical Chemistry – by Alka L. Gupta, Pragati Prakashan.
7. Instrumental methods of chemical analysis – by H. Kaur, Pragati Prakashan.
8. Instrumental methods of analysis – by B. Sivasankar, Oxford University Press.

M.Sc. (Analytical Chemistry) SEMESTER-III			
M18CHOC302	**Pharma Regulatory Affairs**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs.
Unit.1	**Documentation** Introduction and outline of standard operating procedures (SOP), Preparation of SOP, SOP of SOPs, benefits of SOPs, guidelines for writing SOPs, example and drafting of SOPs for various departments, supporting data formats of SOPs, preparation of standard testing procedures (STP), Raw data sheets (RDS), batch manufacturing/cleaning records (BMR/BCR) and other system related documents, Review and Control of Documents.	**12**
Unit.2	**Qualification** Introduction, basic concept and objectives of qualification, types of qualifications, qualification parameters (IQ/OQ/PQ/DQ/MQ), qualification of chemist/analyst, qualification of instrument/apparatus, facility qualification, preparation of qualification documents.	**10**
Unit.3	**Calibration and Validation** **Calibration** Introduction, need of calibration, types of calibration, calibration procedures for minor and major instruments, calibration standards, calibration frequency, preventive maintenance, change control. **Validation** Analytical method validation: General principles, types of validation,validation of analytical method as per ICH guidelines and USP. Process validation: Concept, process and documentation of process validation. prospective, concurrent & retrospective validation, re-validation criteria, Concept of process validation.	**14**
Unit.4	**Stability Study** Introduction, basic concept and objectives of stability study, Order of reaction and their applications in predicting shelf life and half-life of pharmaceutical formulations, Importance of accelerated and long term stability study, Effect of various environmental/ processing factors like light, pH, temperature, etc. on stability of the formulation and techniques for stabilization of product, Preparation of stability study	**14**

	protocols and reports, Regulatory requirements related to stability testing with respect to bracketting techniques, climates zone, impurities in stability study, photostability testing etc.	
Unit.5	**Good Laboratory Practices** History, Introduction, definition, principles of good laboratory practice.	**10**

Reference Books

1. Modern Approaches to Quality Control - by Isin Akyar, Web of Science
2. Bentley's Pharmaceutics.
3. GMP practices for pharmaceutical –James Swarbrick.
4. How to practice GMPs - by P.P.Sharma.
5. Pharmaceutical Process Validation - by Loftus and Nash.
6. Drug stability -Principles and Practices - by Jens. T. Carstensen.
7. Stability of drug and dosage forms - by Yoskioka
8. ICH guidelines on Harmonization.

M.Sc. (Organic & Analytical 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& Analytical 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 ofIC_{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.	**12**

	(b) Combinatorial chemistry 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, NiraliPublication, 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. (Analytical 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. (Analytical Chemistry) SEMESTER-III			
M18CHOP305	**Practical**	**12 hrs./Wk**	**6 Credits**

SR. No.	Practical Detail	Lab Hours
Unit-1	**Instrumental Analysis** **Perform 2 to 3 practical in each following segment** 1. Estimation of drugs (NSAID, Antacids, hypertensive) by spectrophotometry 2. Estimation of metal (Na, K) by flame photometer. 3. Organic mixture separation by column chromatography. 4. Organic mixture separation and determination of R*f* value by TLC. 5. Extraction of Nature products and TLC analysis. 6. Specific rotation determination by polarimeter.	**9**
Unit-2	**Extraction of Natural Products** **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. Svehla, G. (1996, Seventh edition) *Vogel's Qualitative Inorganic Analysis*. New Jersey: Pearson Education.(ISBN: 0582218667).
4. Jeffery, G. H.; Bassett, J.; Mendham, J.; Denny, R. C. (1989) Vogel's Textbook of Quantitative Chemical Analysis. Hoboken: John Willey & Sons (ISBN: 0-582-44693-7).

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

M.Sc. (Organic& Analytical 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. (Analytical Chemistry) SEMESTER-IV			
M18CHOC401	**Analysis of Selected Materials**	**4 hrs./Wk.**	**4 Credits**

SR No.	Course Detail	Inst. Hrs
Unit.1	**Analysis of Food Additives** Introductions, Types of Additives, Qualitative and Quantitative Determination of following food additives. **Preservatives:** Benzoic acid, Sorbic acid, Propionic acid. **Antioxidants:** Butylated hydroxytoluene (BHT), Butylated hydroxyanisole (BHA), Tocopherol, Ascorbic acid. **Non Nutritive Sweeteners:** Saccharin, Dulcin, Cyclamate, Aspartame. **Flavours and Flavour Enhancers:** Vanillin, Monosodium glutamate (MSG).	**12**
Unit.2	**Analysis of Food Products** Introductions, composition Characteristics Qualitative and Quantitative Analytical profiling of following food Products. **Oil:** Sesame oil, Cotton Seed oil, Mineral Oil, Rice Bran Oil, etc. **Dairy Products:** Milk, Ghee, Cheese, Ice-Cream, etc. **Alcoholic and Non-alcoholic Beverages:** Cola, Fruit drinks, Whisky, Beer, etc. **Fruits and Vegetable Products:** Tomato Ketchup, Sauce, Jam, Dehydrated Fruits and Vegetables, etc.	**12**
Unit.3	**Phyto-pharmaceuticals Analysis** Occurrence, screening, isolation, chemical nature and uses in pharmacy of following **Carotenoids:** α and β – Carotene, Xanthophyll (Lutein) **Flavonoids:** Resveratrol, Rutin, Hesperidin, Naringin, Quercetin **Limonoids:** d-Limonene, α-Terpineol, **Saponins:** Shatavarins **Phenolic acids:** Ellagic acid, **Vitamins**, **Tocotrienols** and **Tocopherols**	**12**
Unit.4	**Analysis of Soil, Water and Water Pollutants** **Soil:** Introduction, Importance of soil testing, Types of soils and analysis of soil for following: pH, Electrical Conductance, Organic Carbon, Determination of Sodium, Potassium, Boron, Phosphorous etc. **Water:** Introduction, Sampling techniques, Peservation and Pre-concentration methods, Determination of following: Total Acidity, Alkalinity, Free Carbon	**12**

	Dioxide, Chloride, Calcium, Magnesium, Iron, Silver, Heavy Metals, DO, COD, BOD, National and International standards for drinking water.	
Unit.5	**Analysis of Petrochemical Products** **Petroleum:** Introduction, Definition, Composition, Test methods for following: **Naphtha:** Aniline and Mixed Aniline point, Composition, Density, Evaporation rate, Flash point, Velocity, Volatility, Appearance, Kauri-Butanol value. **Gasoline:** Additives, Composition, Corrosiveness, Density, Flash and Fire point, Volatility, Water and Sediments **Kerosene:** Acidity, Composition, Flash and Fire point, Pour point, Density, Viscosity, Water and Sediments **Diesel:** Acidity, Composition, Flash and Fire point, Pour point, Density, Viscosity, Water and Sediments Distillate **Fuel oil and Mineral oil:** Acidity, Composition, Flash and Fire point, Pour point, Density, Viscosity, Water and Sediments	**12**

Reference Books

1. Manuals of Methods of Analysis of Food: Fruit and Vegetable products by FSSAI, GOI,2012
2. Manuals of Methods of Analysis of Food: Milk and Milk products by FSSAI, GOI,2012
3. Manuals of Methods of Analysis of Food: Oil and Fats by FSSAI, GOI,2015
4. Manuals of Methods of Analysis of Food: Meat and Meat products by FSSAI, GOI,2012
5. Manuals of Methods of Analysis of Food: Alcoholic Beverages, by FSSAI, GOI,2015
6. Handbook of food analysis, Edited by L. M.L. Nollet (vol 1- 3)published by Marcel Dekker Inc
7. Analytical methods for food additives,by Roger wood, Lucy Foster, Andrew Damant and Pauline key, CRC, Woodhead Publishing Limited.
8. Environmental Chemistry by B.K. Sharma, Gole Publishing House
9. Methods for Analysis of Petroleum Products by ASTM, International USA

M.Sc. (Analytical Chemistry) SEMESTER-IV			
M18CHOC402	**Regulatory Affairs- II**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs.
Unit.1	**Good Manufacturing practices** **Organization:** Structure, Chart, And Role, **Personnel:** Responsibilities, Training, and Hygiene. **Premises:** Location, Design, Plant Layout, Construction, Maintenance and Sanitation, Environmental control, **Equipments:** Selection, Specifications, SOPs, Qualifications, Maintenance, Clean in place, Sterilize in place. **Raw Materials:** Purchase specifications, Storage, Selection of Vendors, Vendor qualification, Control on Raw materials and Finished products	**12**
Unit.2	**Good Manufacturing practices** **Manufacturing & control:** Manufacturing documents, Batch formula records, SOPs, Quality audits of manufacturing processes and facilities, **In Process quality controls:** Role of IPQC, In process testing, SOP for various operations like cleaning, filling, drying, compression, coating, disinfections, sterilization, **Packaging and labelling control**: Line clearance, reconciliation of labels, cartons and other packaging materials, **Quality control Laboratory:** Responsibilities, Routine controls instruments, Reagents, Sampling plans, SOPs, STPs, Protocols, Data generation and storage, quality control documents, Retention samples, Records, Audits of quality control facilities.	**14**
Unit.3	**Good Manufacturing practices** **Finished product:** Product release, Quality review, Quality audits and batch release documents, **Warehousing**: Design, Construction, Maintenance and Sanitation, **Distribution and distribution records**, **Handling of returned goods, recovered materials and reprocessing, Complaints and recalls**: Evaluation of complaints and related records**.** Example and case studies for violation of GMP practices.	**12**
Unit.4	**Quality by Design** Introduction, Background, Elements of Quality by Design approach, Key characteristics, Benefits and outcome of Quality by Design	**10**

Unit.5	**Regulatory Documentation** Introduction, Elements and Preparation Site Master File (SMF). Introduction, Background, Elements, Preparation of Drug Master File (DMF), Filling of DMF, Its various aspects and Regulatory requirements, Introduction of key regulatory agencies like USFDA, TGA, MHRA etc.	**12**

Reference Books

1. GMP practices for pharmaceutical –James Swarbrick.
2. How to practice GMPs - by P.P.Sharma.
3. ICH guidelines on Harmonization.

M.Sc. (Analytical Chemistry) SEMESTER-IV			
M18CHOC403	**Pharmaceutical Technology**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs.
Unit.1	**Powders** Introduction, Particle size, Expression of Diameter**,** Methods for particle characterization and Determination of Particle Size, Bulk Properties of Powder like Surface area, Porosity, Flowability, Water content, Solubility etc. Production Methods, Particle Size Reduction, Introduction of methods like SEM/TEM and Particle Size Analyzer	**12**
Unit.2	**Solutions, Suspensions and Emulsions** **Solutions:** Introduction, Solvents for Liquid Pharmaceutical preparations, Preservatives, Sweet and other aqueous solutions, Non-aqueous solutions, Jellies, Elixirs etc, Commercial **Suspensions:** Introduction, Physical Characteristics, Preparation of Suspensions, Sustained Release Suspensions, Commercial Preparations. **Emulsions:** Introduction, Types, Theory of Emulsion, Commercial Preparations.	**12**
Unit.3	**Solid Dosage Forms: Tablet** **Tablet:** Definition, Advantages and Disadvantages, Types of tablets**,** Granulation techniques, Machinery for large scale granulation and compression, Physics of tablet making, In process controls, processing problems and remedies. **Coating of Tablets:** Objectives, Types of coating, Film forming materials, Formulations of coating solution, Equipments for coating, Coating process, Evaluation of coated tablets, Coating defects.	**14**
Unit.4	**Solid Dosage Forms: Capsules** **Capsules:** Definitions, Advantages, disadvantages, Ideal requirements, Production of Hard capsules (Gelatin and non-gelatin e.g. vegetable), Capsule storage, Size of capsules, Methods of capsule filling, Problems and Remedies, Quality control **Soft Gelatin Capsules:** Formulation of shell and capsule coat, and Quality control.	**14**
Unit.5	**Pharmaceutical Excipients** History, Introduction, Classification of Excipients, Discussion of its role in Pharmaceutical Preparations, Examples in each case with basic properties, Some case studies and Preparation of formulation.	**08**

Reference Book

1. The Theory and Practice of Industrial Pharmacy by L Lachman, H Lieberman and J

2 .Kanig. Gennaro, Alfonso R., Remington: The Science and Practice of Pharmacy, Vol-I & II, Lippincott Williams & Wilkins, New York.

3. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel& others.

4. Pharmaceutics: The Science of Dosage Form Design by Michael E. Aulton

5. Remington : Essentials of Pharmaceutics, by Linda A. Felton, Published by Pharmaceutical Press, London, 2013

6. Pharmaceutical Quality by Design, A Practical Approach, by Mark Gibson & Walkiria Schilndwein., Wiley Publication.

M.Sc. (Organic & Analytical 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.	**20**

	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)	

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. (Analytical Chemistry) SEMESTER-IV			
M18CHE2404	**Chemistry of Forensic Science**	**4 hrs./Wk**	**4 Credits**

SR No.	Course Detail	Inst. Hrs
Unit.1	**Forensic Toxicology** Drug of Abuse, Introduction, Classification, Drug regulations and Scheduled drugs, Drug Testing and Confirmation, Law related to drugs, Introduction and scope of Forensic Toxicology, Different types of poisons commonly encountered. Different Routes of Ingestion, Toxicity of poisons. Fate of drug in body. Samples in fatal and no fatal cases. Packing and preservations of viscera. Extraction and screening of common poisons and methods of analysis of poisons. Forensic Toxicology of Ethyl alcohol. Determination of alcohol in field by breath analyser.	**14**
Unit.2	**Textile Fibres** Introduction and Construction of Textile Fibres and Yarns, Fabric characteristics, Microscopy characteristic, Birefringence, Fluorescence Microscopy, Colours in Textile, Colour assessment, Chemical properties.	**12**
Unit.3	**Fires and Explosions** Introduction, Occurrence, Recognition and Collection of Fire scene evidence, Preliminary analysis of fire scene residue evidence, Case studies related to Arson.	**10**
Unit.4	**Explosives** Introduction, Types of Explosives, High and Low order explosions, Explosive trains, Collection and Preservation of Exhibits, Preliminary analysis of Explosives, Case studies related to Explosives.	**12**
Unit.5	**Paint and Glass** **Paint:** Introduction, Types and Composition of Paint, Paint analysis, Paint manufacturing, Collection, Preliminary analysis of paints samples, Interpretations. **Glass:** Introduction, Type and Composition of Glass, Forensic examination of Glass, The effects of projectiles on Glass, Lamp analysis, Case studies related to Glass.	**12**

Reference Books

1. Handbook of Forensic Medicine & Toxicology by Chadha P. V. Jaypee Brothers, New Delhi,2004
2. Text Book of Medical Jurisprudence, Forensic Medicine & Toxicology by C. K. Parikh CBS Pub.
3. Toxicology- Principles and Applications by Niesink RJM, CRC Press,1996
4. Spot test in Organic Analysis by Feigl, Elsevier Pub. New Delhi, 2005
   Spot test in Inorganic Analysis by Feigl Elsevier Pub. New Delhi, 2005
5. Fundamentals of Forensic Science, by Houck & Siegel, Acadamic Press, London, 2006.
6. Forensic Science in Criminal Investigation & Trials, by B. R. Sharma, Universal Pub., New Delhi, 2003

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

SR. No.	Practical Detail	Lab Hours
	Instrumental Analysis	
1	1. Determination of wavelength for various APIs, Intermediates, Simple Organic and Inorganic molecules by VIZ Spectrophotometer. 2. Estimation of drugs (NSAID, Antacids, hypertensive, etc.) by colorimeter. 3. Determination of wavelength and type of shifts for various APIs, Intermediates, Simple Organic and Inorganic molecules by UV-VIZ Spectroscopy. 4. Linearity study for various APIs, Intermediates and simple Organic molecules by UV-VIZ Spectroscopy. 5. Accuracy & Precision study for various APIs, Intermediates and simple Organic molecules by UV-VIZ Spectroscopy. 6. Spectral analysis of APIs, Intermediates and Simple Organic molecules by IR Spectroscopy.	**08**
	Pharmaceutical Technology	
2	1. Preparation and evaluation of simple syrup IP 2. Preparation and evaluation of suspension (eg. milk of magnesia suspension) 3. Preparation and evaluation of eye drop (eg. atropine sulphate) 4. Preparation and evaluation of infusion (eg. 5% dextrose, metronidazole) 5. Preparation and evaluation of injection (eg. ascorbic acid IP, NaCl IP) 6. Preparation and evaluation of lotion (eg. calamine IP)	**06**

Reference Books

1. Remington : Essentials of Pharmaceutics, by Linda A. Felton, Published by Pharmaceutical Press, London, 2013
2. ICH Guidelines (Q2A) on Validation of Analytical Method.

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