VIVEKANAND EDUCATION SOCIETY'S
COLLEGE OF PHARMACY
Hashu Advani Memorial Complex, Behind Collector Colony, Chembur (E), Mumbai – 400 074

Sindhi Linguistic Minority, Approved by AICTE, DTE, Pharmacy Council of India & Govt. of Maharashtra, Affiliated to University of Mumbai
B. Pharm Programme is accredited by NBA, New Delhi from 2016-17 to 2021-22

2.6.1

Teachers and students are aware of the stated Programme and Course outcomes of the Programme offered by the institution

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Teachers and students are aware of the stated Programme and course outcomes of the Programmes offered by the institution (15)
Describe Course Outcomes (COs) for all courses and mechanism of communication

M PHARM CBCS SYLLABUS COURSE OUTCOMES

SEM	SUBJECT	Course Outcome	STATEMENTS	PO MAPPING	PSO MAPPING
	Modern Pharmaceutical and Medicinal Chemistry (CBCS)	CO1	Recall the concept of protein folding, receptors and their types, SAR, mechanism of action of certain class of drugs, enzyme kinetics and principles of enzyme inhibitors	1, 2, 3, 7, 8, 11	1,2,3
		CO2	Explain and illustrate the principles and applications of medicinal chemistry to impart knowledge about recent advances in the field of medicinal chemistry at the molecular level including different techniques for the rational drug design.	1, 2, 3, 4, 6, 7, 11	1,2,3
		CO3	Application of the gained knowledge in basic research of rational design of enzyme inhibitors along with their metabolic profile and stereochemistry.	1, 2, 4, 6, 7, 8, 11	1,2,3
		CO4	Evaluating and interpreting the role of chirality in selective and specific therapeutic agents to realize that stereo-selectivity is a prerequisite for drug evolution.	1, 2, 3, 4, 5, 10, 11	1,2,3
	Modern Pharmaceutics (CBCS, 2016-17)	CO1	Understand the concepts of pre-formulation, micromeritics, tablet compression, optimization.	1, 3, 4, 6, 7	1,2,3
		CO2	Apply the preformulation and excipient knowledge for proper design of safe, efficacious, stable and quality formulations.	1, 2, 3, 4, 6, 7, 8, 10, 11	1,2,3
		CO3	Investigate various aspects of solubility, dissolution and stability	1, 2, 3, 4, 6, 7, 8, 11	1,2,3
		CO4	Analyze the formulation parameters, apply optimization techniques and devise suitable formulation composition.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1,2,3

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Dr. (Mrs.) Supriya S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
HAMC, Behind Collector Colony,
Chembur, Mumbai - 400 074.

M Pharm CBCS SYLLABUS

SEM I	**Modern Pharmacology (CBCS Revised 2019)**	**CO1**	Explain the mechanisms of drug transport and concepts of Pharmacokinetics, pharmacodynamics.	1, 3, 6, 8, 9	1,2,3
		CO2	Explain the factors affecting drug responsiveness, mechanisms of drug dependence and microbial resistance and apoptosis.	1,3,4, 6, 7, 8, 9	1,2,3
		CO3	Explain Immunopharmacology and advances in the pharmacotherapy of CNS, CVS and Diabetes Mellitus.	1,3,4, 6, 8, 9	1,2,3
	Modern Analytical Techniques (CBCS)	**CO1**	Recall with examples the terminologies associated with spectroscopy, chromatography, X-ray diffraction, electrophoresis, potentiometry and thermal analysis	1, 2, 3, 8, 11	1,2,3
		CO2	Explain and illustrate the theory, instrumentation and applications of various techniques involved in spectroscopy, chromatography, X-ray diffraction, electrophoresis, potentiometry and thermal analysis	1, 2, 3, 4, 6, 8, 11	1,2,3
		CO3	Apply the knowledge gained to calculate concentration by UV-visible spectroscopy, predict the IR frequencies, number of signals in NMR and fragmentation pattern in MS for simple organic compounds	2, 3, 4, 11	1,2,3
		CO4	Predict the spectroscopic behavior of molecules	2, 3, 4, 8, 11	1,2,3
	Study of Natural Products (CBCS)	**CO1**	Define and summarize phytochemicals and herbal drugs used in drug discovery, nutraceuticals, immunoglobulins and related applications	1, 2, 3, 8, 11	1, 2, 2003
		CO2	Explain the use of herbal drugs as excipients, in utraceuticals, as immunoglobulins and related applications	1, 2, 3, 4, 6, 8, 11	1, 2, 2003
		CO3	Apply the knowledge gained to isolate phytochemicals from herbal drugs and carry out standardization	2, 3, 4, 11	1, 2, 2003
		CO4	Summarize the information of various herbs from Herbal Pharmacopoeia	2, 3, 4, 8, 11	1, 2, 2003

Dr. (Mrs.) Supriya S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
HAMC, Behind Collector Colony,
Chembur, Mumbai - 400 074.

	Biostatistics & Research Methodology (CBCS)	**CO1**	Students will be able to explain basic research methodologies like objectives study design, review of literature, randomization, types of studies	1,2,6,7,8,9,10,11	1, 2, 3
		CO2	Students will be able to explain, analyze the data and apply the statistical principles in the evaluation of the research data	1,2,3,6,7,8,9,10,11	1, 2, 3
		CO3	Students will be able to explain the basic concepts of medical research including informed consent, , concepts like autonomy, beneficence and non-maleficence, as well as about the declaration of Helsinki and other guidelines like ICH GCP, Nuremberg code which govern ethical conduct of clinical trials	1,2,3,6,7,8,9,10,11	1, 2, 3
		CO4	Students will be able to explain the basic facilities in animal handling and animal house facilities like transport, storage and care of animals. As well as about the basic procedures to be followed to ensure the efficient management of animal house facility at the site	1,2,3,6,7,8,9,10,11	1, 2, 3
	Advanced Pharmaceutical and Medicinal Chemistry (CBCS)	**CO1**	Recall and relate the concept of enzyme kinetics and principles of enzyme inhibitors with the new advancements in medicinal chemistry with respect to synergism, biological activity of the molecule. Finding peptide synthesis and RNA structure to develop potential agents.	1, 2, 3,4, 6, 8, 9, 11	1, 2, 3
		CO2	Classify the type of enzyme inhibitors and interpret their nature of inhibition from the various plots of enzyme kinetics to explain and understand their molecular mechanism of inhibition and establish the relation with their IC50 and Ki values.	1, 2, 4, 5, 6, 8, 9, 11	1, 2, 3
		CO3	Identify and make use of descriptors of molecules to develop an equation to quantitatively establish the structure activity relationship.	1, 2, 3, 4, 7, 8, 9, 10, 11	1, 2, 3
		CO4	Apply the acquired knowledge in design of covalently and non-covalently binding enzyme inhibitors, peptidomimetics, antisense agents and biologicals based on converged fields of chemistry and biology.	1, 2, 3, 4, 6, 7, 9, 11	1, 2, 3

Dr. (Mrs.) Supriya S. Shidhaye

Vivekanand Education Society's College of Pharmacy
HAMC, Behind Collector Colony,
Chembur, Mumbai - 400 074.

Advanced Organic Chemistry	**CO1**	Learn and apply advanced concepts of Stereochemistry	1,3,4,8,10,11	1, 2, 3
	CO2	Understand and explain basic concepts of Catalysis, its types and different reactions of organometallic compounds.	1,3,4,8,10,11	1, 2, 3
	CO3	Understand the restrosynthetic methods and apply the knowledge of reactions covered for predicting retrosynthetic pathways of newer drugs	1,3,4,8,10,11	1, 2, 3
	CO4	Apply and integrate acquired concepts of asymmetric synthesis in synthesis of chiral medicinal compounds.	1,3,4,8,10,11	1, 2, 3
	CO5	Understand the merits and techniques involved in combinatorial synthesis	1,3,4,8,10,11	1, 2, 3
	CO6	Understand various greener chemistry approaches and compare them against conventional methods of Synthesis	1,3,4,8,10,11	1, 2, 3
Advanced Pharmaceutics I (CBCS Revised 2016)	**CO1**	Understand the recent advances in tablet technology. Will acquire insight to oral controlled release drug delivery system and machinery used for the same.	1,3,5,6,9,11	1,3
	CO2	Familiarize with the recent advances in particulate drug delivery systems, provide an insight to formulation and evaluation of small volume and large volume Parenterals and study the recent advances in injectable controlled release and long acting formulations	1,3,5,6,9,11	1,3
	CO3	Will be introduced to specialized pharmaceutical disperse phase systems	1,3,5,6,9,11	1,3
	CO4	Understand the recent advances in gastro retentive oral drug delivery systems, concepts and various types of oral controlled release drug delivery system and evaluation methods for the same	1,3,5,6,9,11	1,3

Dr. (Mrs.) Supriya S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
HAMC, Behind Collector Colony,
Chembur, Mumbai - 400 074.

		CO5	Acquire knowledge on site specific drug delivery systems to increase therapeutic efficacy of drug with minimum side-effects. Understand physiology of eye and develop advancements in ocular controlled drug delivery systems.	1,3,5,6,9,11	1,3
		CO6	Acquire knowledge on site specific drug delivery systems to increase therapeutic efficacy of drug with minimum side-effects. Understand in detail biochemistry and anatomy of skin, recent developments in transdermal drug delivery systems and evaluate TDDS as per regulatory guidelines. Perceive knowledge on Quality by design to obtain safe, effective and reproducible formulations (as per ICH guidelines)	1,3,5,6,9,11	1,3
	Advanced Pharmaceutics II (CBCS Revised 2016)	**CO1**	Understand site specific drug delivery systems to increase therapeutic efficacy of drug with minimum side-effects. Will know specialized pharmaceutical dispersed systems and recent advances in particulate drug delivery systems.	1,3,5,6,9,11	1,3
		CO2	Understand anatomy and physiology of nasal mucosa and lungs. Have knowledge on recent developments in nasal and pulmonary drug delivery systems and its applications.	1,3,5,6,9,11	1,3
		CO3	Understand the structural complexity and challenges to peptides and protein delivery of drugs and develop recent developments in peptide based drug delivery systems.	1,3,5,6,9,11	1,3
		CO4	Gain knowledge on recent advances in particulate drug delivery systems.	1,3,5,6,9,11	1,3
SEM II		**CO5**	Acquire knowledge on site specific drug delivery systems to increase therapeutic efficacy of drug with minimum side-effects. Understand physiology of brain, its barriers and develop advancements in brain controlled drug delivery systems.	1,3,5,6,9,11	1,3
	Quality Assurance System (CBCS)	**CO1**	Understand the concept of validation, qualification and calibration	1,2,3,4,8, 11	1

Dr. (Mrs.) Supriya S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
HAMC, Behind Collector Colony,
Chembur, Mumbai - 400 074.

	CO2	Describe procedure for qualification of instruments and equipment	1.2.3.4	1
	CO3	Summarize the parameters of ICH guidelines for analytical method validation.	1, 11	3
	CO4	Comprehend the concept of process validation of different dosage forms	1,2,3,4,5, 6,7,8	1
	CO5	Gain knowledge of the process of cleaning validation	1,2,3,4,8, 10	2
	CO6	Correlate the knowledge of IPR with respect to pharmaceutical products	1,2,3,4,7, 8,11	3
Pharmaceutical Quality Management (CBCS)	**CO1**	Understand the concept of quality, strategic quality management and define different terms involved in quality management systems.	1,2,5,6	1,3
	CO2	Understand the concept of statistical process control (SPC) and explain the principles involved in SPC like process capability, control chart analysis and process control.	2,3,4,5,11	1,3
	CO3	Recognize the importance of customer, different concepts required to achieve customer satisfaction and desired quality the development of quality culture and define and comprehend the different terms, types and process involved in benchmarking.	3,6,8,9,10	3
	CO4	Comprehend principles involved in pharmaceutical quality management like six sigma, ISO, WHO-GMP and CFR-21	2,3,4,5,6,7,10	1,2
	CO5	Apply ICH guidelines for drug stability, risk management and quality by design.	1,2,3,5,8,9	1,3
Drug Metabolism (CBCS)	**CO1**	Recall the concept of drug metabolism, types of drug metabolism and in silico drug metabolism prediction	1, 2, 3, 7, 8, 11	1,2,3
	CO2	Explain and illustrate the mechanism for metabolism of drugs through primary and secondary pathways	1, 2, 3, 4, 6, 7, 11	1,2,3

Dr. (Mrs.) Surekha S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
HAMC, Behind Collector Colony,
Chembur, Mumbai - 400 074.

	Experimental Techniques in Pharmaceutica	CO3	Application of the gained knowledge in basic studies on metabolism and metabolic profiling	1, 2, 4, 6, 7, 8, 11	1,2,3
		CO1	Design novel drug delivery systems and evaluate them.	1, 3, 4, 6, 7	1,2,3
		CO2	Apply the preformulation and excipient knowledge for proper design of safe, efficacious, stable and quality formulations.	1, 2, 3, 4, 6, 7, 8, 10, 11	1,2,3
		CO3	Investigate various aspects of dissolution and its mathematical treatment.	1, 2, 3, 4, 6, 7, 8, 11	1,2,3
		CO4	Analyze the formulation parameters, apply optimization techniques and devise suitable formulation composition.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1,2,3
	Rational Drug Design (CBCS)	CO1	Recall and relate the different structures of protein along with the structure activity relationship of existing studied drugs and their interactions with the protein residues.	1, 2, 3, 4, 7, 8, 11	1,2,3
		CO2	Classify and explain the different techniques to calculate the potential and kinetic energies of the system using Quantum and Molecular Mechanics, energy minimization and molecular conformational space search in the binding cavity of protein.	1, 2, 3, 4, 5, 8, 9, 11	1,2,3
		CO3	Make use of the minimal energy conformation of protein and ligand to construct and develop a model based on desired techniques like molecular docking, 3D-QSAR, pharmacophore modelling, homology modelling, molecular dynamics, etc.	1, 2, 4, 5, 6, 8, 9, 11	1,2,3
		CO4	Analyze the results obtained based on the characteristics of different interactions (docking), equations (QSAR), binding energy (dynamics) and interpret the molecular mechanism of how a drug act in a particular manner to be either inhibiting or stimulating the enzyme/receptor.	1, 2, 3, 4, 5, 7, 8, 9, 11	1, 2, 3
SEM II	Advanced Biochemistry (CBCS)	CO1	Recall the protein subfamilies along with defining the terminologies like metabolism, nucleic acid, enzymes, cofactors, biomolecules, etc.	1, 2, 3, 4, 7, 8, 11	1, 2, 3

Dr. (Mrs.) Supriya S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
HAMC, Behind Collector Colony,
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	CO2	Classify and nomenclature of lipids, carbohydrates and nucleic acids, purification, characterization and synthesis of proteins	1, 2, 3, 4, 5, 8, 9, 11	1, 2, 3
	CO3	Apply the knowledge gained in understanding the effects of drugs on lipid metabolism, protein function, nucleic acid biosynthesis, carbohydrates linkages to improve the pharmacokinetic properties of certain drugs	1, 2, 3, 4, 5, 8, 9, 11	1, 2, 3
Green Chemistry (CBCS)	CO1	Know the terms involved in green chemistry and know various guidelines of the environmental management system.	1, 2, 3, 4, 8, 9, 10, 11	1, 2, 3
	CO2	Understand the concept and techniques of waste management and illustrate the twelve principles of green chemistry. Make use of the microwave concept in the synthetic reactions.	1, 2, 3, 4, 5, 6, 8, 9, 10, 11	1, 2, 3
	CO3	Outline type of catalysis and their uses, safe solvents, water as reaction solvent.	1, 2, 3, 4, 5, 7, 8, 10, 11	1, 2, 3
	CO4	Learn greener process designing and future prospects to be applied in their research areas.	1, 2, 3, 4, 5, 7, 8, 10, 11	1, 2, 3
Drug Regulatory Affairs (CBCS)	CO1	Understand the concepts of innovator and generic drugs, drug development process and the Regulatory guidance and guidelines for filing and approval process.	1,2,4,6,7,9,1	1, 2
	CO2	Develop and submit the dossiers in CTD/ eCTD formats and the post approval regulatory requirements for actives and drug products	1,2,3,4,7,8,10	1,2
	CO3	Understand the requirements in the clinical trials settings and pharmacovigilance activities	1,2,3,4,5,6,7,8,9,10,11	1,2,3
	CO4	professional and practical need of pharmaceutical industry.	1,2,3,4,5,6,7,8,10,11	3

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Dr. (Mrs.) Supriya S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
HAMC, Behind Collector Colony,
Chembur, Mumbai - 400 074.

	Cosmeticology (CBCS Revised 2016)	**CO1**	Describe the role and functional performance of cosmetic excipients , therapeutics ingredients and perfumes in the formulation of cosmetics for skin, hair, nails and oral care.	1,2,3,4,6,7,9,10,11	1,2,3
		CO2	Understand the quality evaluation and regulations for the use of colors in cosmetics	1,2,3,4,6,7,9,10,11	1,2,3
		CO3	Formulate and evaluate cosmetics for skin care and hair care as well as dental and oral care	1,2,3,4,5,6,7,8,10,11	1,2,3
		CO4	Design and evaluate herbal cosmetics for skin care, hair care and oral care	1,2,3,4,5,6,7,8,10,11	1,2,3
		CO5	Utilize novel approaches of formulation technologies in delivery of functional ingredients to skin, hair nails and oral cavity.	1,2,3,4,6,7,9,10,11	1,2,3
	Polymers in Pharmacy (CBCS Revised 2016)	**CO1**	Study the classification and preparation methods of synthetic polymers	1,2,3,4,6,7,9,10,11	1,2,3
		CO2	Study the characterization of polymers rheologically and thermally.	1,2,3,4,6,7,9,10,11	1,2,3
		CO3	Know about biocompatibility of polymers and understanding the properties of biocompatible polymers are.	1,2,3,4,5,6,7,8,10,11	1,2,3
		CO4	Explain why polymers are used in drug delivery applications	1,2,3,4,6,7,8,9,10,11	1,2,3
SEM II	**Drug Evaluation Techniques (CBCS)**	**CO1**	Recall with examples the terminologies associated with in vitro methods available for targeted drug delivery systems	1, 2, 3, 8, 11	1,2,3
		CO2	Explain and illustrate the various evaluation techniques available for targeted drug delivery systems, basic principles of drug discovery and estimation of drug from complex media	1, 2, 3, 4, 6, 8, 11	1,2,3

Dr. (Mrs.) Supriya S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
HAMC, Behind Collector Colony,
Chembur, Mumbai - 400 074.

SEM II		**CO3**	Apply the knowledge gained to perform in vitro assays and screening methods for different drugs and novel drug delivery systems	2, 3, 4, 11	1,2,3

Vivekanand Education Society's College of Pharmacy
Chembur
Mumbai
400 074.
INDIA

Dr. (Mrs.) Supriya S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
HAMC, Behind Collector Colony,
Chembur, Mumbai - 400 074.

2.6.1 QIM

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Describe Course Outcomes (COs) for all courses and mechanism of communication

M PHARM R 2019 SYLLABUS COURSE OUTCOMES

SEM	SUBJECT	Course Outcome	STATEMENTS	PO MAPPING	PSO MAPPING
	Modern Pharmaceutical Analytical Techniques	**CO1**	Recall with examples the terminologies associated with spectroscopy, chromatography, X-ray diffraction, electrophoresis & immunoassaya	1, 2, 3, 8, 11	1, 2, 3
		CO2	Explain and illustrate the theory, instrumentation and applications of various techniques involved in spectroscopy, chromatography, X-ray diffraction, electrophoresis and immunoassaya	1, 2, 3, 4, 6, 8, 11	1, 2, 3
		CO3	Apply the knowledge gained to calculate concentration by UV-visible spectroscopy, predict the IR frequencies, number of signals in NMR and fragmentation pattern in MS for simple organic compounds	2, 3, 4, 11	1, 2, 3
		CO4	Predict the spectroscopic behavior of molecules	2, 3, 4, 8, 11	1, 2, 3
	Drug Delivery Systems	**CO1**	Understand the concepts and various approaches for development of novel drug delivery systems.	1,2,4,5,6,7 , 10,11	1, 2,3
		CO2	Understand criteria for selection of drugs and polymers for the development of delivery system.	1,2,3,4,7,8,10 ,11	1,2,3
		CO3	Understand formulation and evaluation of Novel drug delivery systems..	1,2,3,4,5,6,7, 8,10,11	1,2,3
	Modern Pharmaceutics	**CO1**	Understand the concepts of pre-formulation, tablet compression, optimization, validation and cGMP.	1, 3, 4, 6, 7,	1, 2, 3
		CO2	Apply the preformulation knowledge for proper selection of formulation excipients.	1, 2, 3, 4, 6, 7, 8, 10, 11	1, 2, 3
		CO3	Investigate various qualification parameters for equipments and validation parameters for dosage forms.	1, 2, 3, 4, 6, 7, 8, 11	1, 2, 3
		CO4	Analyze the formulation parameters, apply optimization techniques and device suitable formulation composition.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1, 2, 3

M PHARM R 2019 Syllabus

Dr. (Mrs.) Supriya S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
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	Regulatory Affairs	CO1	Understand the concepts of innovator and generic drugs, drug development process and the Regulatory guidance and guidelines for filing and approval process.	1,2,4,6,7,9,11	1, 2
		CO2	Develop and submit the dossiers in CTD/ eCTD formats and the post approval regulatory requirements for actives and drug products	1,2,3,4,7,8,10	1,2
		CO3	Understand the requirements in the clinical trials settings and pharmacovigilance activities	1,2,3,4,5,6,7, 8,9,10,11	1,2,3
		CO4	To correlate the theoretical knowledge with professional and practical need of pharmaceutical industry.	1,2,3,4,5,6,7, 8,10,11	3
	Pharmaceutics Practicals - I	CO1	Estimate the active pharmaceutical ingredients in formulations by using different modern analytical techniques.	1,3,4,8,11	1
		CO2	Apply the concepts of pre-formulation in formulation development.	1,2,3,4,8,11	3
		CO3	Understand the formulation and evaluation methods of different novel drug delivery system.	1,2,3,4,8,9,10 ,11	1,3
SEM I		CO4	Plan, execute the experiment using various methodologies (defined protocol or qualitative or quantitative techniques) and summarize the findings in systematic way verbally and in written communication.	1,2,3,4,8,9,10 ,11	1,2,3
SEM I	**M PHARM PHARMACEUTICAL CHEMISTRY**				
	Modern Pharmaceutical Analytical Techniques	CO1	Recall with examples the terminologies associated with spectroscopy, chromatography, X-ray diffraction, electrophoresis, potentiometry and thermal analysis	1, 2, 3, 8, 11	1, 2, 3
		CO2	Explain and illustrate the theory, instrumentation and applications of various techniques involved in spectroscopy, chromatography, X-ray diffraction, electrophoresis, potentiometry and thermal analysis	1, 2, 3, 4, 6, 8, 11	1, 2, 3
		CO3	Apply the knowledge gained to calculate concentration by UV-visible spectroscopy, predict the IR frequencies, number of signals in NMR and fragmentation pattern in MS for simple organic compounds	2, 3, 4, 11	1, 2, 3
		CO4	Predict the spectroscopic behavior of molecules	2, 3, 4, 8, 11	1, 2, 3
		CO1	Predict and explain the reaction products based on reaction intermediates and mechanism involved.	1,3,8,11	1
		CO2	Comprehend various synthetic routes available for synthesis of medicinal drugs.	1,3,8,10,11	1

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	Advanced Organic Chemistry –I	**CO3**	Apply Concept of protecting and deprotecting groups in synthetic schemes.	1,3,8,11	1,2
		CO4	Apply the knowledge of reactions covered in syllabus for predicting retrosynthetic pathways of newer drugs.	1,3,8,11	1,2,3
	Advanced Medicinal Chemistry	**CO1**	Summarize Different stages of drug discovery	1,11	1
		CO2	Explain Role of medicinal chemistry in drug research	1,6,11	1
		CO3	Correlate different techniques for drug discovery and medicinal chemistry	1,3,11	1,2
		CO4	Drive or deduce appropriate enzyme inhibitor or peptidomimetic if given the case	1,2,3,11	1,2,3
	Chemistry of Natural Products	**CO1**	Recognize the different types of natural compounds and their chemistry and medicinal importance	1,6,9,10,11	1,2
		CO2	Explain the phytochemical importance of alkaloid, flavonoid, steroids, terpenoids and vitamins in drug discovery	1,3,6,7,9,10,11	1,2
		CO3	Use rDNA technology in new drug discovery	1,4,6,7,9,10,11	1,2,3
		CO4	Justify the structural elucidation of natural compound based on its various spectroscopic parameters	1,3,4,7.9,10,11	1,2,3
	PHARMACEUTICAL CHEMISTRY PRACTICAL - I	**CO1**	perform quantitative analysis of organic compounds	1-6,8,11	1-6,8,11
		CO2	perform the various reactions of synthetic importance	1,2,3,5,6,8,11	1,2,3,5,6,8,11
SEM I		**CO3**	isolate products and interpret the experimental data	1,2,3,5,6,8,11	1,2,3,5,6,8,11
	M PHARM QUALITY ASSURANCE				
	Modern Pharmaceutical Analytical Techniques	**CO1**	Recall with examples the terminologies associated with spectroscopy, chromatography, X-ray diffraction, electrophoresis, potentiometry and thermal analysis	1, 2, 3, 8, 11	1, 2, 3
		CO2	Explain and illustrate the theory, instrumentation and applications of various techniques involved in spectroscopy, chromatography, X-ray diffraction, electrophoresis, potentiometry and thermal analysis	1, 2, 3, 4, 6, 8, 11	1, 2, 3
		CO3	Apply the knowledge gained to calculate concentration by UV-visible spectroscopy, predict the IR frequencies, number of signals in NMR and fragmentation pattern in MS for simple organic compounds	2, 3, 4, 11	1, 2, 3
		CO4	Predict the spectroscopic behavior of molecules	2, 3, 4, 8, 11	1, 2, 3

Quality Management Systems	**CO1**	Understand the concept of quality, strategic quality management and define different terms involved in quality management systems.	1,2,5,6	1,3
	CO2	Understand the concept of statistical process control (SPC) and explain the principles involved in SPC like process capability, control chart analysis and process control.	2,3,4,5,11	1,3
	CO3	Recognize the importance of customer, different concepts required to achieve customer satisfaction and desired quality the development of quality culture and define and comprehend the different terms, types and process involved in benchmarking.	3,6,8,9,10	3
	CO4	Comprehend principles involved in pharmaceutical quality management like six sigma, ISO, WHO-GMP and CFR-21.	2,3,4,5,6,7,10	1,2
	CO5	Apply ICH guidelines for drug stability, risk management and quality by design.	1,2,3,5,8,9	1,3
Quality Control and Quality Assurance	**CO1**	Understand the roles and responsibilities of Quality Control and Quality Assurance departments in pharmaceutical industry	1,	1
	CO2	Understand the significance of cGMP and ICH Guidelines in pharmaceutical industry	1,2	1
	CO3	Describe the analysis of raw materials, packaging materials, in process quality control (IPQC) and finished products for different pharmaceutical dosage forms	1,	1
	CO4	Apply knowledge of regulatory requirements for preparing, maintaining, retaining and retrieving the data and documents in pharmaceutical industry	1	1
	CO5	Understand the scope and importance of Intellectual Property Rights (IPR) in pharmaceutical industry (IPR) in pharmaceutical industry	1	1
Product development and technology transfer	**CO1**	Understand the new product development process, pilot plant scale up and packaging requirements	1,2,4,6,7,9,11	1, 2
	CO2	Understand the necessary information to transfer technology from R&D to actual manufacturing by sorting out various information obtained during R&D	1,2,3,4,7,8,10	1,2,3
	CO3	Understand the requirements in the manufacturing settings and regulatory activities	1,2,3,4,5,6,7, 8,9,10,11	1,2,3
	CO4	Correlate the theoretical knowledge with professional and practical need of pharmaceutical industry.	1,2,3,4,5,6,7, 8,10,11	3
	CO1	Apply the principles of uv-vis spectroscopy, fluorescence spectroscopy and flame photometry to perform, analyze, determine and report the content of drugs in formulation/sample solution	2, 3, 4, 6, 8, 10	1, 2, 3

Dr. (Mrs.) Supriya S. Shidhaye
PRINCIPAL
Vivekanand Education Society's
College of Pharmacy
HAMC, Behind Collector Colony,
Chembur, Mumbai - 400 074.

SEM I	Quality Assurance Practical-I	CO2	Relate the concept of in process quality control & stability studies to design and develop the protocol for testing of pharmaceuticals		1, 2, 3
		CO3	Plan, execute and conclude the experiment using qualitative or quantitative techniques	1, 2, 3, 4	1, 2, 3
	M PHARM PHARMACEUTICS SEM II				
	Nano technology and targeted DDS	CO1	Understand concept of drug targeting, its application, pulmonary drug delivery systems and gene therapy.	1, 4, 6, 9, 11	1, 2, 3
		CO2	Apply the knowledge for selection of appropriate Nanotechnology and delivery system for given class of drug and route of administration.	1, 3, 4, 6, 10, 11	1, 2, 3
		CO3	Analyze the parameters for evaluation of Nano and Micro drug delivery systems.	1, 3, 4, 6, 11	1, 2, 3
		CO4	Construct composition of NDDS, encompassing Micro and Nano drug delivery systems.	1, 2, 3, 4, 5, 6, 8, 9, 10, 11	1, 2, 3
	Biopharmaceutics & Pharmacokinetics	CO1	Understand the basic concepts in biopharmaceutics and pharmacokinetics..	1,2,4,6,7,10,11	1, 2,3
		CO2	Understand how to use raw data and derive the pharmacokinetic models and parameters that best describe the process of drug absorption, distribution, metabolism and elimination.	1,2,3,4,7,8,9, 10,11	1,2,3
		CO3	Understand the critical evaluation of biopharmaceutic studies involving drug product equivalency...	1,2,3,4,5,6,7, 8,10,11	1,2,3
		CO4	Understand the design and evaluation of dosage regimens of the drugs using pharmacokinetic and biopharmaceutic parameters.	1,2,3,4,5,6,7, 8,10,11	123
		CO5	Understand the potential clinical pharmacokinetic problems and application of basics of pharmacokinetic	1,2,4,6,7,10,11	123
	Computer Aided Drug Delivery Systems	CO1	Recall & relate skills necessary for computer applications in pharmaceutical research and development who want to understand the application of computers across the entire drug research and development process	1,2,3,4,6,8,11	1,2,3
		CO2	Outline the principles of more integrated and coherent use of computerized information (informatics) in the drug development process	1,2,3,4,6,9,11	1,2,3
		CO3	Construct the simulated model of drug delivery systems based on ADME parameters, use of statistical techniques, clinical data collection and management	1,2,3,4,5,8,9, 11	1,2,3
		CO4	Recommend applications of artificial intelligence and robotics in pharmaceutical automation, evaluate the current challenges and predict the future directions	1,2,3,4,5,8,11	1,2,3

	Cosmetics and Cosmeceuticals	**CO1**	Define cosmetics and understand the regulatory requirements for labeling, import, manufacturing and sale of cosmetic products in India.	2,6,7,8,9,11	2
		CO2	Understand the biological concepts related to different problems of the skin, hair, oral cavity.	1,3,9,11	3
		CO3	Study and review COSMOS guidelines for different classes of ingredients.	1,5,9,10,11	2
		CO4	Classify the key ingredients, building blocks, their chemical classes and types, the herbal ingredients used in skin care, hair care required for making cosmetics and cosmeceuticals.	1,2,3,4,10,11	1,3
		CO5	Apply the key ingredients for design and formulation of cosmeceutical products like sunscreen, antiageing, anti-acne and formulations for oral cavity problems.	1,2,3,4,5,10	1,3
SEM II	**Pharmaceutics Practical II (**	**CO1**	Learner will gain knowledge in the area of advances in novel drug delivery systems.	1,2,3,4,7,8,9	1,3
		CO2	Learners will have knowledge of methods used to determine and interpret the bioavailability and bioequivalence parameters along with statistical aspects of bioequivalence study.	1,2,3,4,7,8,9	1,2,3
		CO3	Learner will attain knowledge and skills necessary for computer applications in pharmaceutical research and development, preclinical and clinical development using statistical models/ software, including optimization of formulation and process of manufacturing, computational modeling of drug disposition.	1,2,3,4,7,8,9	1,2,3
		CO4	Learner will gain knowledge and skills necessary for the developing synthetic and herbal cosmetic and cosmeceutical products.	1,2,3,4,7,8,9, 10	1,3
	PHARMACEUTICAL CHEMISTRY SEM II				
	Advanced Spectral Analysis	**CO1**	Recall with examples the terminologies of advanced chromatographic & hyphenated techniques, thermal analysis & radio immunoassays	1, 2, 3, 8, 11	1, 2, 3
		CO2	Explain and illustrate the theory and applications of 1-D & 2-D NMR, advanced chromatographic & hyphenated techniques, thermal analysis & radio immunoassays	1, 2, 3, 4, 6, 8, 11	1, 2, 3
		CO3	Apply the knowledge gained and perform mathematical calculations to obtain: chemical shift values and relative intensities of peaks in 1H NMR; λmax, and DBE of organic compounds; mass to charge ratio of fragments in MS	2, 3, 4, 8, 11	1, 2, 3
		CO4	Interpret the spectral data and predict the structure of organic compounds	2, 3, 4, 6, 7, 8, 9	1, 2, 3

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	Advanced Organic Chemistry -II	**CO1**	Understand various greener chemistry approaches and compare them against conventional methods of syntheis	1,3,4,8,10,11	1,2
		CO2	Learn and express advanced techniques of peptide synthesis	1,3,4,8,10,11	1
		CO3	Describe and discuss upon photochemical and pericyclic reactions	1,3,8,10,11	1
		CO4	Learn type of catalysis, its basic mechanism, and various catalytic named reactions used in industrial manufacturing set up.	1,3,7,8,10,11	1,2
		CO5	Apply and integrate acquired concepts of asymmetric synthesis in synthesis of chiral medicinal compounds.	1,3,7,8,10,11	1,2,3
	Computer Aided Drug Design	**CO1**	Recall and relate the different structures of protein along with the structure activity relationship of existing studied drugs and their interactions with the protein residues	1,2,3,10,11	1,2,3
		CO2	Classify and explain the different techniques to calculate the potential and kinetic energies of the system using Quantum and Molecular Mechanics, energy minimization and molecular conformational space search in the binding cavity of protein	1,2,3,10,11	1,2,3
		CO3	Make use of the minimal energy conformation of protein and ligand to construct and develop a model based on desired techniques like molecular docking, 3D-QSAR, pharmacophore modelling, homology modelling, molecular dynamics, etc.	1,2,3,4,6,8,11	1,2,3
		CO4	Analyze the results obtained based on the characteristics of different interactions (docking), equation (QSAR), binding energy (dynamics) and interpret the molecular mechanism of how a drug acts in a particular manner to be either inhibiting or stimulating the enzyme/receptor	1,2,3,5,7,10,11	1,2,3
	Pharmaceutical Process Chemistry	**CO1**	Describe the strategies of scale up process of APIs and intermediates	1,2,3,4,6	1,3
		CO2	Elaborate various unit operations and various reactions in process chemistry	12,3,4,6,7,10, 11	1,2,3
		CO3	Describe various principles of Industrial Safety	12,3,5,6,8,10, 11	1,2,3
SEM II	**PHARMACEUTICAL CHEMISTRY PRACTICAL - II**	**CO1**	perform the various reactions of synthetic importance	1-6,8,10,11	1,2,3
		CO2	isolate products and interpret the experimental data	1-6,8 ,11	1,2,3
		CO3	Experiment with computer aided techniques, validate the models and interpret and predict the results	1-6,8,10,11	1,2,3

	QUALITY ASSURANCE SEM II				
	Hazards and safety Management	**CO1**	Recall the environmental problems and develop an attitude of concern for the industry environment	1, 2, 3, 8, 10, 11	1, 2, 3
		CO2	Make use of the knowledge gained to ensure safety standards in pharmaceutical industry	1, 2, 3, 4, 6, 8, 10, 11	1, 2, 3
		CO3	Analyze and simplify the mechanism and management in different kinds of hazard management system	2, 3, 4, 10, 11	1, 2, 3
		CO4	Propose the method of Hazard assessment, procedure and methodology for safe industrial atmosphere.	2, 3, 4, 8, 10, 11	1, 2, 3
	Pharmaceutical Validation	**CO1**	Understand the concept of validation, qualification and calibration	1,2,3,4,8, 11	1
		CO2	Describe procedure for qualification of instruments and equipment	1.2.3.4	1
		CO3	Summarize the parameters of ICH guidelines for analytical method validation.	1, 11	3
		CO4	Comprehend the concept of process validation of different dosage forms	1,2,3,4,5, 6,7,8	1
		CO5	Gain knowledge of the process of cleaning validation	1,2,3,4,8, 10	2
		CO6	Correlate the knowledge of IPR with respect to pharmaceutical products	1,2,3,4,7, 8,11	3
		CO1	Understand the concept of Quality Management System, Quality audits& its role, importance in pharmaceutical manufacturing environment.	1, 5, 6,	1
		CO2	Apply the conceptual knowledge gained to design & conducting Audits of various areas in the pharmaceutical manufacturing, packaging, storage, distribution, Quality control and ancillary areas (utilities) to assess compliance to the applicable Regulatory requirements.	1, 2, 6, 8	3
		CO3	Create Audit check lists to conduct audits in the above specified areas in pharmaceutical industries including vendors and suppliers of API Raw & packaging materials.	1, 2, 6, 7	2

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Audits and Regulatory Compliance	**CO4**	Evaluate Audit observations into categories such as Critical, Major & Minor based on the severity of non-compliance to cGMP aspects and Regulatory requirements. Suggest CAPAs for compliance to CGMP aspects & Regulatory requirements	1, 3, 6	1
Pharmaceutical Manufacturing Technology	**CO1**	Understanding the legal requirements, licenses, plant layout, production planning for the pharmaceutical industry, process automation with respect to different dosage forms.	1,2,3,4,5	1,2
	CO2	Explain the concept of quality by design (QbD) and process analytical technology (PAT) and understand the different terminologies and aspects involved in QbD and PAT.	1,2,3,4,5,8,9	1,2
	CO3	Analyze the aseptic and non-sterile process technology including manufacturing requirements, new technologies and equipment required at each stage of manufacturing.	1,2,3,4,5,10,11	1,3
	CO4	Evaluate packaging technology required for different types of dosage forms, evaluation of product package compatibility and stability aspects of packaging material.	1,2,3,4,5,10,11	1
Quality Assurance Practical-II	**CO1**	Understand the significance of control of hazardous substances and perform analysis to determine and report the content of hazardous substances in air/environment	2, 3, 4, 6, 8, 10, 11	1, 2, 3
	CO2	Relate the concept of quality assurance to design and develop the protocol f& checklists for testing of pharmaceuticals	1, 2, 3, 4, 6, 10, 11	1, 2, 3
	CO3	Plan, execute and conclude the experiment using qualitative or quantitative techniques	1, 2, 3, 4, 10, 11	1, 2, 3
M PHARM SEM III AND IV				
	CO1	Students will be able to explain basic research methodologies like objectives study design, review of literature, randomization, types of studies	1,2,6,7,8,9,10,11	1,2,3
	CO2	Students will be able to explain, analyze the data and apply the statistical principles in the evaluation of the research data	1,2,3,6,7,8,9, 10,11	1,2,3
	CO3	Students will be able to explain the basic concepts of medical research including informed consent, , concepts like autonomy, beneficence and non-maleficence, as well as about the declaration of Helsinki and other guidelines like ICH GCP, Nuremberg code which govern ethical conduct of clinical trials	1,2,3,6,7,8,9, 10,11	1,2,3

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	Research Methodology and Biostatistics	**CO4**	Students will be able to explain the basic facilities in animal handling and animal house facilities like transport, storage and care of animals. As well as about the basic procedures to be followed to ensure the efficient management of animal house facility at the site.	1,2,3,6,7,8,9, 10,11	1,2,3
		CO1	Develop knowledge to advance your career, specialize in a particular area and help take career in a promising new direction via experimental learning	1,11	1,2,3
		CO2	Acquire skills related to literature survey, planning of experiments, data collection, data interpretation	1,2,3,11	1,2,3
		CO3	Learn handling of modern instruments, equipments or software required in the chosen area of work	1,2,4	1,2,3
		CO4	Progress of critical thinking and analytical skills through hands-on learning	1,3,11	1,2,3
		CO5	Develop oral and written scientific communication skills	8,11	1,2,3
SEM II	**: Project Work**	**CO6**	Create innovative ideas or project which will help in understanding the specialized area in more depth and society in large	1,9,11	1,2,3

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