



UNIVERSITY OF LUCKNOW
MASTERS OF PHARMACEUTICAL CHEMISTRY PROGRAMME
REGULATION 2020

1. Applicability

These regulations shall apply to the Masters in Pharmaceutical Chemistry programme from the session 2020-21.

2. Minimum eligibility for admission

A three/four years Bachelor's degree or equivalent with chemistry as one of the subject in final year awarded by University or Institute established as per law and recognized as equivalent by university with minimum 45% marks for general and OBC (SC/ST 40%) or equivalent grade shall constitute the minimum requirement for admission to the Masters in Pharmaceutical Chemistry Programme

3. Programme Objectives

- i. To enable the students to understand the basic concepts of bio-inorganic, bio-organic, physical chemistry, analytical chemistry, drug formulation, drug design and development.
- ii. To develop the ability to present pharmaceutical chemistry research by means of an oral presentation, a scientific poster or a written report.
- iii. To be able to use and apply professional softwares relevant to chemistry.
- iv. To equip the students with the knowledge to develop Pharmaceutically important molecules, new drug delivery systems etc.
- v. To learn the application of analytical tools for determination of organic molecules and to generate validation protocol for all pharmaceutical operations starting from drug research to development to formulation.
- vi. To learn the Mechanism of Action of various class of drugs.
- vii. To learn the brief overview of the use of various drugs in treatment of various diseases.

4. Programme Outcomes

- PO-1.** Demonstrate, solve and an understanding of major concepts in all disciplines of Chemistry independently and in group as well as draw logical conclusions through Project and Seminar Presentation.
- PO-2.** Encourage students to make critical thinking and the scientific knowledge gained would help them to design, carry out, record and analyze the results of Chemistry as well pharmaceutical experiments.
- PO-3.** Equip students to face the employment challenges and instil confidence to turn into entrepreneur and also step into research career.
- PO-4.** Generation of new scientific insights or to the innovation of new applications of chemical research
- PO-5.** Present scientific and technical information resulting from laboratory as well as Industrial/pharmaceutical experimentation in both written and oral formats, would make them perfect.
- PO-6.** Learns modern methods of chemical systems in a laboratory setting make them perfect for any scientific laboratory and industry.
- PO-7.** The students will become well versed in the mechanisms and also with the mode of action of drugs.
- PO-8.** The present course content will build confidence in students and the students will improve their competencies on par with their counterparts in premier institutions across the nation.

5. Programme Specific Outcomes

- PSO-1.** Students will be able to understand the basic concepts of bio-inorganic, bio-organic, physical chemistry, analytical chemistry, drug formulation, drug design and development, and green chemistry
- PSO-2.** Students will develop the ability to present pharmaceutical chemistry research by means of an oral presentation, a scientific poster or a written report.
- PSO-3.** Students will be able to use and apply professional software~~s~~ relevant to chemistry.



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- PSO-4.** Students will be able to demonstrate knowledge to develop Pharmaceutically important molecules, new drug delivery systems etc.
- PSO-5.** Students will demonstrate an ability to analyze and interpret data of analytical experiments in production, quality control & assurance of pharmaceutical synthesis and formulation.
- PSO-6.** Students will be able to apply analytical tools for determination of organic molecules.
- PSO-7.** Students will be able to generate validation protocol for all pharmaceutical operations starting from drug research to development to formulation.
- PSO-8.** Learn Role of drugs to inhibit the particular enzymes and treatment of disease
- PSO-9.** Learn Mode of action of different drugs.

6. Course Structure

The course structure of the Masters in Pharmaceutical Chemistry programme shall be as under.

Course No.	Name of the Course	Credit	Remark
Semester I			
PHCHCC-101	Physical Chemistry	04	Core Course
PHCHCC-102	Organometallic & Nuclear Chemistry	04	Core Course
PHCHCC-103	Organic Chemistry	04	Core Course
PHCHCC-104A PHCHCC-104B	Inorganic Chemistry Practical Organic Chemistry Practical	08	Core Course
PHCHVC-101	Separation Techniques	04	Value Added (Credited)
Semester Total		24	
Semester II			
PHCHCC-201	Pharmacology and Drug Design	04	Core Course
PHCHCC-202	Pharmacognosy	04	Core Course
PHCHCC-203	Chemistry of Natural Products and Biomolecules	04	Core Course
PHCHCC-204	Project and Seminar Presentation	04	Core Course
PHCHCC-205A PHCHCC-205B	Inorganic Chemistry Practical Organic Chemistry Practical	08	Core Course
PHCHVNC-201	Science and Technology of Cosmetics	00	Value Added (Non Credited)
Semester Total		24	
Semester III			
PHCHCC-301	Project and Seminar	04	Core Course/ MOOC
PHCHCC-302	Pharmaceutical Chemistry Practical	04	Core Course
PHCHEL-302	Spectroscopic Methods in Pharmaceutical Chemistry	04	Elective Course
PHCHEL-301A	Medicinal Chemistry-I	04	Elective Course
PHCHEL-301B	Medicinal Chemistry-II		
PHCHIN-301	Summer Training	04	Summer Training
PHCHIER-301	Concepts of Chemistry	04	Interdepartmental Course
Semester Total		24	
Semester IV			
PHCHCC-401	Advance Organic Chemistry Practical	04	Core Course
PHCHEL-401	Biochemistry and Bacteriology	04	Elective Course
PHCHEL-401A	Chemistry of Analgesics and Antipyretics	04	Elective Course



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Course No.	Name of the Course	Credit	Remark
PHCHEL-401B	Bioethanol as Biofuel		
PHCHMT-401	Dissertation and Master Thesis	08	Master Thesis
PHCHIRA-401	Analytical Chemistry	04	Intradepartmental Course
	Semester Total	24	
	GRAND TOTAL	96	

PHCH - Subject; PHCHCC - Core Course; PHCHVC – Value added (credited); PHCHVNC – Value added (non-credited); PHCHEL – Elective; PHCHIER – Interdepartmental course; PHCHIRA – Intradepartmental course

7. Course Outlines

PROGRAMME STRUCTURE

The Master of Science in Pharmaceutical Chemistry is a Two Year Full Time Course consisting of Four Semesters.

Semester I

Semester II

Semester III

Semester IV

Sem	Core Course			Elective Course			Open elective Course			Value Added		Total Credits
	No. of Paper	Credits (L+T/P)	Total Credits	No. of Papers	Credits (L+T/P)	Total Credits	No. of Papers	Credits (L+T/P)	Total Credits	No. of Papers	Credits	
I	4	12+8	20	0	0+0	0	0	0+0	0	1	4	24
II	5	16+8	24	0	0+0	0	0	0+0	0	1	0	24
III	3	4+4+4	12	2	4+4	8	1	4+0	4	0	0	24
IV	2	4+8	12	3	4+4+4	12	0	0+0	0	0	0	24
Total Credits			68			20			4		4	96



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Semester-II

Paper Code	Title of the paper	Credits	Int. Ass.	Uni. Exam.	Marks
PHCHCC-201	Pharmacology and Drug Design	4			
PHCHCC-202	Pharmacognosy	4			
PHCHCC-203	Chemistry of Natural Products and Biomolecules	4			
PHCHCC-204	Project and Seminar Presentation	4			
PHCHCC-205A PHCHCC-205B	Inorganic Chemistry Practical Organic Chemistry Practical	8			
PHCHVNC-201	Science and Technology of Cosmetics	00			
	Total	24			

**PHCH - Subject; PHCHCC - Core Course; PHCHVC – Value added (credited);
PHCHVNC – Value added (non-credited); PHCHEL – Elective; PHCHIER – Interdepartmental course; PHCHIRA – Intradepartmental course**

M.Sc. Pharmaceutical Chemistry Semester II Syllabus
Core Course

Paper Code PHCCCH-201: Pharmacology and Drug Design

Credits 04

Hours 60

Course Objective:

This core course helps the learner in correlating between pharmacology of a disease and its cure. To understand the drug metabolic pathways, adverse effect. In addition it helps to understand the structural activity relationship of different class of drugs.

Course Outcome:

- CO-1. It makes the student aware of absorption, distribution metabolism, excretion of drugs, mechanism of drug structure and the adverse response of drug.
- CO-2. The chapters of drug therapy explain the various parameters involved in making the drug reach the site of action. Various methods involved in increasing the solubility of drug (Prodrug concept).
- CO-3. The chapter on drug action on CNS explains various category of anaesthetic, hypertensive, sedatives, hypnotics and their mode of action. Synthesis of various drugs of this category also explained.
- CO-4. The antipyretic chapter gives accounts of various drugs involved in controlling fever and their mode of action.

Unit I

General principles of pharmacology: Pharmacokinetic principles: absorption, distribution, metabolism and excretion of drugs. Dose of drugs and routes of administration. Pharmacodynamic principles: dose response relationships, mechanism of drug action, unusual and adverse responses of drugs, structurally specific and nonspecific drugs. Ferguson's principle. Drug interactions-synergism, antagonism, drug addiction and drug dependence, drug tolerance, drug hypersensitivity.

Unit II

General Principles of Drug Therapy. Relationship between chemical structure, lipid solubility and biological activity of drugs. Stereochemistry and biological activity.



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Drug action-receptor theories. Drug metabolism different pathways. Drug design: various factors of drug design, rational drug design. Methods of lead discovery: optimisation of the lead, natural and synthetic sources of lead compounds. Bioisosterism. Prodrug and soft drug concept. Drug synthesis. Combinatorial synthesis (basic concepts). Retrosynthetic analysis of benzocaine, saccharin, salbutamol and benzodiazepines.

Unit III

Drugs acting on CNS General anaesthetics. Inhalation anaesthetics - ether, enflurane, halothane, nitrous oxide, cyclopropane. Intravenous anaesthetics - thiopentone sodium, ketamine.

Hypnotics, sedatives and anxiolytic agents: -benzodiazepines, buspirone and meprobamate.

Anticonvulsants: convulsions, types of epilepsy, barbiturates-hydantoin, oxazolidinediones, succinimides.

Analeptics: xanthines, amphetamines, nikethamide and ethamivan. Antiparkinson's agents: dopamine agonists, dopamine releasing agents and synthetic anticholinergics. Drugs for Alzheimer's disease: cholinergic agonists and acetylcholine esterase inhibitors.

Unit IV

Synthesis of the following drugs - Enflurane, Ketamine, Etomidate, Phenobarbital, Diazepam, Chlordiazepoxide, Meprobamate, Buspirone, Ethinamide, Nikethamide, Ethamivan, Trimethadione, Ethosuximide, Denzimol, Topiramate, Mephensin, Levodopa, Besiperidine and Tacrine.

Narcotic analgesics - morphine and its analogues, phenyl (ethyl) piperidines, diphenyl heptanones.

Unit V

Antipyretics and NSAIDs: Basic idea of COX I & II inhibitors, salicylates aspirin, p-aminophenol derivatives-paracetamol, phenacetin, pyrazolidinediones phenyl butazone, oxyphenbutazone, anthranilic acid derivatives-mefenamic acid, flufenamic acid, indoleacetic acid derivatives-indomethacin, arylacetic/propionic acid derivatives (ibuprofen, ketoprofen, flubiprofen and diclofenac), oxicams (piroxicam and tenoxicam).

Synthesis of the following drugs-levorphanol, pethidine, methadone, phenyl butazone, flufenamic acid, diclofenac, piroxicam, allopurinol and celecoxib.

Recommended Books-

1. Medicinal Chemistry, D. Sriram, P. Yogeeswari, Pearson Education.
2. Medicinal Chemistry, Ashutosh Kar, New Age International (P) Limited.
3. An Introduction to Medicinal Chemistry, Graham L. Patrick, Oxford University Press.
4. Textbook of Medicinal Chemistry, V. Alagarsamy, Elsevier Health Sciences.
5. The Practice of Medicinal Chemistry, Camille G. Wermuth, Elsevier Health Sciences.
6. Drug-like Properties: Concepts, Structure Design and Methods: From ADME to Toxicity Optimization, Edward H Kerns, Li Di, Elsevier Health Sciences.



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M.Sc. Pharmaceutical Chemistry Semester II Syllabus

Core Course

Paper Code PHCHCC-202: Pharmacognosy

Credits 04

Hours 60

Course Objective:

The main objective of the course is to give a better understanding of The recognition of medicinal plants, knowledge about different pharmacopeias, laws regarding pharmaceuticals and the use of inorganic compounds as drugs.

Course Outcome:

- CO-1. It makes the students aware of various types of active compounds isolated from different plants and the biological importance of these active principles.
- CO-2. The students are also made aware of fixed and essential oils isolated from natural sources and their importance.
- CO-3. The students get insight about various pharmacopoeia, its importance in studying various parameters of drugs.
- CO-4. The students are also made aware of various pharmaceutical legislature in India patents, etc.
- CO-5. Students are made aware of various inorganic compounds used as drugs, their methods of preparation and properties.
- CO-6. In addition heavy metal toxicity in environmental and in living organism is also explained.
- CO-7. The use of various radioisotopes of metals and their use as diagnostic agents in the identification of various diseases.

Unit I

Pharmacognosy

Pharmacognosy of the official drugs frequently used in pharmacy: their sources and constituents. Eg:- senna, belladonna, digitalis, stramonium, vasaka, cinnamon, cinchona, ergot, cannabis, ipecacuanha, rauwolfia, liquorice, ginger, cloves, pyrethrum, santonica, nutmeg, nuxvomica, cardamom, umbelliferous fruits like Cumin, Fennel, Caraway, Opium, Aloes, Asafoetida, Vinca rosea, Brammi (two varieties).

Fixed oils and essential oil used in pharmacy-their sources. Extraction, constituents, composition analysis of fixed oils. Elementary study of adulteration of fixed oils.

Unit II

Fixed Oils: Castor oil, Olive oil, Shark liver oil.

Essential Oils: Eucalyptus oil, Turpentine oil.

A brief study of the substances used as pharmaceutical necessities ó Starches, Gum Acacia, Gum Tragacanth, Agar Agar, Gelatin, Talc, Kaolin. Bentonite.

Unit III

Metallic compounds used in pharmaceutical chemistry: Calcium lactate, calcium gluconate, iron gluconate, iron fumarate, ferric ammonium citrate, ferrous sulphate, aluminium hydroxide gel, calamin, zinc oxide, zinc stearate, magnesium stearate, talc, yellow mercuric oxide, trivalent and pentavalent antomionals, selenium sulfide, lithium salts, gold, platinum and bismuth compounds.

Metal toxicity - cadmium, lead, copper and mercury.

Unit IV

Pharmaceutical Legislation in India. Legal aspects of trade in drugs. The drug Act and Drug rules. The Pharmacy Act. The dangerous Drug Act and Rules. The Drugs and Cosmetic Act and rules



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Introduction to Pharmacopeia B.P, I.P. and general standard analysis,
Intellectual Property Rights (IPR), Patents, Trademarks, Copy rights, Patent Acts relevant sections (basic ideas only)

Unit V

Diagnostic Agents and Tests

Radiopaques - organo iodo compounds. Compounds used in function tests, dyes, radio isotopes, RIA, ELISA. Dyes used in pharmacy: fluorescein, mercurochrome, acridine dyes. Colouring agents: official colours, colour code. Liver and gastric function tests and kidney function tests.

Recommended Books:

1. Pharmacognosy by Kokate, C.K A and Purohit, A.P
2. Pharmacognosy and Pharmacobiotechnology by Ashutosh Kar
3. Text book of Pharmacognosy by T.E.Wallis
4. Gokhale, S. B., Kokate, C. K. and Purohit, A. P. 2003. Pharmacognosy, Nirali Prakashan Publishers, Pune, India.
5. Singh, V. K., Govil, J. N. and Singh, G. 2002. Recent progress in Medicinal Plants: Vol 1 Ethnomedicine and Pharmacognosy. SCI Tech Publishing, LLV, USA.
6. NIIR Board of Consultants & Engineers, 2004. Drugs & Pharmaceutical: Technology and Hand book, Asia Pacific Business Press Inc. Delhi, India.

M.Sc. Pharmaceutical Chemistry Semester II Syllabus

Core Course

Paper Code PHCHCC-203: Chemistry of Natural Products and Biomolecules

Credits 04

Hours 60

Course Objective:

Students will be taught about synthesis of natural products and biomolecules, their uses and roles in the human body and various chemical processes related to them.

Course Outcome:

- CO-1. The course content would help students to learn about various category of steroid, classification, nomenclature and various types present in the human body and their function.
- CO-2. The student would also learn about various reaction involved in steroid chemistry and also their structure elucidation. The chapter also makes the student aware of synthesis of various steroid hormones.
- CO-3. The alkaloid chapter would make the student aware of various categories of alkaloid, their importance and their structure elucidation. Students will also learn about steps involved in synthesis of few alkaloids.
- CO-4. The chapter of vitamins gives insight into the importance, structure and their synthesis.
- CO-5. The chapter on natural colouring species gives emphasis on the anti-oxidant activity of these compounds and their uses. Synthesis of these compounds is also emphasized.

Unit I

Steroids: classification and nomenclature of steroids. Reactions, structure elucidation, stereochemistry and biosynthesis of cholesterol. Structure and semi synthesis of steroid hormones-testosterone, estrogen and progesterone. Biosynthesis of steroids.



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Unit II

Alkaloids: General methods of structure elucidation of alkaloids. Structure elucidation and synthesis of papaverine, quinine and morphine. Stereoselective synthesis of reserpine. Biosynthesis of alkaloids.

Unit III

Vitamines: classification, structure and synthesis of vitamins A, C, B1 and B2.

Unit IV

Antibiotics: structure determination of penicillins and cephalosporins, synthesis of penicillins and chloramphenicol. A brief study of macrolide antibiotics, aminoglycoside antibiotics, polyene antibiotics, fluoroquinolones.

Unit V

Natural colouring species: anthocyanins and carotenoids, structure and synthesis of cyanin, flavone, quercetin and β -carotene.

Recommended Books:

1. Chemistry of Natural Products, Sujata V. Bhat, B.A. Nagasampagi, Meenakshi Sivakumar, Springer.
2. The Chemistry of Natural Products, R.H. Thomson, Springer.
3. Bioactive Natural Products: Chemistry and Biology, Goutam Brahmachari, Wiley India Pvt. Ltd.
4. Organic Chemistry Vol. II, I.L. Finar, Pearson Education India.
5. Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), The Chemistry of Heterocycles (Nomenclature and Chemistry of three to five membered Heterocycles), Elsevier publication.

M.Sc. Pharmaceutical Chemistry Semester II Syllabus

Core Course

Paper Code PHCHCC-204: Project and Seminar Presentation

Credits 04

Course Objective:

To inculcate in students the art of public speaking, presentation and discussion of seminars.

Course Outcome:

- CO-1. students should be able demonstrate ability to plan and strategize a scientific problem, and implement it within a reasonable time frame.
- CO-2. It is expected that after completing this project dissertation, students will learn to work independently and how to keep accurate/readable record of assigned project.
- CO-3. In addition, students will be able to know the library search and handle the data in a meaningful way.
- CO-4. Also, students will be able to interpret the spectral data independently.
- CO-5. Subsequently, the students should be able to critically examine research articles, and improve their scientific writing/communication skills and power point presentation.

For project work and seminar presentation, the area of the work would be to be decided by the advisor/mentor based on syllabus. On completion of the project work, students have to submit the work in the form of seminar followed by oral presentation in the presence of faculty members.



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M.Sc. Pharmaceutical Chemistry Semester II Syllabus
Core Course
Paper Code PHCHCC205A: Inorganic Chemistry Practical
Paper Code PHCHCC205B: Organic Chemistry Practical

Credits 08

Course Objective:

The practicals have been designed in a way to enhance students' knowledge with respect to coordination compounds, purification of organic compounds and two step organic reactions.

Course Outcome:

- CO-1. Students will be able to demonstrate ability to plan and strategize a scientific problem, and implement it within a reasonable time frame.
- CO-2. The students will become familiar about the inorganic coordination compounds and transition elements will also be able to prepare various inorganic complexes.
- CO-3. Students will be able to understand methods for separation and purification of organic compounds and chromatographic techniques for their separation.
- CO-4. Students will understand how to recrystallize the organic compounds.
- CO-5. Students will be able to perform two step organic preparations involving different organic reactions such as Acetylation, Oxidation, Grignard reaction, Aldol condensation, Sandmeyer reaction etc.

PC-205A: INORGANIC CHEMISTRY

Synthesis of

- (a) Ni(DMG)₂
- (b) Hg[Co(CSN)₄]
- (c) Cis- and trans-[Cu(gly)₂]
- (d) [Ni(PPh₃)₂Cl₂]
- (e) [Ni(PPh₃)(SCN)₂]
- (f) [Al(acac)₃]

General methods of separation and purification of organic compounds such as:

1. Solvent extraction
2. Fractional crystallization
3. TLC and Paper Chromatography
4. Column Chromatography

PC-205B: ORGANIC CHEMISTRY

Two steps synthesis involving-

Acetylation

Oxidation

Grignard reaction

Aldol condensation

Sandmeyer reaction

Acetoacetic ester Condensation

Cannizaro reaction

Friedel Craft reaction

Aromatic Electrophilic Substitution

Recommended Books:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.



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- Marr, G. and Rockett, R.W. Practical Inorganic Chemistry, Van Nostrand Reinhold. 1972.
- Sethi, Arun., Systematic Lab Experiments in Organic Chemistry, New Age International Publisher.
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).
- Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

M.Sc. Pharmaceutical Chemistry Semester II Syllabus
Value Added (Non Credited)
PHCNVNC-201 Science and Technology of Cosmetics

Credit 00

Hours 50

Course Objective:

To provide students coming in the first year and second semester of Masters program better understanding into basic cosmetic technology which can form an apt platform for the student to move into cosmetic industry after completing their masters.

Course outcomes:

- CO-1. This course allows students to understand and learn about the chemistry of cosmetics.
- CO-2. More specifically, this course aims to introduce the scientific aspects such as chemical, physical and biological functions of different ingredients present in the cosmetics.
- CO-3. This course also gives information about the formulation and technology of cosmetics

Unit I

Basic concept of Cosmetics. Classification of cosmetic products for skin, hair and oral care. Forms of cosmetics and their suitable examples: Solutions, creams, lotions, ointment, paste, gels, sticks, tablets, capsules, powders and aerosols.

Unit II

Cosmetic Ingredients and Classifications: Water, Surfactants, Foaming agents, Emulsifiers, and Solubilizers, rheological additives, Antioxidants, Antimicrobial and Chelating agents used as preservatives.

Unit III

Perfume: Classification of perfumes, Perfume ingredients
Colour Cosmetics: Building block and formulation of Lipsticks, mascara, and nail polish
Hair conditioner: Building blocks and formulation of Hair conditioners, hair oils, hair dye
Herbal cosmetics

Unit IV

Use of nanotechnology in cosmetics, suspensions, creaming, cracking and phase inversion
Micrometrics: Methods of determining particle size, optical microscopy, sieving, sedimentation measurements
Powders: porosity, densities, bulkiness and flow properties.



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Unit V

Rheology of Cosmetics: Newtonian systems, law of flow, kinematic viscosity, effect of temperature on viscosity,
non-Newtonian systems ó Plastic, pseudoplastic and dilant system, thixotropy determination of viscosity,

Recommended Books:

1. Harry's Cosmeticology ó Wilkinson, Moore, seventh edition, George Godwin.
2. Cosmetics ó Formulation, Manufacturing and Quality Control, P.P. Sharma, 4th edition, Vandana Publications Pvt. Ltd., Delhi.
3. Drugs and Cosmetic act/rules by govt. of India Publication
4. Handbook of Cosmetic Science and Technology, 3rd Edition, André O. Barel, Marc Paye, Howard
5. Maibach, Marianne Mahieu Informa Healthcare USA, Inc.