ACADEMIC PROGRAMME GUIDE

of

BACHELOR OF SCIENCE
(PHARMACEUTICAL CHEMISTRY)

Batch 2023

Based on Choice Based Credit System (CBCS) /
Elective Course System

CHITKARA UNIVERSITY
HIMACHAL PRADESH
NAAC A+ ACCREDITED

w.e.f
Academic Year: 2023-2024

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1. GENERAL INFORMATION

The academic program guide is a comprehensive document detailing course scheme, associated credits per course and the distribution of each course in lecture, tutorial and practical hours. It also details the eligibility criteria for admission, for award of degree, the assessment and evaluation procedures along-with a glimpse of the pedagogical aspects of the programs. This guide is to be used in association with the academic regulations of the university to make a complete rule set. The course schemes given in this document are approved by respective Board of Studies and the Academic Council of Chitkara University, Himachal Pradesh.

1.1 Programme Educational Objectives (PEO)

PEO-1 To produce graduates with strong fundamental concepts and high technical competence in pharmaceutical chemistry who shall be able to use these tools in pharmaceutical industry.

PEO-2 To provide students with strong and well-defined concepts in the various fields of pharmaceutical chemistry i.e., operation management, quality control and quality assurance according to the requirement of pharmaceutical industries and society.

PEO-3 To promote the development of trained human resource in pharmaceutical chemistry with highly professional and ethical attitude, effective skills to work in a team with a multi-disciplinary approach.

PEO-4 To develop overall personality and character with team spirit, professionalism, integrity and moral values.

1.2 Programme Outcomes (PO)

The proposed outcomes for the B. Sc. Pharmaceutical Chemistry program focus on the ability of a graduating student to develop himself/herself as a competent professional with appropriate pharmaceutical operations.

The programme outcomes for the B.Sc. Pharmaceutical Chemistry are following:

PO1. Ability to acquire knowledge of fundamentals of pharmaceutical chemistry principles and their applications in the area of pharmaceutical industries.

PO2. Identify, formulate, research literature, and analyze health problems reaching substantiated conclusions using principles of natural and allopathic science.

PO3. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data to provide valid conclusions.

PO4. To impart knowledge of professional, societal and legal responsibility related to pharmaceutical industry.

PO5. The impact of pharmaceutical operations in environment & societal context and demonstrate the need for sustainability.

PO6. Development of an aptitude for lifelong learning as well as continuous professional development.

PO7. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary environment.

1.3 University Vision and Mission

Vision: To be a globally recognized organization promoting academic excellence through interdisciplinary applied research and to expand realms of knowledge through innovation.

Mission:

M1: To carry out the academic processes in accordance with global standards through active teacher-student-industry participation.

M2: To promote research, innovation and entrepreneurship in collaboration with industry, research laboratories and academic institutions of global repute.

M3: To inculcate high moral, ethical and professional values amongst our students, faculty & staff.

M4: To contribute in building skillful society by preparing competent pharmacist.

M5: To prepare globally recognized pharmaceutical professional who can effectively contribute in new molecule research, formulation, preclinical and clinical growth and regulatory submissions.

M6: To become efficient leaders providing academic and other interactions in various stages of pharmaceutical operations, marketing and distribution.

The programme educational objectives (PEOs) in Bachelor of Science in Pharmaceutical Chemistry are well-designed based on the mission of providing the graduating students with knowledge and for expertise required for professional practices in pharmaceutical sector. This

course empowers the students to learn and work in harmony with other members of health care is the immediate needs for the ideal role and social relevance in the health care system of our country. The graduating students are prepared for demonstrating knowledge of and ability to use principles of pharmaceutical sciences, chemistry, industrial safety and environmental sciences, microbiology and pharmaceutical analysis, pharmaceutical operations, pharmaceutical regulatory affairs, pharmaceutical process, packaging technology, dosage form design and quality assurance. Each year, experts from pharmaceutical industries and different universities across the globe visits Chitkara University, Himachal Pradesh to provide industrial and international exposure to the students.

NSS programmes are provided to students to teach the notion of social welfare and to provide service to society without prejudice. To develop student's interpersonal skills, a plethora of extracurricular activities such as national level technical and cultural festivals are organized. Students are encouraged to take part in or organize such activities. These value-added activities were developed with several Programme Objectives (POs) in consideration, including PO3, PO4, PO5, PO6, and PO7, and adhere to all of the aforementioned Programme Educational Objectives (PEOs).

1.4 Placement Opportunities: The Bachelor program in B.Sc Pharmaceutical Chemistry provides ample opportunity to a graduate to join various areas in Pharmaceutical industry set up as well as in healthcare sectors. The level of appointment and compensation there upon may depend upon the job profile and need for further additional post graduate specialization in specific areas. The possible positions are:

a. Production Executive: Managing and supervising production of pharmaceutical formulations.
b. Research and Formulation Development Executive: Development of new formulations.
c. Project Executive (New Products): Coordinating the research, production and marketing activities in a pharmaceutical organization, deciding as to what and how to develop a new product and plan production and marketing activity as per available capacity.
d. Project Executive (New Plant): coordinating and erection, installation commissioning of production in a new plant / facility and ensuring that all installation and procedures are as per compliance norms laid out by regulatory agencies.
e. Executive (Administration and Finance)/ management Trainee: in a pharmaceutical organization.

f. Executive /Assistant Manager, Regulatory affairs: Helping the research team to compile drug master files for new drug products for registration and approval with the food and Drug authority of different countries.

2. ELIGIBILITY FOR ADMISSION

The student seeking admission in B.Sc. pharmaceutical chemistry should have minimum 60% marks in 12th grade (Science) or equivalent exam with Physics, Chemistry, Biology or Mathematics. The admission is based purely on merit. During admission process, the university follows reservation policy as decided by the State.

3. PROGRAMME DURATION

The duration of the B.Sc. pharmaceutical chemistry is three years - divided into 6 semesters. University conducts mid-term examination & end-term examination at the end of each semester.

4. PEDALOGICAL ASPECTS

The structural layout of the program and its courses requires that each course be divided in lecture, tutorial, practical sessions and projects.

Lecture sessions: Lectures are delivered by traditional- chalk board method, supplemented by modern Information Communication Technology (ICT) methods. The students are encouraged to ask questions and involve in group discussion to the extent allowed by the teacher.

Tutorial Sessions: The tutorial sessions are small groups of students interacting with the teacher, solving application oriented analytical problems. The tutorial sessions are very interactive and inculcate problem solving skills in the students.

Lab / Practical Sessions: During lab / practical sessions, the students work on prescribed list of experiments and do what they have learnt in the lecture / tutorial sessions.

Projects: The students are assigned project in each semester to make them ready for industry.

5. PROGRAM STRUCTURE

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, tutorial hours, practical classes and projects etc. are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly, the credit associated with any of the other academic, co/extra-curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week.

The course scheme to be followed is given as under**.**

YEAR - I			
Semester-I			
Course Code	**Title of the Course**	**Hours (L+T+P)**	**Credits**
BPL3101	Introduction to Pharmaceutical Sciences	4+0+0	4
BPL3103	Pharmaceutical Chemistry-I	4+0+0	4
BPP3103	Pharmaceutical Chemistry-I Practical	0+0+4	2
BPL3105	Physical Chemistry	4+0+0	4
BPL3107	Industrial Safety and Environmental Sciences	4+0+0	4
BPL3111	Basic Engineering Skills	4+0+0	4
Total Semester Credits and Hours		24	22

Semester II			
Course Code	**Title of the Course**	**Hours (L+T+P)**	**Credits**
BPL3102	Chemistry of Natural Products (CNP)	4+0+0	4
BPL3104	Physical Pharmaceutics-I	4+0+0	4

BPP3104	Physical Pharmaceutics-I Practical	0+0+4	2
BPL3106	Pharmaceutical Microbiology	4+0+0	4
BPL3108	Pharmaceutical Analysis-I	4+0+0	4
BPL3109	Mechanical Engineering	4+0+0	4
Total Semester Credits and Hours		24	22
Year 1 Total Credits and Hours		48	44

List of courses offered in as per UGC guidelines:			
Course Code	**Course Name**	**L+T+P**	**Credits**
-	National Service Scheme (NSS)	-	2
-	National Cadets Corps (NCC)	-	2

YEAR - II			
Semester - III			
Course Code	**Title of the Course**	**Hours (L+T+P)**	**Credit**
BPL3211	Pharmaceutical Chemistry-II (Organic Chemistry)	4+0+0	4
BPL3213	Physical Pharmaceutics-II	4+0+0	4
BPL3215	Pharmaceutical Operation-I	4+0+0	4
BPP3215	Pharmaceutical Operation-I Practical	0+0+4	2
BPL3217	Pharmaceutical Regulatory Affairs	4+0+0	4
Total Semester Credits and Hours		20	18

Semester - IV			
Course Code	**Title of the Course**	**Hours (L+T+P)**	**Credits**
BPL3212	Physiology and Pharmacology-I	4+0+0	4
BPP3212	Physiology and Pharmacology-I Practical	0+0+4	2
BPL3214	Biochemistry	4+0+0	4
BPL3216	Pharmaceutical Process-I	4+0+0	4
BPL3218	Industrial Pharmacy & Packaging Technology	4+0+0	4
BPL3222	Electrical & Electronics Engineering	4+0+0	4
BPPR3109	Project-I	10	5
Total Semester Credits and Hours		34	27
Year 2 Total Credits and Hours		54	45

YEAR - III			
Semester - V			
Course Code	**Title of the Course**	**Hours (L+T+P)**	**Credits**
BPL3321	Pharmaceutical Quality Assurance	4+0+0	4
BPL3323	Medicinal Chemistry-I	4+0+0	4
BPP3323	Medicinal Chemistry-I Practical	0+0+4	2
BPL3325	Pharmaceutical Process-II	4+0+0	4
BPL3327	Pharmaceutical Analysis-II	4+0+0	4
BPP3327	Pharmaceutical Analysis-II Practical	0+0+4	2
BPL3331	Measurement and Measuring Instruments	4+0+0	4
BPPR3110	Project-II	10	5
Total Semester Credits and Hours		38	29

Semester - VI			
Course Code	**Title of the Course**	**Hours (L+T+P)**	**Credits**
BPL3322	Dosage Form Design (DFD)	4+0+0	4
BPP3322	Dosage Form Design (DFD) Practical	0+0+4	2
BPL3324	Pharmaceutical Operation-II	4+0+0	4
BPL3326	Pharmaceutical Operation Management-Elective I	4+0+0	4
BPL3329	Pharmaceutical Product Management-Elective II	4+0+0	4
BPL3328	Medicinal Chemistry-II	4+0+0	4
BPP3328	Medicinal Chemistry-II Practical	0+0+4	2
BPPR3219	Project-III	10	5
	Total Semester Credits and Hours	34	25
	Year 3 Total Credits and Hours	72	54

Value Added Courses

Course Code	Name of the Course	No. of Hours	Credit Points
24VC001	Current Good Manufacturing Practices	30	-
24VC002	Health education	30	-
24VC003	Intellectual Property Rights	30	-
24VC004	Drug regulatory affairs	30	-
24VC005	Data Integrity		
24VC006	AI and Machine Learning in Healthcare	30	-
24VC007	Quality by Design (QbD)	30	-
24VC008	Laboratory Safety Guidelines	30	-
24VC009	Health and wellbieng	30	
24VC010	Quality Management System	30	-
24VC011	Humidity, Ventilations and Air Conditioning (HVAC) in Pharmaceutical Industries	30	-
24VC012	Maintenance and Calibration of Laboratory equipment	30	-

24VC013	Health and Hygiene	30	-
-	Interpersonal, skills and emotional intelligence	30	-
-	Data Analysis using software packages	30	-
-	Pharmaceutical and Medical Device Innovations	30	-

CREDIT DISTRIBUTION AND CALCULATION

Cumulative Grade Point Average (CGPA) calculated on a 10-point scale is used to describe the overall performance of a student. The Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) are calculated as:

$$SGPA_i = \frac{\sum_{j=1}^{n} C_{ij} G_j}{\sum_{j=1}^{n} C_{ij}}$$

$$CGPA = \frac{\sum_{i=1}^{N} \left(SGPA_i * \sum_{j=1}^{n} C_{ij} \right)}{\sum_{i=1}^{N} \left(\sum_{j=1}^{n} C_{ij} \right)}$$

Where n = number of subjects in the Semester; N = number of Semesters; $SGPA_i$ = SGPA for the i^{th} Semester; C_{ij} = number of credits for the j^{th} course in i^{th} Semester; and G_j = Grade point corresponding to the grade obtained in the j^{th} course.

6. ASSESSMENT AND EVALUATION

The examinations have two segments:

(a) **Internal Assessment**: It may comprise quiz tests, seminars, class participation and mid semester examination. There will be one mid semester examination conducted during the mid of the semester and two quiz tests one before the mid semester examination and one after the mid semester examination.

(b) **External End Term Examination**: At the end of each semester.

Controller of Examinations conducts mid semester and the end semester examination Weightage for various evaluation components in each course of the program is as below:

Sr. No.	Evaluation Component	Weightage
1	Quiz	20
2	Mid Semester Exam	30

3	End Semester Exam	50

The end term examination for practical courses includes conduct of experiment and a viva voce.

Sr. No.	Evaluation Component	Marks
1	Internal exam and viva	30
2	External exam and viva	70

7. RULES FOR ATTENDANCE

A minimum attendance criterion of 75% is mandatory in each course for appearing in End Semester Examinations. The program being highly rigorous, all the students are expected to show utmost regularity in attendance. Even a day's absence is detrimental to student's interest. The university expects its students to be regular in attending the classes and practicals. In order to be eligible to appear for End Term Examination, 75% attendance (all held sessions – lectures, tutorials, project work) is compulsory in each course.

8. GRADING SYSTEM

Grade points for every grade are as follows:

Marks Range	Grade	Grade Weightage	Qualitative Meaning
80 - 100	O	10	Outstanding
70-79	A+	9	Excellent
60-69	A	8	Very Good
55-59	B+	7	Good
50-54	B	6	Above Average
45-49	C	5	Average
40-44	P	4	Pass
0-39	F	0	Fail
	AB		Absent
	I		Incomplete

If the student is detained from appearing in the end term examination because of the shortage of attendance in the regular semester or is absent in the end term examination, his grade in that subject is 'AB', till he/she appears again in the end term exam and obtains a new grade.

The grade I (Incomplete) may be awarded in the following conditions:

(i) Where a case of unfair means is pending, a 'Grade I' is awarded till the case is finalized.

(ii) Where a case of indiscipline is pending, a 'Grade I' is awarded till the case.

9. PROMOTION AND REGISTRATION

The registration of the student may be cancelled, if at the later stage, it is found that the student is not eligible for registration due to the following reasons:

(a) If the registration of a student in a course is not found to be as per the regulations, his /her registration in that course will be cancelled and the grade obtained, if any, will be rejected.

(b) The registration of a student in a course or complete set of courses in a term can be cancelled by the concerned authority when he is found guilty in case of unfair means, breach of discipline, etc. or when he/she persistently and deliberately does not pay his dues.

(c) Absence for a period of four or more weeks at a stretch during a term shall result in automatic cancellation of the registration of a student from all the courses in that term.

A student who is duly registered in a term is considered to be on the rolls of the university. After registration, if he/she withdraws from the term, or has been given prior permission to temporarily withdraw from the University for the term, or has been asked to stay away by an appropriate authority of the University will be considered to be on the rolls of the University for that term. While such a student retains the nominal advantage of being on the rolls of the University the loss of time from studies and its consequences cannot be helped by the University. If for any valid reason a student is unable to register in a term, he/she must seek prior permission of Dean of Department to drop the term.

10. MIGRATION/CREDIT TRANSFER POLICY

The following procedures will be followed for credit transfer for student under migration, studied in other Universities in India and Abroad: "The credits earned by the student from the other universities in India or abroad shall be transferred as such. The Degree shall only be awarded to candidate subject to the condition that student earned the minimum no. of credit defined by Academic Regulation/APG of the Programme run by the Chitkara University." In case a student undergoes international exchange programme or internship for 1 semester/ 1 year, then the courses, credits and grades earned by the student in abroad during that period should be reflected on the grade card issued by the Chitkara University. If consolidated credits are less than 143 credits, then the student has to earn extra credits to attain minimum credits requirement for B.Sc Pharmaceutical Chemistry degree. The instructions regarding criteria to acquire this credit point will be informed to the students by the department from time to time.

11. ELIGIBILITY FOR THE AWARD OF DEGREE

A student has to qualify/earn all course credits and to maintain a minimum CGPA of 4.5 to receive degree in B.Sc. Programs. The duration of the B.Sc. (Pharmaceutical Chemistry) program is three years - divided into 6 semesters. The maximum duration of completion of degree is 3+2 years.

12. PROGRAMME OVERVIEW

Semester-I Courses

BPL3101	**Introduction to Pharmaceutical Sciences**	**4-0-0**	**4 Credits**

Course Learning Outcomes:

Students will

CLO1: understand various types of routes for administration of drugs.

CLO2: formulate, prepare and evaluate various types of dosage forms.

CLO3: remember the basics of quality control and know about various techniques of analysis.

CLO4: understand basic concepts of formulations and its employability in quality control.

CLO5: analyze the various techniques used in formulation development.

Syllabus Content:

Orientation and historical background of pharmacy profession: Pharmacy as a career, Pharmacy Profession: History of Pharmacy in India, Pharmaceutical education in India and abroad.

Official books: Introduction to official compendia with emphasis on Indian pharmacopeias, British Pharmacopeias and United State Pharmacopeias.

Routes of Drug Administration: Need for dosage forms, therapeutic consideration in dosage form designing. Routes of drug administration and dosage forms for oral, rectal, parentral, subcutaneous, ocular, optic and nasal route.

Introduction to different dosage forms, their classification with examples: Definitions of solid dosages form like powders and granules, dentifrices, capsules and tablets, liquid orals like solutions, aromatic waters, syrups, spirits, elixirs, glycerine, lotions, liniments, gargles, mouth washes, douches, draught preparation, sterile products like injectables, implants, ophthalmic formulations and semi solid products, solutions for external use- suppositories.

Important terminologies in Pharmacy: Definitions and examples. Introduction to Quality Control, Significance of quantitative analysis in quality control, Different techniques of analysis, Pharmacy and Prescription Abbreviations.

Recommended Books:

1. Loyd V, Allen Nicholas G, Popovich Howard C, Ansel, "Pharmaceutical Dosage Forms and Drug Delivery", Lippincott Williams and Wilkins, 9th edition.

2. Carter SJ, "Cooper and Gun's Tutorial Pharmacy", CBS Publishers and Distributors, 12th edition.

3. Carter SJ, "Dispensing for Pharmaceutical Students", CBS Publishers and Distributors, 12th edition.

4. Raymond C, Rowe Paul J, Sheskey Marian E, Quinn, "Handbook of Pharmaceutical Excipients", Pharmaceutical Press,6th edition.

BPL3103	Pharmaceutical Chemistry-I	4-0-0	4 Credits

Course Outcomes:

Students will

CLO1: understand various concepts of acid-bases and buffers.

CLO2: understand about chemistry of various inorganic pharmaceutical agents.

CLO3: remember the basics of various aromatic and heterocyclic compounds.

CLO4: understand the basic concept of electrolytes and metal ions.

CLO5: gain knowledge about analysis and become employable in different chemical techniques.

Syllabus Content:

Acid-base concept and Buffers: Arrhenius concept, Bronsted Lowry concept and Lewis concept. Buffer action, buffer capacity and pharmaceutical applications of buffers. **Gastrointestinal agents:** Acidifying agents, antacids, cathartics, emetics and antimicrobial agents. Major Intra and extra cellular electrolytes: Major physiological ions, electrolytes used in replacement therapy, physiological acids-base balance, electrolytes used in acid-base therapy, electrolyte combination therapy.

Essential and trace ions: Copper, zinc, chromium, manganese, molybdenum, selenium, sulphur and iodine. Miscellaneous inorganic pharmaceutical agents: Inhalants; respiratory stimulants, expectorants, poison and antidote and pharmaceutical aids.

Aromatic Compounds: Major source of aromatic compounds, Structure, properties and resonance of benzene, aromatic character, mechanism of electrophilic aromatic substitution, orientation effects in electrophilic substitution, nucleophilic aromatic substitution. Preparation, properties and actions of: Phenols, carboxylic acids, amines, diazonium salts, aryl halides and ketones. Poly nuclear aromatic hydrocarbons: Naphthalene, phenanthrene and anthracene, pharmaceutical applications.

Heterocyclic compounds: Study of fundamentals of heterocyclics, nomenclature, methods of synthesis and important chemical reactions of the following: (a) Five-membered heterocycles: Furan, thiophene, pyrrole, thiazole, oxazole, imidazole, pyrazole, triazole and tetrazole; (b) Six-membered heterocycles: Pyridine, pyridazine, pyrimidine, pyrazine. Benz-fused heterocycles: Quinoline, isoquinoline, indole.

Recommended Books:

1. Chaudhary NC, Gurbani NK, "Pharmaceutical Chemistry I", Vallabh Prakashan, 5th edition.

2. Nadendla RR, "Pharmaceutical Organic Chemistry (Part I)", Vallabh Prakashan, Ist edition.

3. Nadendla RR, "Pharmaceutical Organic Chemistry (Part II)", Vallabh Prakashan, Ist edition.

4. Kasture AV, Wadodkar SG, "Pharmaceutical Chemistry-I", Nirali Prakshan, Kindle edition.

BPP3103	Pharmaceutical Chemistry-I Practical	0-0-4	2 Credits

Course Learning Outcomes:

Students will

CLO 1: gain knowledge about various types of limit tests for impurities.

CLO 2: improve skills of qualitative analysis of pharmaceutical products.

CLO 3: gain hand on experience about tests for purity of pharmaceutical products.

CLO 4: understand the preparation of inorganic pharmaceutical products.

CLO 5: gain hand on experience on quantitative analysis of pharmaceutical products.

Syllabus Content:

Limit tests for impurities in Pharmacoepial compounds.

Quantitative/Qualitative analysis: Assay of the following compounds will be done: solution of ammonia, boric acid, sodium bicarbonate, sodium carbonate, ferrous sulphate, strong and weak iodine solutions, copper sulphate, chlorinated lime, sodium chloride, ammonium chloride, sodium sulphate, calcium gluconate, magnesium sulphate, arsenic trioxide, bismuth oxychloride, and bismuth subnitrate.

Recommended Books:

1. Beckett AH, Stenlake JB, "Practical Pharmaceutical Chemistry", The Athelone Press,4th edition.

2. Singh HK, Kapoor VK, "Practical Pharmaceutical Chemistry", Vallabh Prakashan, Ist edition.

3. Rajasekaran VN, "Pharmaceutical Chemistry I Theory and Practical", CBS Publishers and Distributors", Kindle edition.

4. Gupta R, " Practical Pharmaceutical Chemistry", Anmol Publications Pvt.Ltd,12th edition.

BPL3105	Physical Chemistry	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: remember various concepts of laws of thermodynamics and Carnot cycle.

CLO2: understand about various types of colligative properties of solutions.

CLO3: apply basics of electrochemistry techniques and photochemistry laws.

CLO4: understand basics of phytochemistry laws.

CLO5: remember Rate laws and become employable in research analytics.

Syllabus Content:

Thermodynamics: Preliminary and definitions of systems, surrounding, macroscopic properties and state variables, thermodynamic equilibria, extensive and intensive properties, first law of thermodynamics, internal energy and first law, enthalpy of system, heat capacity, correlation between Cp and Cv for an ideal gas. Work done on reversible isothermal expansion of an ideal gas. Adiabatic expansion of an ideal gas, work of expansion, internal energy change and enthalpy change. Comparison of isothermal and adiabatic changes. Limitations of first law and need of second law. Cyclic process, Carnot cycle, definition of second law of thermodynamics, spontaneous process. Concept of entropy, entropy change accompanying change of phase, entropy changes in reversible and irreversible processes. Absolute entropy, determination of absolute entropy with the help of third law of thermodynamics. Applications of thermodynamics.

Solutions: Solutions of liquids in liquids, ideal and real solutions, colligative properties of dilute solution, lowering of vapor pressure of non-volatile solute, osmosis and osmotic pressure in terms of chemical potential, Vant-Hoff equation for osmotic pressure of dilute solutions, elevation of boiling point and depression in freezing point by a non-volatile solute, determination of molar mass from vapor pressure lowering, osmotic pressure, boiling point elevation and freezing point depression, Solute distributing in immiscible solvent, distribution coefficient, conditions for validity of distribution law and the thermodynamic derivation, biological applications.

Electrochemistry: Electrode potential, Nernst equation, standard potential, standard hydrogen electrode, reference electrodes, indicator electrodes. Potentiometry: Theoretical consideration, ion-selective electrodes, measurement of potential, location of the end point,

equipment, analytical applications, differential curves, determination of Ksp, pH measurements, dead-stop titrations; pH meter, pH definition, equipment, applications.

Kinetics: Reaction Rate: Rate and rate constant, order and molecularity, zero, first and second order reactions, half life time, integration of rate expressions, methods of determining order of a reaction, effect of temperature on reaction rates, Arrhenius equation. Concept of steady state approximation, activation energy, energy barrier. Collision and activated complex theory of bimolecular reactions. Catalysis: Characteristics of catalyzed reactions; definition of the terms, autocatalysis, negative catalysis, inhibitors, promoters, homogeneous and heterogeneous catalysis, acid base catalysis and its mechanism, enzyme catalysis, Michaelis Menten equation, turn over number, the Line Weaver- Burk method.

Photochemistry: Introduction, consequences of light absorption, the Jablonski diagram, Lambert Beer law, Grothus Draper law, the Stark-Einstein law of Photochemical equivalence, Quantum efficiency of quantum yield, Photochemical reaction.

Recommended Books:

1. Laidler KJ, “Physical Chemistry with Biological Applications”, Benjamin Publications, Kindle edition.
2. Puri BR, Sharma LR, Pathania MS, “Principles of Physical Chemistry”, Vishal Publishing, 48th edition.
3. Bahl BS, Tuli GD, Bahl A, “Essentials of Physical Chemistry”, S Chand Publishers, 28th edition.
4. Bahadur P,”Basic concepts of Physical Chemistry”, Prakash Publications.

BPL3107	Industrial Safety and Environmental Sciences	4-0-0	4 Credits

Course Learning Outcomes:

Students will:

CLO1: gain knowledge about the environment and its allied problems.

CLO2: understand about industrial hazards and safety measures.

CLO3: understand effect of human population on environment.

CLO4: analyze social issues affecting environment.

CLO5: remember the basic concept of environmental entrepreneurship.

Syllabus Content:

Personal Basics and Chemical Safety: PPE, Compatibility Matrices, MSDS, Waste Management, Storage Concerns, Safety measures in handling and storage of chemicals, Fire chemistry and its control, Safety color codes of chemicals.

Hazard Classification: Hazard Classification chemical, physical, mechanical, ergonomics, biological and noise hazards, Hazards from utilities like air, water, steam through industrial pollution, nuclear radiation, toxic wastes, dam failures, transport accidents, factory explosions, fires and chemical spills.

Process Safety: Process Regulation Via Controls, Runaway Reactions, Vents and Valves, Licencing, Plant Design/Layout, Energetic Concerns (Explosions), Spill Clean-Up, Accident Analysis, Utilities Management, Safety in plant design and layout, Safety provisions in the factory act 1948, Indian explosive act 1884, ESI act 1948. Risk Management: Overall risk analysis, Methods for determining consequences effects: Effect of fire, Effect of explosion and toxic effect, Emergency Planning, First aids.

Environmental Pollution: Definition; Causes, effects and control measures of air, water, soil, marine, noise, thermal, and nuclear pollution; Solid waste management, Role of an individual in prevention of pollution, Disaster management. Social Issues and the **Environment:** From unsustainable to sustainable development, Urban problems and related to energy, Water conservation, Rain water harvesting, Watershed management, Resettlement and rehabilitation of people, Environmental ethics, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation, Consumerism and waste products, Acts (EPA, Water, Air, Wildlife and Forest conservation); Environmental legislation.

Human Population and the Environment: Effect of human population and growth on the environment human health, Population growth and explosion, Environment and human health, Human Rights, Value Education, HIV / AIDS, Family, Women and Child Welfare, Role of Information Technology in Environment and Human Health.

Recommended Books:

1. Blake RP, "Industrial Safety", Prentice Hall Publishers

2. Lees FP, "Loss Prevention in Process Industries: Hazard Identification, Assessment and Control", Butterworth Heinemann, Oxford Publications.

3. Bharucha E, "Textbook of Environmental Studies for Undergraduate Courses", Universities Press, Kindle edition.

4. Asthana DK, Asthana M, "A Textbook of Environmental Studies",S. Chand Publications.

BPL3111	**Basic Engineering Skills**	**4+0+0**	**4 Credits**

Course Learning Outcomes:

Student will

CLO1: develop skills in tools handling.

CLO2: understand and develop skill in machines operation.

CLO3: understand concept of maintenance of equipments

Syllabus Content:

Fitting & Drilling: Hand tools. Their types, characteristics, Use, Do's & Don's, specification and sizes, Like Files, Calipers, scribers, Vices, Scale, Gauges, Hammers, Pliers, Screw Drivers, Chisels & punches, Hacksaw, Selection of Hacksaw Blades, Various types of Spanners, L & N Keys, Screw drivers etc, Introduction to Drilling Machine, types of Drilling Machine, Drill bits & reamers, their description, size, types & use , Taps & Dies, Care to be taken while Drilling and use Taps & Dies.

Maintenance Concepts: Preventive maintenance, predictive maintenance, breakdown maintenance, management of spares, inspection, keeping the machine efficiency, partnership with operator and maintenance, reliability centered maintenance, operator care, CLITA, how to direct mechanic ,Corrosion and leakage management.

Passive Components: Resistor, Capacitors & Inductor, Moving coil & Moving Iron meter. Working principle of analog multimeters. Conductor,

Insulator and Semi Conductor:. P Type and N-Type semi conductors. P-N Junction, Diode Construction, transistors, LED, LDR, IRED, LCD, etc.Operation of PLC , SCADA systems.

Recommended Books:

1. Agrawal B, Basic Mechanical Engineering, John Wiley and Sons, 2008.
2. Singal R, Singal M, Basics of Mechanical Engineering, I.K. International, 2010.

Semester - II Courses

BPL3102	Chemistry of Natural Products (CNP)	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand various chemical and spectral approaches.

CLO2: understand about stereoisomerism taking examples of natural products.

CLO3: remember pharmacology of various natural products.

CLO4: understand chemistry of alkaloids and glycosides.

CLO5: understand chemistry of medicinally important compounds.

CLO6: analyze various antibiotics and employable research techniques.

Syllabus Content:

Chemical and spectral approaches: to characterize molecules of natural origin. Different types and concept of stereoisomerism taking examples of natural products.

Chemistry and pharmacological activity: Chemistry of following medicinally important terpenoids: Monoterpenes, sesquiterpenes, diterpenes and triterpenoids.

Carotenoids: α- carotenoids, β- carotenes, vitamin A. Glycosides: Chemistry, pharmacological activity of digitoxin, digoxin, hecogenin, sennosides, diosgenin and sarasapogenin.

Alkaloids: Explain chemistry, pharmacological activity and application of atropine and related compounds; quinine, reserpine, morphine, papaverine, ephedrine, ergot and vinca alkaloids. Chemistry and pharmacological activity of medicinally important lignans and quassinoids, flavonoids and xanthophylls. Chemistry and therapeutic activity of penicillin, streptomycin and tetracycline.

Recommended Books:

1. Trease GE Evans WC, “Pharmacognosy”, Elsevier India Pvt. Ltd.

2. Aggarwal OP, “Organic Chemistry Natural Products”, Vol. I,Krishan Publishers.

3. Aggarwal OP, “Organic Chemistry Natural Products”,Vol. II. Krishan Publishers.

4. Rahman AU, “Studies in Natural Products Chemistry (Volume 71): Bioactive Natural Products, Elsevier - Health Sciences Division.

BPL3104	Physical Pharmaceutics-I	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand various properties of ideal gases.

CLO2: remember principles of matter and its states.

CLO3: analyze about micromeretics and powder rheology.

CLO4: understand principles of viscosity and rheology in relation to drugs.

CLO5: remember various aspects of kinetics and drug stability.

CLO6: evaluate buffers and its employability in pharmaceutical applications.

Syllabus Content:

Ideal Gases: Behaviour of ideal gases, Application of ideal gas law, Vapor pressure, Effect of temperature on vapor pressure, Properties of Miscible and Immiscible Liquids, Solutions.

Matter and Properties of Matter: State of matter, change in the state of matter, latent heats and vapour pressure, sublimation-critical point, Eutectic mixtures, gases, aerosols - inhalers, relative humidity, liquid complexes, liquid crystals, glassy state, solids crystalline, amorphous and polymorphism.

Micromeretics and Powder Rheology: Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement, particle shape, specific surface, methods of determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.

Viscosity and Rheology: Newtonian systems, laws of flow, cinematic viscosity, effect of temperature on flow and viscosity. Determination of viscosity, capillary, falling ball, and rotational viscometers. Non-Newtonian systems, pseudoplastic and plastic systems. Thixotropy in formulations. Rheological properties of emulsions, and theory of emulsification.

Kinetics and Drug Stability: General considerations & concepts, half-life determination, Influence of temperature, light, solvent, catalytic species and other factors, Accelerated stability study, expiration dating. Buffers: Buffer equations and buffer capacity in general, buffers in the pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.

Recommended Books:

1. Lachman L, Lieberman HA, Kanig JL, "The Theory & Practice of Industrial Pharmacy", Varghese Publishing House.

2. Sinko PJ, "Martin's Physical pharmacy & Pharmaceutical sciences", B.I. Publications Pvt. Ltd, Seventh edition.

3. Subhramanyam CVS, "Textbook of Physical Pharmaceutics", Vallabh Prakashan, New Delhi, 2018th edition.

4. Remington's The Science & Practice of Pharmacy Mack Publishing Co. Easton, PA.

BPP3104	Physical Pharmaceutics-I Practical	0-0-4	2 Credits

Course Learning Outcomes:

Students will

CLO1: gain knowledge about particle size distribution and its employability in particle size analysis

CLO2: determine the derived properties of powders like densities, porosities, compressibility etc.

CLO3: apply hand on experience about preparation of various types of suspensions and determination of their sedimentation parameters.

CLO4: understand basic skills in the preparation of pharmaceutical buffers and determination of buffer capacity

CLO5: apply hand on experience on experiments involving tonicity adjustments.

Syllabus Content:

Determination of particle size, particle size distribution and surface area using various methods of Particle size analysis.

Determination of derived properties of powders like densities, porosities, compressibility, angle of repose.

Study of rheological properties of various types of systems using different Viscometers. Preparation of various types of suspensions and determination of their sedimentation parameters.

Preparation and stability studies of emulsions and suspensions. Studies on different types of complexes and determination of their stability constants. Accelerated stability testing, shelf-life determination and expiration dating of pharmaceuticals. Preparation of pharmaceutical buffers and determination of buffer capacity. Experiments involving tonicity adjustments.

Recommended Books:

1. Carter SJ, “Cooper and Gunn’s Tutorial Pharmacy”, CBS Publishers & Distributors, 12th edition.
2. Remington’s The Science & Practice of Pharmacy Mack Publishing Co. Easton, PA.
3. Gaud RS Gupta GD, “Practical Physical Pharmacy”,CBS Publishers & Distributors.
4. Subhramanyam CVS, “Textbook of Physical Pharmaceutics”, Vallabh Prakashan.

BPL3106	Pharmaceutical Microbiology	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand history of microbiology and biochemical organization of cell.

CLO2: analyze techniques for identification of microorganisms.

CLO3: understand about cultivation of microorganisms.

CLO4: understand about microbial genetics and gene expression.

CLO5: learn various techniques of sterilization and its employability in sterility testing of pharmaceutical products.

CLO6: evaluate sterility testing of pharmaceutical products.

CLO7: understand about immunity and microbial resistance.

Syllabus Content:

Introduction: Biochemical organization of the cell and transport process across cell membrane. Historical development and scope of pharmaceutical microbiology, Structure of Bacterial Cell. Identification of microbes: Stains and types of staining techniques, electron microscopy.

Nutrition, cultivation and Isolation: Bacteria, Actinomycetes, Fungi and Virus.

Microbial genetics and variation: Structure of gene, genetic code, transcription, translation, mutation and regulation of gene expression, bacterial enzymes. Genetic Code and Protein Synthesis: Genetic code, Components of protein synthesis, and Inhibition of protein synthesis. Brief account of genetic engineering and polymerase chain reactions. Regulation of gene expression.

Control of Microbes: Physical and chemical methods: (a) Disinfectants: Dynamics of disinfection, factors affecting the process of disinfection, Evaluation of liquid disinfectants & methods of measuring growth inhibition (MIC). Types of chemical agents employed for disinfection, antisepsis and preservation with their full description & use. (b) Principles and Practice of sterilization methods: Introduction, sensitivity of microorganisms, typical survival curves for bacterial spores exposed to moist heat or gamma radiations, expression of resistance in terms of D value and Z value & sterility assurance, factors affecting the D-value. **Sterilization methods** (Heat, Gaseous, Radiations & Filtration using different filter devices) with emphasis on sterilization of items used in hospital, thermolabile drugs and injectables. Monitoring of sterilization processes.

Laminar aseptic hoods and aseptic processing. Sterility Testing: Methods and media used with emphasis of the specific details of the sterility testing of parenterals and ophthalmics and other non injectable preparations such as catgut etc.

Immunity: Primary and secondary, defensive mechanisms of body, microbial resistance, interferon, role of interferon's in the body's defense.

Recommended Books:

1. Hugo and Russel, "Pharmaceutical Microbiology", Blackwell Scientific publishers, Eighth edition
2. Prescott LM, Harley GP, Klein DA, "Microbiology". V.C., Brown Publishers.
3. Pelczar MJ, Chan ECS, Krieg NR, "Microbiology", Tata McGraw Hill publishers.
4. Ananthanarayan R, Panikar CKJ, "Textbook of Microbiology", Orient Longmann,10th edition.
5. Gupte S, "The short textbook of Medical Microbiology", Jaypee Brothers.

BPL3108	Pharmaceutical Analysis-I	4-0-0	4 Credits

Course Learning Outcomes:

Student will:

CLO1: understand the principles of acid base titrations.

CLO2: understand the principles of oxidation-reduction titrations.

CLO3: remember and apply the principles of precipitation titrations.

CLO4: understand the principles of gravimetric analysis.

CLO5: apply principles of phase solubility analysis and its employability in research analytics.

CLO6: understand the principles of chromatography.

Syllabus Content:

Acid Base Titrations: Acid base concept, role of the solvent, Relative strengths of acids and bases; Law of mass action; common-ion effect, ionic product of water, pH, Hydrolysis of salts, Handerson – Hesselbach equation; Buffer and buffer capacity:

Acid base indicators, Theory of indicators, Choice of indicators; Neutralization curves (Strong acid and strong base, strong acid weak base, weak acid strong base and weak acid weak base) Polyprotic system, dissociation calculations for polyprotic acids, fractions and equilibrium concentrations of dissociating species at a given pH, salts of polyprotic acids, (Amphoteric salts and unprotonated salts), Buffer calculations for polyprotic acids, titrations of polyprotic acid, amino acid system and its titrations. Application in assay of H_3B0_3, HCl, H_3P0_4, NaOH and Na_2B0_3.

Oxidation-Reduction Titrations: Concepts of oxidation and reduction, redox reactions, equivalent weights of oxidizing and reducing agents, electrochemical cells, reduction potential, standard reduction potential, Nernst equation, cell representations, measurement of electrode potential and its application in determining the equilibrium constant of a reaction, concept of formal potential, oxidation reduction curves, redox indicators, potassium permanganate titrations, iodimetry and iodimetry, ceric sulphate titrations, potassium iodate titrations, sodium 2, 6- dichlorophenol - indophenol titrations, pharmaceutical applications.

Precipitation Titrations: Precipitation reactions, solubility product, effects of common ion, acids, temperature and solvent upon the solubility of a precipitate, conditional solubility product, fractional precipitation, argentiometric titrations, ammonium or potassium

thiocyanate titrations, mercuric nitrate titrations, indicators, Gay-Lussac method, Mohr's method, Volhard's method, Fajan's method, Pharmaceutical applications.

Gravimetric Analysis: Precipitation techniques, the colloidal state, gravimetric factor, super saturation, co precipitation and its types, Post precipitation, digestion, washing of the precipitate, filtration, filter papers and crucibles, ignition, thermo gravimetric curves of copper sulphate, specific examples like barium as barium sulphate, aluminium as aluminium oxide, calcium as calcium oxalate and magnesium as magnesium pyrophosphate, organic precipitants.

Phase Solubility Analysis: Theory, experimental procedures, methods used for determination of solubility, applications in Pharmaceutical analysis.

Chromatography: Various principles of chromatography including adsorption, partition, ion exchange, size exclusion, gel and other methods. Gas chromatography: Introduction; Principles of gas chromatography, basic GLC apparatus, carrier gases; sample introduction, column, column efficiency, solid support, liquid phases, branches of gas chromatography; Detectors, temperature effect; HPLC: Introduction and methods for qualitative and quantitative analysis using HPLC.

Recommended Books:

1. Mendham J, Denney RS, Barnes JD, Thomas MJK, “Vogel’s Textbook of Quantitative chemical analysis”, Addison Wesley Longman Ltd,6th edition.
2. Chatwal GR, Anand SK, “Instrumental Methods of Chemical Analysis”,Himalaya Publishing House.
3. Kamboj PC, “Pharmaceutical Analysis”, Vallabh Prakshan.
4. Shankar R, “Textbook of Pharmaceutical Analysis”, RX Publisher.
5. Kasture AV, Mahadik KR, “Pharmaceutical Analysis”, Nirali Prakshan, 13th edition.

BPL3109	Mechanical Engineering	4+0+0	4 Credits

Course Outcomes

Students will

CLO1: apply knowledge and develop skills in selecting the machine elements.

CLO2: understand the structure and specification of mechanical transmission.

CLO3: learn the physical fundamentals of pneumatic equipments.

CLO4: understand the physical fundamentals of hydraulic equipments.

Syllabus Content:

Machine elements: Structure, classification, applications, and typical troubles of: bolt and nut; keys; bearing; gear; belt and pulleys; chain and joint. Gasket specifications and food grade quality .Mechanical seals .

Faulty Finding and Adjustment of Accuracy: Structure and specification of mechanical transmissions such as spindles, gear trains, and driving gears. Finding faults in machine elements by checking noises and temperature. Methods to adjust machine elements (LLF)

Lubricant Management: Functions and effects of lubricant in driving systems Classification, specification, lifetime and viscosity of lubricant. Inspection and maintenance of lubricator , Usage and maintenance of grease, specifications and usage of food grade lubricant.

Introduction to pneumatics- Definition, force, pressure and its units;

Physical Fundamentals: - Air composition, definition of atmospheric pressure, absolute pressure, gauge pressure; Safety requirements for pneumatic systems; Air compressors:- Principle operation of reciprocating compressor and applications; Air receiver; Compressed air refrigerant / desiccant air dryers , air dew point temperature and significance of dry compressed air . Functional description of pressure gauge, FRL (Filter, regulator, lubricator) service unit; Compressed air distribution system controls .

Basic Hydraulics: Pascal's law; Application of hydraulics

Hydraulic Pump:- Concept of positive displacement and non-positive displacement pumps; Positive displacement pumps – Functional description of Gear pump, Vane pump, Piston pump, Function of fluid, type of fluid,

Hydraulic actuators:- Functional description of hydraulic element:-- single and double acting cylinder, hydraulic gear motor

Hydraulic circuit:- brief description of hydraulic circuit of regeneration circuit, counter balance circuit, by pass circuit, pressure sequence circuit; General maintenance procedure for hydraulic and pneumatic control system.

Recommended Books:

1. Agrawal B, Basic Mechanical Engineering, John Wiley and Sons, 2008.
2. Singal R, Singal M, Basics of Mechanical Engineering, I.K. International, 2010.

BPPR3109	Project-I	10 hrs	5 Credits

Course Learning Outcomes:

Students will

CLO1: understand and develop skills in the formulation of pharmaceutical dosage forms.

CLO2: evaluate various pharmaceutical dosage forms

CLO3: understand manufacturing and packaging operations.

CLO4: gain knowledge about formulation methods.

CLO5: analyze chemistry of various inorganic pharmaceutical agents.

CLO6: remember features of various environmental hazards.

Syllabus Content:

In this student will submit the projects which cover basic understanding of pharmaceutical dosage forms, formulation methods, chemistry of various inorganic pharmaceutical agents, various aromatic and heterocyclic compounds, colligative properties, heterocyclic compounds and various environmental hazards.

Semester – III Courses

BPL3211	**Pharmaceutical Chemistry-II (Organic Chemistry)**	**4-0-0**	**4 Credits**

Course Learning Outcomes:

Students will

CLO1: understand basic facts related to structure and properties of organic compounds.

CLO2: gain knowledge about preparation and properties of aldehydes and ketones.

CLO3: gain knowledge about stereochemistry and its employability in organic chemistry.

CLO4: learn nomenclature, preparation and reactions of alkane.

CLO5: gain knowledge about chemistry and analysis of proteins and peptides.

CLO6: apply knowledge about preparation and reactions of alcohols and ethers.

Syllabus Content:

Structure and Properties: Organic chemistry, structural theory, chemical bond, quantum mechanics, atomic orbitals, electronic configuration, molecular orbitals, bond lengths, bond angles, bond energy, polarity of bonds, polarity of molecules, dipole moment, structure and physical properties including melting point, boiling point and solubility, acidity and basicity, isomerism.

Aldehydes and Ketones: Nomenclature of aldehydes and ketones (carbonyl compounds), preparation of aldehydes and ketones. Reactions of aldehyde and ketones: Oxidation, reduction, addition of Grignard reagents, Cannizaro reaction.

Stereochemistry of Organic Compounds: Stereoisomers, enantiomers, diastereoisomers, optical activity, chiral centre, racemic modification, meso-structures, configuration, reactions involving stereoisomers, stereoselective and stereospecific reactions. Geometric isomers, conformational isomers, configurational isomers, conformational analysis of ethane and n-butane, conformations of cyclohexanes, axial and equatorial bonds, Newman projections, Fischer and Wedge formula. Relative and absolute configuration, sequence rules, D & L, R & S and E & Z system of nomenclature.

Alkanes: Nomenclature of straight and branched chain alkanes and alkyl groups, classification of carbon atoms of alkanes, isomerism, sources, methods of preparation, physical properties and chemical reactions. Mechanism of free radical halogenation of alkanes, orientation, reactivity and selectivity, chlorofluorocarbons and ozone layer.

Proteins and Nucleic Acid: Structure of amino acids, amino acids as dipolar ions, isoelectric point, configuration of natural amino acids, preparation and reactions of amino acids, peptides, geometry of peptide linkage, determination of structure of peptides, terminal residue analysis, partial hydrolysis, synthesis of peptides, classification, function and denaturation of proteins, structure of proteins, peptide chain, side chains, electrophoresis, conjugated proteins, coenzymes, secondary structure of proteins.

Alcohol, Ethers and Role of the Solvent: Nomenclature, methods of preparation, physical properties and chemical reactions. Role of Solvent: Secondary bonding, solubility of non-ionic and ionic solutes, protic and aprotic solvents, ion pairs, role of solvent in substitution reactions, phase-transfer catalysis.

Recommended Books:

1. Morrison RT, Boyd RN, “Organic Chemistry”, Prentice-Hall of India, Pvt. Limited, New Delhi, 7th edition.
2. Solomens G, Fryhle C, Johnson R, “Organic Chemistry”, Wiley (Singapore).
3. Smith MB, March J, “March’s Advanced Organic Chemistry: Reactions, Mechanisms and Structure”, Wiley.
4. Francis A C, “Advanced Organic Chemistry: Part A: Structure and Mechanisms”, Springer, 2008th edition.

BPL3213	Physical Pharmaceutics-II	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand various physicochemical properties of drug molecules and learn various skills in pharmaceutical formulation

CLO2: gain knowledge of various properties of colloidal dispersions.

CLO3: gain knowledge about formulation and stability of suspensions and emulsions.

CLO4: understand mechanism of solute-solvent interactions.

CLO5: understand properties of ideal and real solutions.

CLO6: remember distribution law and its applications.

Syllabus Content:

Surface and Interfacial Phenomena: Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid- gas and solid liquid interfaces, complex films, electrical properties of interface.

Dispersion Systems:

(a) Colloidal Dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy.

(b) Suspensions: Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations.

(c) Emulsions-types, theories, physical stability. Solubility of drugs: (a) Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, quantitative approach to the factors influencing solubility of drugs, Dissolution & drug release, diffusion principles in biological systems. (b) Solubility of gas in liquids. (c) Solubility of liquids in liquids, (Binary solutions, ideal solutions).

(d) Distribution law, its limitations and applications.

Recommended Books

1. Sinko PJ, “Martin’s Physical pharmacy & Pharmaceutical sciences”, B.I. Publications

2. Subhramanyam CVS, “Textbook of Physical Pharmaceutics "Vallabh Prakashan, New Delhi.

3. Troy DB, Beringer P, “Remington’s The Science & Practice of Pharmacy”, Mack Publishing Co. Easton, PA.

4. Vidhyadhara S, “Physical Pharmaceutics-II”, Pharmamed Press, St ed. edition.

BPL3215	Pharmaceutical Operation-I	4-0-0	4 Credits

Students will

CLO1: understand various types of fluid flow and material handling.

CLO2: understand various filtration, centrifugation techniques and its employability.

CLO3: gain knowledge about dehumidification and humidity control.

CLO4: understand about refrigeration, air conditioning and various employable techniques.

CLO5: develop skills in determining humidity-use of Dry Bulb and Wet Bulb.

Syllabus Content:

Unit Operations: Introduction, basic laws.

Fluid Flow: Types of flow, Reynold's number, Viscosity, Concept of boundary layer, basic equations of fluid flow, valves, flow meters, manometers and measurement of flow and pressure.

Material Handling Systems: Liquid handling- Different types of pumps. Gas handling- Various types of fans, blowers and compressors. Efficiency test of Air compressor. Solid handling- Bins, Bunkers, Conveyers, Air transport.

Filtration and Centrifugation: Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, etc. Factors affecting filtration, mathematical problems on filtration, optimum cleaning cycle in batch filters. Principles of centrifugation, industrial centrifugal filters, and centrifugal sedimenters.

Dehumidification and Humidity Control: Basic concepts and definition, wet bulb and adiabatic saturation temperatures, Psychrometric chart and measurement of humidity, application of humidity measurement in pharmacy, equipments for dehumidification operations, principles of humidity and humidity control.

Refrigeration and Air Conditioning: Principles and applications of refrigeration and air conditioning HVAC system, Type of Air filters, AHU, Ventilation units, dry & wet scrubbers, dust extraction system, Filtration concepts, clean room classification as per ISO14644.

Material of Construction: General study of composition, corrosion, resistance, Properties and applications of the materials of construction with special reference to stainless steel and glass. Factors affecting the choice. Temperatures and Its Measurements-

Concept of Heat, Temperature and its Measurements, Liquid Thermometers and Mercury Thermometers, Bimetallic Thermometers, Platinum Resistance Thermometers, Thermoelectric Thermometers, Pyrometers, Factors for Selection of Thermometers for Particular Use, Temperature Range and Comparison of Various Thermometers. Vacuum Science and Technology- Introduction to Vacuum Technology, Physical Parameters at Low Pressure, Classification of Vacuum Ranges, General Idea of Vacuum Pump and System, Classification of Vacuum Pumps, Exhaust Pumps and their Characteristics, Measurements of Low Pressure.

Recommended Books:

1. Badger WL, Banchero JT, "Introduction to Chemical Engineering", McGraw Hill, London.
2. Mc Cabe WL, Smith JC, Harriolt P, "Unit Operations of Chemical Engineering". McGraw Hill, London.
3. Badger WL, Banchero JT, "Introduction to Chemical Engineering", McGraw Hill International Book.
4. Subrahmanyam CVS, "Pharmaceutical Engineering: Principles and Practices", Vallabh Prakashan, New Delhi.
5. Hadkar UB, "Practical Physical Pharmacy & Physical Pharmaceutics".Nirali Prakashan.

BPP3215	Pharmaceutical Operation-I Practical	0-0-4	2 Credits

Course Learning Outcomes:

Students will

CLO1: gain knowledge about flow of fluids and their pressure.

CLO2: evaluate filter media, determination of filtration rate and factors affecting filtration.

CLO3: able to demonstrate and gaining skills in applications of centrifugation.

CLO4: able to study about thermometers and psychometric charts.

CLO5: apply skills in determining humidity-use of Dry Bulb and Wet Bulb.

Syllabus Content:

Measurement of flow of fluids and their pressure, determination of Reynold's number and calculation of Frictional losses.

Evaluation of filter media, determination of rate of filtration and

Study of factors affecting filtration.

Experiments to demonstrate applications of centrifugation. Thermometers and Psychometric charts.

Determination of humidity-use of Dry Bulb and Wet Bulb. Workshop practice of basic maintenance & mechanics.

Recommended Books:

1. Prager G, "Practical Pharmaceutical Engineering",John Wiley & Sons.
2. Hadkar UB, "Practical Physical Pharmacy & Physical Pharmaceutics",Nirali Prakashan.
3. Gaud RS, Gupta GD, "Practical Physical Pharmacy", CBS Publishers & Distributors, New Delhi.
4. Kasture PV, Paradkar AR, Parakh SR, Gokhale SB, "Practical Pharmaceutics- II", Nirali Prakashan.

BPL3217	Pharmaceutical Regulatory Affairs	4-0-0	4 Credits

Students will

CLO1: understand Drugs and Cosmetics Act 1940.

CLO2: understand The Patents and Designs Act 1970.

CLO3: gain knowledge about various Drug Regulatory Agencies globally.

CLO4: understand about preparation of documents for New Drug Application (NDA).

CLO5: learn about patent filing procedure and become employable in patent filing.

CLO6: remember about harmonization of the regulatory requirements and its employability in quality management system.

Syllabus Content:

Overview of drugs: An overview of Drugs and Cosmetics Act 1940 and rules there under, The Patents and Designs Act 1970, Trademarks. Drug Regulatory Agencies-Historical perspectives, organization structure activities & responsibilities:

India (CDSCO), US (FDA), EU (EMEA), Japan (PMDA), UK (MHRA), Australia (TGA) & WHO. Preparation of documents for New Drug Application (NDA) as per requirements of FDA and EUDRA guidelines. GMP requirements as per CFR 210-211 and ICH Q8, Q9 qnd Q10. Master Files, Out of specification. Stability studies as per ICH, EUDRA, FDA, and Analytical Methodology.

Patent: Patent discussion with emphases on: Patentable subject matter, Non-patentable subject matter, Criteria for getting a patent, types of patent and its usefulness. Filing procedure for patents, patent co-operation treaty. Trade related aspects of IPR. Harmonization of regulatory requirements: Study of ICH common technical documents.

Harmonization of Pharmacopoeial standards: Regulatory considerations of Pre-clinical and clinical evaluations with special reference to legislation and guidelines of good clinical practice in US, European community and Japan. Study of Environment Act, Factory Act, Industry Act, Consumer Protection Act, Narcotic Psychotropic Substance Act and Copy Right Act. CFR: Quality Management Systems, GLP, GCP. SUPAC guideline.

Recommended Books:

1. Ira R. Berry, Robert P. Martin, "The Pharmaceutical Regulatory Process", Current edition.
2. Roop K khar, SP Vyas, Farhan J Ahmad and Gaurav K Jain, "Lachman/Lieberman's The Theory and Practice of Industrial Pharmacy, Fourth Edition", CBS Publishers and Distributors Pvt. Ltd.
3. Jain NK, "Pharmaceutical Product development"CBS Publishers and distributors Pvt.
4. Leon Lachman, H. A. Lieberman & J. L. Kanig: "The Theory and Practice of Indusrtrial Pharmacy", 3rd edition, Varghese Publishing House.

Semester – IV Courses

BPL3212	**Physiology and Pharmacology-I**	**4-0-0**	**4 Credits**

Course Learning Outcomes:

Students will

CLO1: understand about gastrointestinal and respiratory system.

CLO2: gain knowledge about CNS and ANS.

CLO3: learn urinary system and its disorders.

CLO4: gain knowledge about reproductive & endocrine system and sense organs.

CLO5: understand various food requirements and its employability.

CLO6: gain knowledge about various communicable diseases.

Syllabus Content:

GIT system and associated endocrines; those of liver, pancreas and gall-bladder various gastrointestinal secretion and their role in the absorption and digestion of food. Disorder of digestive system.

Respiratory System: Anatomy of respiratory organs, functions of respiration, mechanism and regulation of respiration, respiratory volumes and vital capacity.

Central Nervous System: Functions of different parts of brain and spinal cord. Neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, specialized functions of the brain, Cranial nerves and their functions. Autonomic Nervous System: Physiology and functions of the autonomic nervous system. Mechanism of neurohumoral transmission in the A.N.S.

Urinary System: Various parts, structures and functions of the kidney and urinary tract. Physiology of urine formation and acid-base balance. Diseases of the urinary system. Reproductive System: Male and female reproductive systems and their hormones, physiology of menstruation, coitus and fertilization. Sex differentiation, spermatogenesis & oogenesis. Pregnancy its maintenance and parturition.

Endocrine System: Basic anatomy and physiology of Pituitary, Thyroid, Parathyroid, Adrenals, Pancreas, Testes and Ovary, their hormones and functions. Sense Organs: Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, nose (smell) and skin (superficial receptors).

Classification of food requirements: Balanced diet, nutritional deficiency disorders, their treatment and prevention, specifications for drinking water.

Communicable diseases: Brief outline, their causative agents, modes of transmission and prevention (Chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis, poliomyelitis, helminthiasis, malaria, filariasis, rabies, trachoma, tetanus, leprosy, syphilis, gonorrhoea, and AIDS).

Recommended Books

1. Tortora GJ, Grabowski SR , "Principles of Anatomy and Physiology". Collins College Publishers, Luciano, New York.
2. Ganong WF, "Review of Medical Physiology". Prentice-Hall.
3. Parmar NS, "Health Education and Community Pharmacy",CBS Publishers & Distributors, New Delhi.
4. Guyton AC, Hall JE, "Textbook of Medical Physiology".W.B. Sanders Co.

BPP3212	Physiology and Pharmacology-I Practical	0-0-4	2 Credits

Course Learning Outcomes:

Students will

CLO1: gain knowledge about different types of tissues and develop skills for its identification.

CLO2: learn to determine the bleeding, clotting time and develop skills for its determination.

CLO3: gain hand on experience to estimate haemoglobin value and blood pressure.

CLO4: understand the properties of drugs and the ways in which these properties react along with their mechanisms of action.

CLO5: understand the experiments on detection of blood groups and measurement of erythrocyte sedimentation rate.

Syllabus Content:

Microscopic studies of different tissues. Simple experiments involved in the analysis of normal and abnormal urine.

Collection of specimens, appearance, determination of pH of urine by pH meter. Quantitative determination of Sugars, proteins, urea, lipid profile, uric acid & creatinine.

Physiological experiments on nerve-muscle preparations. Determination of vital capacity, experiments of spirometry. Estimation of SGOT, SGPT, Alkaline phosphotase and Bilirubin in the serum.

Recommended Books

1. Tortora GJ, Grabowski SR, “Principles of Anatomy and Physiology”, Collins College Publishers, Luciano, New York.

2. Ganong WF, “Review of Medical Physiology”, Prentice-Hall.

3. Parmar NS, “Health Education and Community Pharmacy, CBS Publishers & Distributors, New Delhi.

4. Ghai CL, “A Textbook of Practical Physiology”, Jay Pee Brothers, New Delhi.

5. Guyton AC, Hall JE, “Textbook of Medical Physiology”,W.B. Sanders Co.

BPL3214	Biochemistry	4-0-0	4 Credits

Course Outcomes Content:

Students will

CLO1: understand major pathways of carbohydrates metabolism.

CLO2: gain knowledge on major pathways and its employability in lipid metabolism.

CLO3: gain knowledge about biological oxidation (respiratory chain).

CLO4: understand biosynthesis of amino acid, and urea cycle, metabolic disorder of urea cycle.

CLO5: gain knowledge about the metabolism of sulphur containing amino acid.

CLO6: understand genetic organization of mammalian genome and mechanism of enzyme action.

Syllabus Content:

Carbohydrate Metabolism: Conversion of polysaccharide to glucose-1- phosphate, Glycolysis and fermentation and their regulation, gluconeogenesis and glycogenolysis, Metabolism of galactose and galactosemia, role of sugar nucleotides in biosynthesis, and Pentose phosphate pathway.

The Citric Acid Cycle: Significance, reactions and energetic of the cycle, Amphibolic role of the cycle, and Glyoxalic acid cycle.

Lipids Metabolism: Oxidation of fatty acids, ı-oxidation & energetic, ı-oxidation, ı-oxidation, Biosynthesis of ketone bodies and their utilization, Biosynthesis of saturated and unsaturated fatty acids, Control of lipid metabolism, Essential fatty acids & eicosanoids **(prostaglandins, thromboxanes and leukotrienes), phospholipids, and sphingolipids.**

Biological Oxidation: Enzymes and co-enzymes involved in oxidation reduction & its control, respiratory chain its role in energy capture and its control, Inhibitors of respiratory chain and oxidative phosphorylation, Mechanism of oxidative phosphorylation. Metabolism of Ammonia and Nitrogen Containing Monomers: Nitrogen balance, Biosynthesis of amino acids, Catabolism of amino acids, Conversion of amino acids to specialized products, Assimilation of ammonia, Urea cycle, metabolic disorders of urea cycle, Metabolism of sulphur containing amino acids, Porphyrin biosynthesis, formation of bile pigments, hyperbilirubinemia, Purine biosynthesis, Purine nucleotide interconversion, Pyrimidine biosynthesis and Formation of deoxyribonucleotides.

Biosynthesis of Nucleic Acids: Brief introduction of genetic organization of the mammalian genome, alteration and rearrangements of genetic material, Biosynthesis of DNA and RNA. Enzymes: Nomenclature, enzyme kinetics and its mechanism of action, mechanism of inhibition, enzymes and iso-enzymes in clinical diagnosis.

Recommended Books:

1. Conn EE, Stump PK, "Outlines of Biochemistry". John Wiley & Sons, New York.
2. Nelson DL, Cox MM , "Lehninger Principles of Biochemistry, Macmillan.
3. Satyanarayana U Chakrapani U, "Biochemistry", Elsevier.
4. Rama RAS, "A Textbook of Biochemistry",UBS Publishers.
5. Jain JL, Jain S, Jain N, "Fundamentals of Biochemistry". S. Chand Publishers.

BPL3216	Pharmaceutical Process-I	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand liquid dosage forms and gaining entrepreneurship in formulation development.

CLO2: gain knowledge about formulation of semi solid dosage forms.

CLO3: gain knowledge about formulation of pharmaceutical aerosols.

CLO4: understand the concept of cosmetology and its formulation methods.

CLO5: understand various novel drug delivery system.

CLO6: apply knowledge about bioavailability and bioequivalence.

Syllabus Content:

Liquid Dosages Forms: Introduction, types of additives used in formulations, Vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavours and others, manufacturing packaging and evaluation of clear liquids, suspensions and emulsions official in pharmacopoeia.

Semisolid Dosage Forms: Definitions, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection. General formulation of semisolids, clear gels manufacturing procedure, evaluation and packaging. Suppositories: Classification, Ideal requirements, bases, manufacturing procedure, packaging and evaluation.

Pharmaceutical Aerosols: Definition, propellants, general formulation, manufacturing and packaging methods, pharmaceutical applications. Ophthalmic Preparations: Requirements, formulation, methods of preparation, containers, evaluation.

Cosmeticology and Cosmetic Preparations: Fundamentals of cosmetic science. Novel Drug Delivery Systems and Controlled release (CR) delivery systems: Principle, Advantages and Disadvantages, Classification and types of oral drug delivery system, transdermal and parenteral CR drug delivery agents including Mucoadhesive, Gastroretentive, MAB based delivery systems, Nanoparticle and nanotechnology, vesicular systems including liposomes, **nanosomes etc.**

Bioavailability of dosage forms and Bioequivalence: Evaluation methods: In vitro dissolution studies for solid oral dosage forms, Federal perspectives on Immediate Release

(IR) and Extended Release (ER) products. Brief Concepts of Biopharmaceutics Classification Scheme (BCS), in-vitro in-vitro correlation and bio-waiver. Important federal considerations for bio-availability and bio-equivalence studies for oral products; Statistical considerations including Crossover ANOVA.

Recommended Books:

1. Lachman L, Lieberman HA, Kanig JL, "The Theory & Practice of Industrial Pharmacy".
2. Aulton ME, "Pharmaceutics- The Science of Dosage Form Design", Churchill Livingstone, New York.
3. Ansel's, "Pharmaceutical Dosage Forms & Drug Delivery Systems".
4. Lieberman HA Lachman L Sachwartz JB." Pharmaceutical Dosage Forms: Tablets".

BPL3218	Industrial Pharmacy & Packaging Technology	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand various building premises.

CLO2: understand testing of various pharmaceutical dosage forms

CLO3: study manufacturing and packaging operations.

CLO4: gain knowledge about pharmaceutical packaging and concept of entrepreneurship.

CLO5: gain knowledge about pharmaceutical machinery.

CLO6: understand features of pharmaceutical containers and types of the corrugation methods.

Syllabus Content:

Building and facilities design: Introduction, Principal Area, layout design for sterile & non sterile facility. Equipment: Introduction, Design, size, location and Construction of Equipment, Cleaning and Maintenance of Equipment, Automatic, Mechanical and Electronic Equipments.

Manufacturing operations and control: Introduction, Sanitation of Manufacturing Premises, Mix-ups and Cross Contamination, Processing of Intermediates and Bulk product, Packaging Operations, I.P.Q.C., Release of Finished Product, Process Deviations, Charge-in of Components, Time Limitations on Production, Drug product Inspection, Expiration Dating, Calculation of Yields, Production Record Review.

Pharmaceutical packaging: Status, Scope in pharmaceutical industry, Classification of packaging material, Primary and secondary packaging, Functions of packaging. Sampling and quality control of packaging materials. Desirable features and a detailed study of different types of Pharmaceutical Containers and closures (Glass, Plastics and Rubber), including their merits and demerits. Packaging machinery: including strip packaging, form, fill and seal machines, liquid and solid filling machines, capping machines.

Product–Package compatibility: Stability of product, package selection and development criteria. Tamper evident packaging systems: Various types and their mechanism. Flexible packaging: Types of films, Co-extruded films, foils, coating and laminates, shrink and stretch

films. Corrugated and solid fibreboards and boxes: Types of corrugation methods and types of box design and Quality control.

Recommended Books:

1. Lachman L, Lieberman H, Kanig JL, "The Theory and Practice of Industrial Pharmacy". Varghese Publishing House, Bombay.
2. Hickey AJ, David GD, "Pharmaceutical Process Engineering",CRC Press.
3. Dean DA, Evans ER, Hall IH, "Pharmaceutical Packaging Technology",CRC Press.
4. Aulton ME, "Pharmaceutics: The Science of Dosage Form Design", Churchill Livingstone.

BPL3222	Electrical and Electronics Engineering	4+0+0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand and develop skills related to basic electrical engineering
CLO2: understand the electrical safety parameters
CLO3: understand the concept of electrical supply system
CLO4: understand about various power distribution systems
CLO5: understand and develop skills related to AC, DC motors and electromagnetism.

Syllabus Content:

Basics of Electrical Engineering: Types, grades, shapes and sizes of insulated wires and cables, their proper selection and use, cable termination, cable safety, different type of joints e.g. Britannia, Straight, Tee, Western union, letters signs and symbols used in Electrical Technology.

Ohm's Law & its application, Concept of Electrical Circuit e.g. Series, Parallel and Mixed Circuits. Identification of AC & DC Meters.

Resistance and laws of resistance, Kirchhoff laws and their application, Wheat stone bridge and its application,

Electrical safety: Good Electrical Practices, electrical zoning, Earthing and bonding concepts and equipments,

Power Generation: Various ways of electrical power generation, Thermal, Hydro electric, Nuclear, Non-Conventional

Electrical Supply System: Typical power supply scheme, Comparison of AC and DC transmission. Advantages of High transmission voltage. Various systems of power transmission and their comparison.

Power Distribution System: Classification of distribution system-AC distribution,

Introduction to Switch Gear: Essential features of switchgears. Switch gear equipments, bus-bar arrangement,

Introduction to protection schemes:Types & Characteristics of relays

Circuit Breakers: Circuit breakers, Classification of circuit breakers, MCB, ELCB and its application.

Fuses: Desirable characteristics of fuse element, Fuse element material

Transformers: Introduction, types (Step up and Step down), Power transformers, Distribution transformers,

Diesel Generators : Technical specifications , operation , maintenance , power change over .

Motors: Introduction to Induction Motor and Servo motors, Applications, types of motors AC and DC motors, Application of AC and DC Motors.

Electromagnetism: Magnets , their types, properties, terms and their definition used in magnetism, electromagnets and their advantage on permanent magnet, various laws applied in electro-magnetism, construction and principles of working of solenoids, Electromagnetic Induction, types of induction, Faraday's law, Lenz's law, ampere rule, eddy current,
Alternating current(AC) , RMS value, Max value , Average Value , Inductance , Capacitance , Reactance Impedance, Power Factor,
Ac generation sources and methods, Brief concept of 3 phase AC Supply also.
Application of electromagnetic induction: Transformer principle, construction and working of Transformer, classification and types of transformer.

Recommended Books:

1. D C Kulshreshtha, "Basic Electrical Engineering - Principal and Applications Revised First edition", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017. ISBN: 0071328963
2. C L Wadhva, "ELECTRICAL POWER SYSTEMS," Seventh Edition, New Age Internationals, 2016. ISBN: 9386070197
3. I.S. Katre, "Electronics Engineering," Tech- Max Publications, 2014. ISBN: 9789350776889

BPPR3110	Project-II	10 hrs	5 Credits

Course Learning Outcomes:

Students will

CLO1: learn various chemical and spectral approaches.

CLO2: understand about alkaloids and glycosides.

CLO3: study about the pharmacological activity of antibiotics.

CLO4: gain knowledge and develop skills about the aspects of kinetics.

CLO5: study about micromeritics.

CLO6: identify microorganism and cultivation of microorganisms.

Syllabus Content:

In this student will submit the projects which cover basic understanding of various chemical and spectral approaches, alkaloids and glycosides, antibiotics, aspects of kinetics, micromeritics, and identification of microorganism and cultivation of micro-organisms.

Semester – V Courses

BPL3321	Pharmaceutical Quality Assurance	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand various types of validation and its employability in quality assurance.

CLO2: gain knowledge about utilities validation and cleaning validation.

CLO3: understand about pharmaceutical quality audits.

CLO4: learn about quality management, complaints and recalls.

CLO5: understand about quality control laboratory.

Syllabus Content:

Pharmaceutical Validation: Definition, scope & organization, manufacturing process model, government regulations. Validation Master Plans, URS, DQ, IQ, and OQ & PQ of facilities, Equipment's, analytical instruments, computer systems and PLC.

Utilities Validation and Cleaning Validation: Pharmaceutical Water System & pure steam, HVAC system and Compressed air system validation. Equipment, working area and cleaning area validation.

Process Validation: Process validation of manufacturing process of different dosage forms including sampling techniques as per guidelines of USFDA/WHO TRS.

Pharmaceutical Quality Audits: Principle of Quality Audit. Quality improvement process, Quality in research and development. Quality Management: Introduction, Quality Assurance, Quality Circles, constitution, functions and benefits, Process and process management, Factors affecting process management, Problems Solving, International Standards Organization (ISO), ISO 9000, Developments of ISO 9000 Systems, ISO 9001: 2008.

Complaints and Recalls: Evaluation of complaints, recall procedure, related records and documents. Quality Control Laboratory – responsibilities and laboratory practices. Routine controls on instruments, reagents, sampling plans, standard test procedures and protocols, control on animal house, data generation and storage, quality control documentation of QC facilities. Finished product release, quality review, and batch release documents.

Recommended Books

1. Potdar M.A, Nirali Prakashan' "Pharmaceutical Quality Assurance", Pune.
2. Sidney H, Willing, Marcel Decker, "Series GMP for Pharmaceuticals", 5th Edition,
3. Dale H, "Total Quality Management" Pearson Education, New Delhi.
4. Sharma D.D, Sultan Chand & Bros, "Total Quality Management" by New Delhi.
5. "Quality Assurance of Pharmaceuticals": A Compendium of Guidelines and Related Materials by WHO.

BPL3323	Medicinal Chemistry-I	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand various techniques of drug design, physiochemical properties of drugs and chemistry of vitamins.

CLO2: learn drugs related to adrenergic and cholinergic system.

CLO3: understand medicinal chemistry of antispasmodic-antiulcer, antiparkinson's and neuromuscular blocking agents.

CLO4: understand medicinal chemistry of antihistaminic drugs.

CLO5: learn pharmacology of analgesics and non-steroidal anti-inflammatory agents and its employability in medicinal chemistry.

Syllabus Content:

Physicochemical and stereo chemical properties: Physicochemical and stereo chemical aspects of drugs including bioisosterism in relation to biological activity, Types of Drug-Receptor interaction. Rationale methods of drug design (QSAR, Pharmacophore mapping, docking) Lead, Discovery of Lead, lead optimization.

Vitamins: Water soluble and fat-soluble vitamins. Introduction, Structure, Stereochemistry, Nomenclature, Synthesis of specified drugs (given in parenthesis), mode of action, Structure Activity Relationships (if any) uses.

Physicochemical properties of the following classes of drugs: Adrenergic and anti-adrenergic drugs including biosynthesis, storage, release and metabolism of Catecholamine (Isoprenaline, Adrenaline, Salbutamol, propranolol).

Cholinergic and Anticholinestarases: Cholinergic and Anticholinestarases including biosynthesis, storage, release and metabolism of acetylcholine (Atropine, Neostigmine bromide, Pyridostigmine Bromide). Antispasmodic and Antiulcer drugs (Propantheline bromide, Dicyclomine hydrochloride).

Antiparkinsonism drugs (levodopa and carbidopa): Neuromuscular blocking agents (Succinylcholine chloride, Gallamine triethiodide). Antihistamines including H1 receptor antagonist Sodium Cromoglycate and Chloropheniramine. Prostaglandins and other Eicosanoids: Nomenclature, biosynthesis and biological activity. Analgesic-antipyretics and Non-steroidal Anti-inflammatory agents: (Indomethacin and Diclofenic sodium).

Recommended Books

1. Wilson and Gisvold's Textbook of "Organic Medicinal and Pharmaceutical Chemistry". Lippincott Williams & Wilkins, Philadelphia.

2. Hansch C. "Comprehensive medicinal Chemistry" Vol. IV, Quantitative Drug Design. Pergamom Press, Oxford.

3. Krogsgaard P, Tommy, "Textbook of Drug Design & Discovery", 3rd edition, 2004.

4. Singh H, Kapoor VK. "Medicinal and Pharmaceutical Chemistry", Vallabh Prakashan.

5.Sriram D, Yogeshwari P, "Medicinal Chemistry". Dorling Kindersley, Pearson Education.

BPP3323	Medicinal Chemistry-I Practical	0-0-4	2 Credits

Course Learning Outcomes:

Students will

CLO1: learn hands-on experience of various *in silico* models for prediction of ADMET and activity.

CLO2: have hands on experience on synthesis and spectral analysis of some selected drugs.

CLO3: gain skills on establishing of pharmacopoeial standards of the drugs synthesized.

CLO4: gain skills in determining partition coefficient, dissociation constant and molar constant.

CLO5: understand basic concept of chemical synthesis and research applications.

Syllabus Content:

Exercises based on QSAR (Activity prediction of compounds by QSAR Model).

Synthesis of selected drugs from the course content.

Spectral analysis of the drugs synthesized. Establishing the pharmacopoeial standards of the drugs synthesized.

Determination of partition coefficient, dissociation constant and molar constant.

Recommended Books:

1. Furniss BS, Hannaford AJ., Smith PWG, Tatchell AR, "Vogel's Textbook of Practical Organic Chemistry", John Wiley and Sons.

2. Singh HK., Kapoor VK, "Practical Pharmaceutical Chemistry". Vallabh Prakashan, New Delhi.

3. Mann FG, Saunders BC, "Practical Organic Chemistry". Orient Longman Pvt. Ltd., Hyderabad.

4. Kar A, "Advanced Practical Medicinal Chemistry". New Age International, New Delhi.

BPL3325	Pharmaceutical Process-II	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand formulation methods of Capsules.

CLO2: gain knowledge about microencapsulation technique and coating methods.

CLO3: gain knowledge about evaluation of micro capsules.

CLO4: gain knowledge about formulation of tablets and granulation technology.

CLO5: study about various pre-formulation factors and different routes of drug administration

CLO6: gain knowledge about aseptic areas and importance of pharmaceutical entrepreneurship.

Syllabus Content:

Capsules: Introduction, types, advantages and disadvantages, material and method of preparation hard gelatin capsules, size of capsules, method of capsule filling, soft gelatin, capsule shell and capsule content, importance of base absorption and minimum/gm factors in soft capsules, evaluation, quality control, stability testing and storage of capsule dosage forms.

Microencapsulation: Types of microcapsules, importance on microencapsulation in pharmacy, microencapsulation by phase separation, coacervation, multi orifice, spray drying, spray congealing, polymerization complex emulsion, air suspension technique, coating pan and other techniques, evaluation of micro capsules.

Tablets: (a) Formulation of different types of tablets, granulation technology or large scale by various techniques, physics of tablets making, different types of tablet compression machinery and the equipment employed, evaluation of tablets.

Coating of Tablets: - Types of coating, film forming materials, formulation of coating solution, equipments for coating, coating process evaluation of coated tablets. (c) Stability kinetics and quality assurance.

Parenteral Products: (a) Preformulation factors, routes of administration, water for injection, pyrogenicity, non-aqueous vehicles, isotonicity and methods of its adjustment. (b) Formulation details, containers and closures and selection. (c) Prefilling treatment, washing

of containers and closures, preparation of solution and suspensions, filling and closing of ampoules, vials, infusion fluids, lyophilization & preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products. (d) Aseptic Techniques: Source of contamination and methods of prevention, design of aseptic area, laminar flow bench services and maintenance.

Recommended Books

1. Aulton ME, "Pharmaceutics- The Science of Dosage Form Design", Churchill Livingstone.
2. Lachman L, Lieberman HA, Kanig, J.L. "The Theory & Practice of Industrial Pharmacy", Current edition, Varghese Publishing House, Bombay.
3. Banker GS, Rhode CT, "Modern Pharmaceutics. Informa Healthcare", New York.
4. Lieberman HA, Lachman L, Sachwartz JB, "Pharmaceutical Dosage Forms: Tablets", Current edition, Marcel Dekker, N.Y.

BPL3327	Pharmaceutical Analysis-II	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: learn about non-aqueous titrations.

CLO2: gain knowledge about various miscellaneous methods of analysis.

CLO3: understand about electrochemical methods of analysis.

CLO4: understand the concept and applications of spectrophotometry.

CLO5: gain knowledge on various extraction methods.

CLO6: learn about HPLC and its employability in analysis.

Syllabus Content:

Non-aqueous Titrations: Theoretical consideration, scope and limitations, acid base equilibria in nonaqueous media, titration of weak bases, titration of weak acids, indicators, and pharmaceutical products should be selected for illustration. Miscellaneous Methods of Analysis: Diazotisation titration, Kjeldahl nitrogen determination, Karl-Fischer titration, Oxygen flask combustion.

Electrochemistry: The electric cell, electrode potential, half cells, types of half cells, sign convention, Nernst equation, the salt bridge, activity series, standard potential, standard hydrogen electrode, measuring the relative voltage of half cells, calculations of standard potential, reference electrodes, indicator electrodes. Potentiometry Theoretical consideration, ion-selective electrodes, measurement of potential, location of the end point, equipment, analytical applications, direct measurement of a metal concentration, differential curves, determination of Ksp, pH measurements, dead-stop titrations; pH meter, pH definition, relation of pH to potential, equipment, applications. b. conductometric and High Frequency Titrations and their Applications.

Polarography and Its Applications: Theory, mass transport processes, current processes, current potential relationship, polarization, choice of eletrodes, effect of oxygen, instrumentation, calculation of concentration, laboratory design and safety. **Spectrophotometry:** Theory, Principle and Instrumentation of UV-Visible Spectrophotometry, Qualitative and Quantitative determinations using Pharmacopoeial UV

based methods for single and multiple component formulations and raw materials. Theory, Principle and Instrumentation of Infrared Spectrophotometry, Qualitative determinations using Pharmacopoeial IR based methods for identification and confirmation of pharmaceutical raw materials. Theory, Principle and Instrumentation of NMR Spectrophotometry, Qualitative determinations using Pharmacopoeial NMR based methods for identification and confirmation of pharmaceutical raw materials. Theory, Principle and Instrumentation of Mass Spectrophotometry, Qualitative and Quantitative determinations using Pharmacopoeial MS based methods for identification and confirmation of pharmaceutical raw materials. LC MS: Instrumentation, working and applications. **Extractions Procedures:** Separation of drugs from excipients, The Craige method of multiple extraction, continuous counter - current extraction, effect of temperature, pH, inert solute, association, ion-pair formation, the emulsion problems in extractions. HPLC: HPLC-UV and HPLC-MS based analytical method development for single and multicomponent formulations.

Recommended Books:

1. Shankar R, “Textbook of Pharmaceutical Analysis”, RX Publisher.
2. Kamboj PC. “Pharmaceutical Analysis – I”, Vallabh Prakashan.
3. Kamboj PC. “Pharmaceutical Analysis – II”, Vallabh Prakashan.
4. Kamboj PC. “Pharmaceutical Analysis – III”, Vallabh Prakashan.
5. Kasture AV, Mahadik KR. “Pharmaceutical Analysis Vol-I”, Nirali Prakashan.
6. Kasture AV, Mahadik KR. “Pharmaceutical Analysis Vol-II”, Nirali Prakashan.

BPP3327	Pharmaceutical Analysis-II Practical	0-0-4	2 Credits

Course Learning Outcomes:

Students will

CLO1: gain skills on preparation and standardisation of analytical reagents.

CLO2: learn on estimation of pharmacopoeial products.

CLO3: gain skills of miscellaneous methods of analysis.

CLO4: gain skills on various separation techniques.

CLO5: learn on various electrochemical methods of analysis.

Syllabus Content:

Preparation and standardization of perchloric acid and sodium/ potassium/ lithium methoxides solutions.

Estimations of some Pharmacopoeial products, Preparations and standardization of EDTA solution, some exercises related to Pharmacopoeial assays by complexometric titrations, Miscellaneous Determinations: Exercises involving diazotisation, Kjeldahl, Karl- Fischer, Oxygen flask combustion and gasometry methods.

Determination of alcohol content in liquid galenicals, Experiments involving separation of drugs from excipients,

Chromatographic analysis of some pharmaceutical products,

Exercises based on acid base titration in aqueous and non-aqueous media, oxidation reduction, Titrations using potentiometric technique, Determination of acid-base disassociation constants and plotting of titration curves using pH meter, Exercises involving polarimetry, Exercises involving conductometric and polarographic techniques.

Recommended Books

1. Kamboj PC. “Pharmaceutical Analysis – I, II and III”, Vallabh Prakashan.
2. Kasture AV, Mahadik KR. “Pharmaceutical Analysis Vol-I & II”, Nirali Prakashan.

BPL3331	Measurement and Measuring Instruments	4+0+0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand and develop skills in basic measurements.

CLO2: learn the concept of theory of errors.

CLO3: understand the working of Air type level measuring instrument

CLO4: be able to measure the pressure and strain using different equipments

CLO5: learn how to calibrate and validate the systems followed by records

Syllabus Content:

System of Units and Basic Measurement : Fundamental & Derived Units, Length, mass, Time & temperature Measurement, Accuracy & Precision of Measuring Instruments, Error in Measurements, Significant Figures, Revision of definition of physical quantities and their mathematical relation to other quantities, Dimensions of Physical quantities, Dimensional analysis and its applications, their SI units,

Theory of errors: Accuracy & Precision, Repeatability & reproductability, Limits of Errors, Systematic & Random error, combination of errors, sensitivity, threshold, drift, calibration.

Velocity Measurement: Measurement of Linear velocity,, mechanical tachometer, Electrical tachometer, stroboscope and stroboscopic method of instruments of angular velocity, Measurement of Vibrations, Accelerometer and their types.

Pressure Measurement:- What is pressure, Theory of Pressure: What's pressure, absolute pressure, atmospheric pressure, differential pressure, elastic pressure, pressure unit, Bourdon tube pressure gauge its principle construction , Differential pressure gauges

Specific Gravity & Viscosity: Definition of density, specific gravity, Hydrometers

Flow: Introduction to flow Theory of flow, description about, stream flow, measurement of pH and conductivity, flow measuring techniques, and flow measurement methods, variable head flow meters, Differential pressure flow meter, Orifice plates, Ventura Tubes, Flow nozzles, Pitot tubes, and Rota meters. Electromagnetic and ultrasonic flow meters, Vortex flow meters, Mass flow type meters. Shunt flow meters.

Level: Float type, Displacement type, Hydrostatic type, Diaphragm type, Differential pressure method, Electrical conductivity method, Capacitance level, Ultrasonic and nucleonic gauges, Capacitance Probes, Solid level detectors.

Air type level measuring instrument, Working principles and construction Displacement and capacitor type level instruments

Description and use of "U" tube monometer well type and inclined.

Thermal & Temperature: Temp, Scales, resistance thermometry, General purpose thermo couples, J/K/R/S & PT-100(RTD) etc, Mineral Insulated Thermo couples, principle of thermocouples. PTC/NTC Thermostats, Construction & Principle of working, operation of Liquid-in-glass thermometer and Liquid-in-metal thermometers, Construction & Principle of working, operation and testing of Vapour, pressure thermometer. Construction & Principle working, operation and testing of Bimetallic thermometer. Construction of Moving coil pyrometer. Construction, repairing and testing. Resistance thermometer. definition, of pyrometer, Optical pyrometers, principle, Construction operation of different types, Radiation pyrometer principle and operation.

Strain Measurements: Electrical strain gauges wire & foil type materials, Adhesives configuration, Protective coatings, Bonding, Temp. Compensation, calibration, Applications Renascence gauges.

Sensors : Proximity sensors, Photo electric Sensors, plug type sensors, univocal, bipolar, techo, leno, liner, FD, Button, Square, level sensors, float type of sensors, Inductive, Capacitive, optical, & Magnetic Proximity sensors Magnetic Float switches & Read Switches.

Basics of Control systems, block diagram of Functional elements & their types, Open loop/Closed loop, concept of feedback, Transfer function, PID, gain margin stability, Single point temperature controller & multi point controller.

Indicator, Recorders and controllers : Single point indicator, multi point indicator, analog and digital indicators,

Recorders : Analog recorders, digital recorder, operating mechanism, strip charge recorders, circular recorders, x-y recorders, single point, multipoint recorders, Part 11 compliance, validation

DATA LOGERS, data acquisition system, supervisory control system, direct digital control, concept of programmable logic control (PLC).

Recommended Books:

1. R.K. Rajput, "Electrical Measurements and Measuring Instruments", S Chand and Company Ltd. , 2007, ISBN: 8121929636

2. R.K. Rajput, "Electronic Measurements and Instrumentation", S Chand and Company Ltd., 2015. ISBN: 9788121929172

Semester – VI Courses

BPL3322	**Dosage Form Design (DFD)**	**4-0-0**	**4 Credits**

Course Learning Outcomes:

Students will

CLO1: understand about preformulation studies.

CLO2: gain knowledge about applications of pro-drugs.

CLO3: gain knowledge about validation and stability studies.

CLO4: learn about performance evaluation methods and its employability in various quality control methods.

CLO5: understand biopharmaceutics classification scheme and bioavailability.

CLO6: gain knowledge about quality by design and various optimization techniques.

Syllabus Content:

Preformulation studies: Study of physical properties of drugs like physical form, particle size, shape, density, wetting, dielectric constant. Solubility, dissolution and organoleptic property and their effect on formulation, stability and bioavailability. Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemisation, polymerization etc., and their influence on formulation and stability of products. Study of pro-drugs in solving problems related to stability, bioavailability and elegancy of formulation.

Design, development and process validation

Methods for pharmaceutical operations involved in the production of pharmaceutical products with special reference to tablets, suspensions. Stabilization and stability testing protocol for various pharmaceutical products.

Performance evaluation methods: In vitro dissolution studies for solid oral dosage forms, Federal perspectives on Immediate Release (IR) and Extended Release (ER) products. Brief Concepts of Biopharmaceutics Classification Scheme (BCS), Lipinski rule of five, in-vitro in-vivo correlation and bio-waiver.

Important federal considerations for bio-availability and bio-equivalence studies for oral products; Statistical considerations including Crossover ANOVA. Introduction to Quality by Design and Optimization Techniques:

Risk Assessment (Matrix, & FMEA): Quality Target Product Profile, Critical Quality Attributes, Critical Material Attributes, & Critical Process Parameters for various dosage forms. Concept of optimization, Optimization parameters, Design of Experiments, Statistical design, and other applications.

Recommended Books:

1. Lachman L, Lieberman HA, Kanig JL, "The Theory & Practice of Industrial Pharmacy". Varghese Publishing House, Bombay.
2. Banker GS, Rhode CT, "Modern Pharmaceutics, 4th Ed, Informa Healthcare", New York.
3. Jain NK, "Controlled and novel drug delivery". CBS Publishers & Distributors, New Delhi.
4. Allen L, & Ansel HC, "Ansel's pharmaceutical dosage forms and drug delivery systems", Lippincott Williams & Wilkins.

BPP3322	Dosage Form Design (DFD) Practical	0-0-4	2 Credits

Course Learning Outcomes:

Students will:

CLO1: understand various preformulation studies.

CLO2: gain skills related to bioavailability improvement through prodrugs.

CLO3: learn and gain knowledge on stability studies.

CLO4: gain skills on dissolution testing.

CLO5: learn and analyze bioequivalence studies.

Syllabus Content:

Preformulation studies including drug-excipient compatibility studies, effect of stabilizers, preservatives etc. in dosage form design.

Experiments demonstrating improvement in bioavailability through prodrug concept. Stability evaluation of various dosage forms and their expiration dating.

Dissolution testing and data evaluation for oral solid dosage forms.

Evaluation of Bioequivalence of some marketed products. Design, development and evaluation of controlled release formulations.

Recommended Books:

1. Bachhav V, “Design and Development at Early Stage”, Innovative Dosage Forms,. Wiley.

2. Gibson M, “Pharmaceutical Preformulation and Formulation”: A Practical Guide from Candidate Drug Selection to Commercial Dosage Form, CRC Press.

3. Jones D S,” FASTtrack Pharmaceutics dosage form and design”. Pharmaceutical press.

BPL3324	Pharmaceutical Operation-II	4-0-0	4 Credits

Course Learning Outcomes:

Students will:

CLO1: understand and gain knowledge about stoichiometry.

CLO2: gain knowledge about heat transfer.

CLO3: understand about evaporation techniques.

CLO4: gain knowledge about distillation and its applications.

CLO5: gain knowledge about various drying methods and basic concept of entrepreneurship.

CLO6: learn and gain knowledge about size reduction, size separation and mixing techniques.

Syllabus Content:

Stoichiometry: Unit processes material and energy balances, molecular units, mole fraction, gas laws, mole volume, primary and secondary quantities, equilibrium state, rate process, steady and unsteady states, dimensionless equations, dimensionless formulae, dimensionless groups, different types of graphic representation, mathematical problems.

Heat Transfer: Source of heat, heat transfer, steam and electricity as heating media, determination of requirement of amount of steam/electrical energy, steam pressure, Boiler capacity, Mathematical problems on heat transfer, pure steam & boiler act.

Evaporation: Basic concept of phase equilibrium, factor affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators, Mathematical problems on evaporation. Distillation: Raoult's law, phase diagrams, volatility; simple steam and flash distillations, principles of rectification, Calculation of number of theoretical plates, Azeotropic and extractive distillation. Mathematical problems on distillation.

Drying: Moisture content and mechanism of drying, rate of drying and time of drying calculations; classification and types of freeze-drying dryers behaviour of solids during drying, MC, EMC, CMC and LOD dryers used in pharmaceutical industries and special drying methods.

Mathematical problems on drying. Size Reduction and Size Separation: Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of mills including ball mill, hammer mill, fluid energy mill etc.

Mixing: Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipments.

Recommended Books:

1. Carter SJ, Cooper & Gunn's, "Tutorial Pharmacy". 6th edition, CBS Publishers & Distributors, New Delhi.
2. Badger WL, Banchero JT," Introduction to Chemical Engineering". McGraw Hill International Book Co., London.
3. Perry RH, Green DW, "Chemical Engineers Handbook". McGraw Hill, International Editors Ltd, London.
4. Subramanyam, CVS, Setty JT, Suresh S, Devi VK, "Pharmaceutical Engineering-Principles & Practices". Vallabh Prakashan, Delhi.

BPL3326	Pharmaceutical Operation Management- Elective I	4-0-0	4 Credits

Course Learning Outcomes:

Students will

CLO1: understand the concept of management.

CLO2: gain knowledge about operations management.

CLO3: gain knowledge about quality management including TQM.

CLO4: understand and analyze the concept of production management.

CLO5: understand and gain knowledge about JIT and lean production system and importance of industrial entrepreneurship.

CLO6: gain knowledge about purchasing management.

Syllabus Content:

Concept of Management: Administrative Management (Planning, Organizing, Staffing, Directing and Controlling), Entrepreneurship development, Operative Management (personnel, Materials, Production, Financial, Marketing, Time/space, margin/ Morale), Principles of Management (Co-ordination, Communication, Motivation, Decision Making, leadership, innovation, creativity, delegation of Authority/ Responsibility, Record keeping).

Operations management: concept, functions; transformation process model: inputs, process and outputs; classification of operations; responsibilities of operations manager, contribution of henryford, deming, crossby, taguchi. Process selection- project, job, batch, mass and process types of production systems.

Quality Management: Introduction, Meaning, Quality Characteristics of Goods and Services, Juran‟s Quality Trilogy, Deming's 14 principles, Tools and Techniques for Quality Improvement, Statistical Process Control Chart, Quality Assurance, Total Quality Management (TQM) Model Concept of Six Sigma and its Application. Acceptance Sampling – Meaning, Objectives, Single Sample, Double Sample and Multiple Sample Plans with sated risk, Control charts for variables – Averages and Ranges, Control Charts for Defectives – Fraction Defective and Numbers Defective.

Production Management: A brief exposure of the different aspects of Production Management-Visible & Invisible inputs, methodology of activities, performance evaluation techniques, process flow, process know- how, maintenance management. JIT and

Lean Production System: JIT Approach, Implementation requirements, Services, Kanban System.

Inventory Management: Concepts, Classification, Objectives, Factors Affecting Inventory Control Policy, Inventory Costs, Basic EOQ Model, Re-order level, ABC analysis. Logistics and Franchising. Purchasing Management – Objectives, Functions, Methods, Procedure, and Value Analysis: Concepts, Stock Control Systems, Virtual Factory Concept and Production Worksheets.

Recommended Books:

1. Robbins, SP, Coulter M, "Management". Pearson Prentice Hall.
2. Robbins SP, Judge TA, "Organizational Behavior". Pearson Publication
3. Koontz H, Weihrich H, "Essentials of Management". Tata McGraw Hill.

BPL3329	**Pharmaceutical Product Management – Elective II**	**4-0-0**	**4 Credits**

Course Learning Outcomes:

After successful completion of the course student will be able to:

CLO 01: understand the concept of product, selling and product environment.

CLO 02: analyze the competitive and consumer buying behavior.

CLO 03: study various qualitative and quantitative aspects related to size and composition of market.

CLO 04: study various pharmaceutical product channels to become an entrepreneaur.

CLO 05: understand Vertical and Horizontal Product concepts.

Syllabus Content:

Product: Definition, general concepts and scope of product; Distinction between product and selling; Product environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior.

Pharmaceutical product: Quantitative and qualitative aspects; size and composition of the product; demographic descriptions and socio-psychological characteristics of the consumer; product segmentation and targeting. Consumer profile; Motivation and prescribing habits of the physician; patient's choice of physician and retail pharmacist. Analyzing the Product; Role of product research.

Product decision: Classification, product line and product mix decisions, product lifecycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.

Promotion: Methods, determinants of promotional mix, promotional budget; An overviewof personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.

Pharmaceutical product channels: Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.

Professional sales representative (PSR): Duties of PSR, purpose of detailing, selection and training, supervising, normsfor customer calls, motivating, evaluating, compensation and future prospects of the PSR.

Pricing: Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of

DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).

Emerging concepts in product: Vertical and Horizontal Product; Rural Product; Consumerism; Industrial Product; Global Product.

Recommended Books: (Latest Editions)

1. Philip Kotler and Kevin Lane Keller: Product Management, Prentice Hall of India, New Delhi
2. Walker, Boyd and Larreche: Product Strategy-Planning and Implementation, Tata MC GrawHill, New Delhi.
3. Dhruv Grewal and Michael Levy: Product and Marketing, Tata MC GrawHill
4. Arun Kumar and N Menakshi: Product Management,Vikas Publishing, India
5. Rajan Saxena: Product Management; Tata MC Graw-Hill (India Edition)
6. Ramaswamy, U.S and Nanakamari, S: Product Management: Global Perspective, Indian Context, Macmilan India, New Delhi.
7. Subba Rao Changanti, Pharmaceutical Product in India (GIFT–Excel series) Excel Publications.

BPL3328	Medicinal Chemistry-II	4-0-0	4 Credits

Course Learning Outcomes:

Students will:

CLO1: learn and gain knowledge about chemistry of various steroid related drugs.

CLO2: gain knowledge about chemistry of general and local anesthetics.

CLO3: gain knowledge about chemistry of sedative & hypnotics, anticonvulsants and antitussives.

CLO4: understand medicinal chemistry of various psychopharmacological agents.

CLO5: understand medicinal chemistry of various diuretics and its employability in SAR.

CLO6: gain knowledge about chemistry of various drugs acting on cardiovascular system.

Syllabus Content:

Introduction: Structure, Stereochemistry, Nomenclature, Synthesis of specified drugs (given in parenthesis), mode of action, Structure Activity Relationships (if any) uses and **Physicochemical properties of the following classes of drugs:** Steroids: Biosynthesis of Cholesterol; Estrogens (Oestradiol), Nonsteroidal estrogens (Stilboesterol), Antiestrogens, Progestogens, (progesterone from stigmasterol), Synthetic Progesterone (norethisterone), antiprogestogens, oral contraceptives, androgens (biosynthesis of testosterone and its synthesis from diosgenin).

General Anaesthetics: Inhalational anaesthetics, Intravenous anesthetics. Local Anaesthetics: Esters (Benzocaine), Amides (Lignocaine). Hypnotics and Sedatives: Barbiturates (Phenobarbitone); benzodiazepines (Nitrazepam). Anticonvulsants: Barbiturates; Hydantoin (Phenytoin); Oxazolidinediones (Troxidone);

Benzodiazepines and Carbamazepine. Antitussive: Centrally acting Antitussive, Opium alkaloids and related agents and Synthetic Antitussives, Peripherally acting antitussives and Expectorants. Central Nervous System Stimulants: Natural and Synthetic (Nikethamide); methylxanthines (Theophyllines) and Modified methylxanthines. Psychopharmacological Agents: Antipsychotic agents: Phenothiazines (chlorpromazine); butyrophenones and miscellaneous; Antidepressants: Tricyclic antidepressants (Amitryptyline), Atypical antidepressants; Monoamine oxidase inhibitors;

Anxiolytics: Meprobamate and related drugs (Meprobamate); benzodiazepines (Diazepam). Diuretics: Carbonic anhydrase inhibitors (Acetazolamide); Thiazides and related drugs (Bendrofluazide); High ceiling diuretics (Furosemide), Aldosterone antagonists (spironolactone); other potassium sparing diuretics and osmotic diuretics. Cardiovascular agents: Cardiac glycosides; Antihypertensive agents; Antianginals and vasodilators; Antiarrhythmic drugs; Antihyperlipidemic drugs.

Recommended Books:

1. Wilson & Gisvold's, "Textbook of Organic Medicinal and Pharmaceutical Chemistry", Lippincott Williams & Wilkins, Philadelphia.
2. Foye's, "Principles of Medicinal Chemistry", Sixth Edition, Wolters Kluwer (India), Lea & Febiger, Philadelphia.
3. Singh H, Kapoor VK, "Medicinal and Pharmaceutical Chemistry", Vallabh Prakashan, Delhi, 2005.
4. Sriram D, Yogeshwari P, "Medicinal Chemistry". Dorling Kindersley, Pearson Education, New Delhi.

BPP3328	Medicinal Chemistry-II Practical	0-0-4	2 Credits

Course Learning Outcomes:

Students will

CLO1: learn and gain skills about various stereo models for drugs.

CLO2: understand about synthesis of selected drugs.

CLO3: gain skills on spectral analysis of selected drugs.

CLO4: understand about pharmacopoeial standards for drugs synthesized.

CLO5: gain skills on stereochemistry model.

Syllabus Content:

Workshop on stereo model use of some selected drugs.

Synthesis of selected drugs from the course content involving two or more steps and their spectral analysis.

Establishing the Pharmacopoeial standards of the drugs synthesized.

Recommended Books

1. Furniss BS, Hannaford AJ, Smith PWG, Tatchell AR, "Vogel's Textbook of Practical Organic Chemistry". John Wiley and Sons.

2. Singh HK, Kapoor VK, "Practical Pharmaceutical Chemistry". Vallabh Prakashan, New Delhi.

3. Mann FG, Saunders BC, "Practical Organic Chemistry". Orient Longman Pvt. Ltd., Hyderabad.

4. Kar A, "Advanced Practical Medicinal Chemistry". New Age International, New Delhi.

BPPR3219	Project-III	10 hrs	5 Credits

Course Learning Outcomes:

Students will

CLO1: understand the principles of various titrations and solubility analysis.

CLO2: gain knowledge of chromatography and stereochemistry of organic compounds and proteins.

CLO3: study the properties of colloidal dispersions.

CLO4: gain knowledge about stability of emulsion and suspensions.

CLO5: gain knowledge and develop skills about Drug Regulatory Agencies and NDA.

CLO6: understand features of various regulatory and skill requirements in quality management system.

Syllabus Content:

In this student will submit the projects which cover basic understanding of principles of various titrations, solubility analysis, chromatography, stereochemistry of organic compounds, proteins, properties of colloidal dispersions, ideal solution, stability of emulsion and suspensions.

Value Added Course

Name of the course	AI and Machine Learning in Healthcare
Duration	30 Hrs
Offering Department	School of Pharmacy, Chitkara University
Name of the faculty	Dr. Amit Chaudhary
Course Outcome	After completion of the course on AI and MI in healthcare, students will be able to use these technologies to enhance patient care, streamline healthcare procedures, and contribute to advancements in the pharma field.
Course Contents	**Introduction to AI and Machine learning in Healthcare:** Introduction, Overview of AI and MI, Importance and relevance in healthcare, Ethics-related issues and difficulties. This will prepare students to learn about AI and MI and knowledge about its applications in healthcare **Machine Learning Fundamentals:** General introduction about fundamentals of machine learning, Model evaluation and validation. This course will help pharma students about how to learn innovations and new approaches in healthcare by using AI and Machine Learning. **Applications of AI & Machine learning in Healthcare:** Electronic health record analysis, Drug discovery and development, Remote patient monitoring, Role of AI in drug discovery **AI in healthcare: Ethics and rules:** Patient data privacy and other regulations, Ethical AI development and deployment This course will provide knowledge to the students about certain ethical rules and regulation of implementation of AI &MI in healthcare
Method of Assessment	Quiz and Group Discussion
Recommended	• Artificial Intelligence in Healthcare: A Comprehensive Survey" by Dr. Dipti Srinivasan and Dr. Kamala Krithivasan • Deep Learning for Healthcare by Disha S. Mookerjee and Nikhil

Reading Books	Gargeya • AI in Healthcare: Building the Future of Healthcare with Artificial Intelligence" by Dr. Pradeep Chowriappa • Deep Learning for Medical Image Analysis by Gustavo Carneiro, Bogdan Georgescu, and Sean Zhou (1st Edition) • Machine Learning for Healthcare: A Comprehensive Guide by Arjun Panesar, Bharat Rao, and Pranav Rajpurkar (1st Edition) • Machine Learning and Medical Imaging by Zahra S. Dizaji, Anand Paul, and Krishnendu Chakrabarty (1st Edition)
Certificate:	A certificate will be issued by Chitkara University after successful completion of the course.

Name of the course	Quality by Design (QbD)
Duration	30 Hrs
Offering Department	School of Pharmacy, Chitkara University
Name of the faculty	Dr. Divya Dheer
Course Outcome	After completion of this course, students will be able to learn about the benefits of exploring Quality by Design (QbD) in the pharmaceutical industry primarily focusing on research and development.
Course Contents	• **Quality by Design (QbD):** Introduction and its application in Pharmaceutical Research and Development. Pharmaceutical Formulation & Analytical Method Development basics. • **ICH QSEM guidelines**: ICH guidelines Q8 to Q11 in detail for product and method development. • **Quality by design (QbD) and process analytical technology (PAT):** QbD and AQbD In Pharmaceutical Development, Current approach and its limitations, FDA initiative, Requirement of QbD, Advantages, Elements of QbD, Terminology: QTPP, ATP (Analytical Target Profile), CQA, Risk Assessment, Formulation and Method Optimization and Development with DoE, MODR (method operable design region), Control Strategy and Risk Assessment, AQbD Method Validation, and Continuous Method Monitoring • **Optimization** techniques in Pharmaceutical Formulation and method development: Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Statistical design, Response surface method, Contour designs, Factorial designs and application in formulation and method development • **Statistical Parameters:** Techniques with special reference to ANOVA method. Case Study
Method of Assessment	Quiz and Group Discussion
Recommended	• Lionberger RA, Lee LS, Lee L, Raw A,Yu LX. Quality by design: Concepts for ANDAs. The AAPS Journal 2008; 10: 268–276.

Reading Books	• Looby M, Ibarra N, Pierce JJ, Buckley K, O'Donovan E, Heenan M. Application of quality by design principles to the development and technology transfer of a major process improvement for the manufacture of a recombinant protein. Biotechnology Progress 2011;27:1718-29. • Q9: Quality Risk Management. ICH Harmonized Tripartite Guidelines. International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use, 2006. • Q10: Pharmaceutical Quality System, ICH Tripartite Guidelines. International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use, 2007. • Q8 (R1): Pharmaceutical Development, Revision 1, ICH Harmonized Tripartite Guidelines, International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use, 2007.
Certificate:	A certificate will be issued by Chitkara University after successful completion of the course.

Name of the course	Health and Well being
Duration	30 Hrs
Offering Department	School of Pharmacy, Chitkara University
Name of the faculty	Dr. Komal Thapa
Course Outcome	After completion of this course, students will be able to deal moreeffectively with the health problems faced during the college experience, and subsequently throughout life.These issues may include stress, sexuality, nutrition, mental health and illness, aging, chronic andcommunicable disease, drug, and alcohol use, and dealing with death, and another selected topic
Course Contents	**Introduction to Health and Wellness** 1. Defining Health and Wellness 2. Personal Health Assessment 3. Factors Contributing to Health Behavior Change **Mental Health** 1. Defining Mental Health a. Characteristics of the Mentally Healthy 2. Major Mental Disorders a. Depressive Disorders b. Suicide c. Eating disorders 3. Types of Therapy and Self-Help **Stress** 1. Stress Defined 2. Causes of Stress a. Life Events and Daily Hassles b. Social Stressors c. Time Management Problems d. College Stressors 3. Coping with Stress

	a. Deep Breathing b. Muscle Relaxation c. Meditation **Nutrition** 1. Introduction to Nutrition & Eating Right a. Food Pyramid b. Serving Size 2. The Six Nutrients 3. Eating for Good Health & Disease Prevention a. Cancer/Heart Disease & Nutrition 4. Obesity, Weight Management & Nutrition a. Diets and Dieting
Method of Assessment	Quiz and Group Discussion
Recommended Reading Books	• Tripathi, K. D. (2022). Essentials of Medical Pharmacology. Jaypee Brothers. • Craig, C. R & Stitzed, R. E. (2012). Modern Pharmacology with clinical Applications. Wolters Kluwer. • Rang, H. P., Dale, M. M., Ritter, J. M., Flower, R. J. (2019) Rang and Dale's Pharmacology. Elsevier • Katzung, B. G., Masters, S. B. & Trevor A.J. (2020). Basic and Clinical Pharmacology. Tata Mc Graw • Marry,K. K., et Applied Therapeutics, The Clinical use of Drugs, Lippincott.
Certificate:	A certificate will be issued by Chitkara University after successful completion of the course.

Name of the course	Laboratory Safety Guidelines
Duration	30 Hrs
Offering Department	School of Pharmacy, Chitkara University
Name of the faculty	Dr. Deepak Yadav
Course Outcome	After completion of this course, students will be able to learn about lab safety culture, precautionary labels, Material Safety Data Sheets, using personal protective equipment, handling labequipment safely, handling, storing and disposing of chemicals safely, using emergency equipment as well as safety planningthe basic safety rules in the laboratory.
Course Contents	**Chemical Labeling & Safety** Demonstrate safe handling of chemicals and equipment in the laboratory.Material safety data sheets **Good Laboratory Practice, LIMS& Fire Safety** Demonstrate knowledge of Good Laboratory Practices (GLPs)and Fire Safety, Maintenance of Equipments **Emergency Equipment & Standard Operating Procedures** Recognize and maintain various PPE and emergency equipment in a laboratory setting as well as evaluating Standard Operating Procedures (SOPs) and safety plans.
Method of Assessment	Quiz and Group Discussion
Recommended Reading Books	• CRC Handbook of Laboratory Safety, 5th Edition, By A. Keith Furr · 2000 • Handbook of Laboratory Health and Safety Measures, 2013, S. B. Pal • Laboratory Biosafety Manual, Third Edition,By World Health Organization · 2004 • Laboratory Safety Manual, Institute of Advanced Study in Science and Technology (IASST), Paschim Boragaon, Garchuk, Guwahati

	• Laboratory Safety Manual, National Centre for Biological Sciences (NCBS) Laboratory Safety Manual, Environmental Health and Safety Department, University of Washington • Laboratory Safety Handbook, Sabanci University Istanbul
Certificate:	A certificate will be issued by Chitkara University after successful completion of the course.

13. APPENDIX A MAPPING OF PROGRAMME OUTCOMES WITH COURSE OUTCOMES

Sr. No.	Course Name	Course code	Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1.	Introduction to Pharmaceutical Sciences	BPL3101	**CLO 01:** Students will understand various types of routes for administration of drugs.	H	M	L	L		M	
			CLO 02: Students will formulate, prepare and evaluate various types of dosage forms	H	L	M			H	
			CLO 03: Students will remember the basics of quality control and know about various techniques of analysis.	M	M	H	L	L		
			CLO 04: Students will understand basic concepts of formulations and its employability in quality control.	H	H	M	M		H	
			CLO 05: Students will analyze the various techniques used in formulation development	H	M	M		L	L	
2.	Pharmaceutical Chemistry-I	BPL3103	**CLO 01:** Students will understand various concepts of acid-bases and buffers		L				M	
			CLO 02: Students will understand about chemistry of various inorganic pharmaceutical agents.				L	H	M	
			CLO 03: Students will remember the basics of various aromatic and heterocyclic compounds.			L			M	
			CLO 04: Students will understand basic concept of electrolytes and metal ions.	H	M	M			M	
			CLO 05: Students will gain knowledge about analysis and become employable in different chemical techniques.	H	H			M	M	
3.	Physical Chemistry	BPL3105	**CLO 01:** Students will remember various concepts of laws of thermodynamics and Carnot cycle.			M				L

			CLO 02: Students will understand about various types of colligative properties of solutions.			L				L
			CLO 03: Students will apply basics of electrochemistry techniques and photochemistry laws.			M				L
			CLO 04: Students will understand basics of phytochemistry laws.	H		H	M		M	
			CLO 05: Students will remember Rate laws and become employable in research analytics.		H	M	H		H	
4.	Industrial Safety and Environment Sciences	BPL3107	**CLO 01:** Students will gain knowledge about the environment and its allied problems.		M			M	H	
			CLO 02: Students will understand about industrial hazards and safety measures.	H				M	H	
			CLO 03: Students will understand effect of human population on environment.	H	H			L	H	
			CLO 04: Students will analyze social issues affecting environment.	H		M	H		L	
			CLO 05: Students will remember the basic concept of environmental entrepreneurship.	H	H			M	M	
5.	Pharmaceutical Chemistry-I Practical	BPP3103	**CLO 01:** Students will gain knowledge about various types of limit tests for impurities.			H			L	
			CLO 02: Students will improve skills of qualitative analysis of pharmaceutical products.	M		H			M	
			CLO 03: Students will gain hand on experience about tests for purity of pharmaceutical products.		M				M	
			CLO 04: Students will understand the preparation of inorganic pharmaceutical products.			H			M	

			CLO 05: Students will gain hand on experience on quantitative analysis of pharmaceutical products.			H			M	
6.	Basic Engineering Skills	BPL3111	**CLO 01:** Students will develop skills in tools handling.	H		H	M		M	
			CLO 02: Students will understand and develop skill in machines operation.		H	M	H		H	
			CLO 03: Students will understand concept of maintenance of equipments		H			M	H	
7.	Chemistry of Natural Products (CNP)	BPL3102	**CLO 01:** Students will understand various chemical and spectral approaches.						M	L
			CLO 02: Students will understand about stereoisomerism taking examples of natural products.		L				L	
			CLO 03: Students will remember pharmacology of various natural products.		H				M	L
			CLO 04: Students will understand chemistry of alkaloids and glycosides.		L	M			L	
			CLO 05: Students will understand chemistry of medicinally important compounds.			M				
			CLO 06: Students will analyze various antibiotics and employable research techniques.		L		M		L	
8.	Physical Pharmaceutics-I	BPL3104	**CLO 01:** Students will understand various properties of ideal gases.			L			L	
			CLO 02: Students will remember principles of matter and its states.	H		M				L
			CLO 03: Students will analyze about micromeretics and powder rheology.			L			M	
			CLO 04: Students will understand principles of viscosity and rheology in relation to drugs.			M	H		L	
			CLO 05: Students will		H	H				M

			remember various aspects of kinetics and drug stability.							
			CLO 06: Students will evaluate buffers and their pharmaceutical applications.		M	L			H	
9.	Physical Pharmaceutics-I Practical	BPP3104	**CLO 01:** Students will gain knowledge about particle size distribution and particle size analysis	H		M	H			
			CLO 02: Students will determine the derived properties of powders like densities, porosities, compressibility etc.		L				M	
			CLO 03: Students will gain hand on experience about preparation of various types of suspensions and determination of their sedimentation parameters.	L		H			M	
			CLO 04: Students will understand basic skills in the preparation of pharmaceutical buffers and determination of buffer capacity		H	M			L	
			CLO 05: Students will apply hand on experience on experiments involving tonicity adjustments.		L				L	
10.	Pharmaceutical Microbiology	BPL3106	**CLO 01:** Students will understand history of microbiology and biochemical organization of cell.	L					L	
			CLO 02: Students will analyze techniques for identification of microorganisms.		M					L
			CLO 03: Students will understand about cultivation of microorganisms.		H	L			M	
			CLO 04: Students will understand about microbial genetics and gene expression.		M	L			H	
			CLO 05: Students will learn various techniques of sterilization and its employability in sterility		M		H			L

			testing of pharmaceutical products.							
			CLO 06: Students will evaluate sterility testing of pharmaceutical products.		H	M		L		
			CLO 07: Students will understand about immunity and microbial resistance.		H		M			L
11.	Pharmaceutical Analysis-I	BPL3108	**CLO 01:** Students will understand the principles of acid base titrations.			L			M	
			CLO 02: Students will understand the principles of oxidation-reduction titrations.			L				M
			CLO 03: Students will remember and apply the principles of precipitation titrations.			M	H			
			CLO 04: Students will understand the principles of gravimetric analysis.			L		M		
			CLO 05: Students will apply principles of phase solubility analysis and its employability in research analytics.	H		M				
			CLO 06: Students will understand the principles of chromatography.			M			M	
12.	Mechanical Engineering	BPL3109	**CLO 01:** Students will apply knowledge and develop skills in selecting the machine elements.		H			H		
			CLO 02: Students will understand the structure and specification of mechanical transmission.			L				M
			CLO3: Students will learn the physical fundamentals of pneumatic equipments.			M				L
			CLO4: Students will understand the physical fundamentals of hydraulic equipments.		L				H	
13.	Project-I	BPPR3109	**CLO 01:** Students will understand and develop skills in the formulation of pharmaceutical dosage forms.	M		M			M	L
			CLO 02: Students will evaluate various	M		M			M	L

			pharmaceutical dosage forms.							
			CLO 03: Students will understand manufacturing and packaging operations.	L		L			M	L
			CLO 04: Students will gain knowledge about formulation methods.	M		M			M	M
			CLO 05: Students will analyze chemistry of various inorganic pharmaceutical agents.			M			M	L
			CLO 06: Students will remember features of various environmental hazards.	L		L	H		H	L
14.	Pharmaceutical Chemistry-II (Organic Chemistry)	BPL3211	**CLO 01:** Students will understand basic facts related to structure and properties of organic compounds			M			H	
			CLO 02: Students will gain knowledge about preparation and properties of aldehydes and ketones.		L		M			
			CLO 03: Students will gain knowledge about stereochemistry and its employability in organic chemistry.		H	L			M	
			CLO 04: Students will learn nomenclature, preparation and reactions of alkane	H		M	L			
			CLO 05: Students will gain knowledge about chemistry and analysis of proteins and peptides.			H	M		M	
			CLO 06: Students apply knowledge about preparation and reactions of alcohols and ethers.			L			M	
15.	Physical Pharmaceutics-II	BPL3213	**CLO 01:** Students will understand various physicochemical properties of drug molecules and learn various skills in pharmaceutical formulation.		L	M		H		
			CLO 02: Students will gain knowledge various		L			H		

			properties of colloidal dispersions							
			CLO 03: Students will gain knowledge about formulation and stability suspensions and emulsions	H		L				
			CLO 04: Students will understand mechanism of solute-solvent interactions.		H	M		L		
			CLO 05: Students will understand properties of ideal and real solutions.		H	M			L	
			CLO 06: Students will remember distribution law and its applications.			L				M
16.	Pharmaceutical Operation-1	BPL3215	**CLO 01:** Students will understand various types of fluid flow and material handling.			M				L
			CLO 02: Students will understand various filtration, centrifugation techniques and its employability.		L				H	
			CLO 03: Students will gain knowledge about dehumidification and humidity control		H					M
			CLO 04: Students will understand about refrigeration, air conditioning and various employable techniques.			M			L	
			CLO 05: Students will develop skills in determining humidity-use of Dry Bulb and Wet Bulb.		H		M			
17.	Pharmaceutical Operation-1 Practical	BPP3215	**CLO 01:** Students will gain knowledge about flow of fluids and their pressure.			M				L
			CLO 02: Students will evaluate filter media, determination of filtration rate and factors affecting filtration			M		H		
			CLO 03: Students will be able to demonstrate			H				M

			and gaining skills in applications of centrifugation.							
			CLO 04: Students will be able to study about thermometers and psychometric charts.					M	L	
			CLO 05: Students will apply skills in determining humidity- use of Dry Bulb and Wet Bulb.			M	H			
18.	Pharmaceutical Regulatory Affairs	BPL3217	**CLO 01:** Students will understand Drugs and Cosmetics Act 1940.			M		H		
			CLO 02: Students will understand The Patents and Designs Act 1970		L			H		
			CLO 03: Students will gain knowledge about various Drug Regulatory Agencies globally.	M				H		
			CLO 04: Students will understand about preparation of documents for New Drug Application (NDA).				H	H		M
			CLO 05: Students will learn about patent filing procedure and become employable in patent filing.				H			M
			CLO 06: Students will remember about harmonization of the regulatory requirements and its employability in quality management system.				H			M
19.	Physiology and Pharmacology-I	BPL3212	**CLO 01:** Students will understand about gastrointestinal and respiratory system.	H			M			
			CLO 02: Students will gain knowledge about CNS and ANS.	H			M		L	
			CLO 03: Students will learn urinary system and its disorders.		H			L		
			CLO 04: Students will gain knowledge about reproductive & endocrine system and	H					L	

			sense organs.							
			CLO 05: Students will understand various food requirements and its employability.		H		M			
			CLO 06: Students will gain knowledge about various communicable diseases.	H			M		L	
20.	Physiology and Pharmacology-I Practical	BPP3212	**CLO 01:** Students will gain knowledge about different types of tissues and develop skills for its identification.		H		L			M
			CLO 02: Students will learn to determine the bleeding, clotting time and develop skills for its determination.			H				
			CLO 03: Students will gain hand on experience to estimate haemoglobin value and blood pressure.	M		H		L		
			CLO 04: Students will understand the properties of drugs and the ways in which these properties react along with their mechanisms of action.			H	L			
			CLO 05: Students will understand the experiments on detection of blood groups and measurement of erythrocyte sedimentation rate.		M	H			M	
21.	Biochemistry	BPL3214	**CLO 01:** Student will understand major pathways of carbohydrates metabolism.	H				L		
			CLO 02: Student will gain knowledge on major pathways and its employability in lipid metabolism.	H		M			L	
			CLO 03: Student will gain knowledge about biological oxidation (respiratory chain).			M	L			
			CLO 04: Student will understand biosynthesis of amino acid, and urea cycle, metabolic disorder of urea cycle.		H	M			M	

			CLO 05: Student will gain knowledge about the metabolism of sulphur containing amino acid.			M		L		
			CLO 06: Student will understand genetic organization of mammalian genome and mechanism of enzyme action.			M	L		H	
22.	Pharmaceutical Process-I	BPL3216	**CLO 01:** Students will understand liquid dosage forms and gaining entrepreneurship in formulation development.	H		L			M	
			CLO 02: Students will gain knowledge about formulation of semi solid dosage forms.		H	L			M	
			CLO 03: Students will gain knowledge about formulation of pharmaceutical aerosols.		H	M		M		
			CLO 04: Students will understand the concept of cosmetology and its formulation methods.		H	L				M
			CLO 05: Students will understand various novel drug delivery system.		H				L	
			CLO 06: Students will apply knowledge about bioavailability and bioequivalence.			M				H
23.	Industrial Pharmacy & Packaging Technology	BPL3218	**CLO 01:** Students will understand various building premises.				H			L
			CLO 02: Students will understand testing of various pharmaceutical dosage forms	L				M		
			CLO 03: Students will study manufacturing and packaging operations.				H	M		
			CLO 04: Students will gain knowledge about pharmaceutical packaging and concept of entrepreneurship.					M		H
			CLO 05: Students will gain knowledge about pharmaceutical machinery.	M			H			
			CLO 06: Students will	L		M			H	

			understand features of pharmaceutical containers and types of the corrugation methods.							
24.	Electrical and Electronics Engineering	BPL3222	**CLO 01:** Students will understand and develop skills related to basic electrical engineering parameters		H		M			L
			CLO 02: Students will understand the electrical safety			L				M
			CLO 03: Students will understand the concept of electrical supply system			M				L
			CLO 04: Students will understand about various power distribution systems		L				H	
			CLO 05: Students will understand and develop skills related to AC, DC motors and electromagnetism.		M	L			M	
25.	Project-II	BPPR3110	**CLO 01:** Students will learn various chemical and spectral approaches.		M	L			M	
			CLO 02: Students will understand about alkaloids and glycosides.		M	M				
			CLO 03: Students will study about the pharmacological activity of antibiotics.	M	H		M			
			CLO 04: Students will gain knowledge and develop skills about the aspects of kinetics.			H	M			M
			CLO5: Students will study about micromeritics.		L	L				
			CLO 06: Students will identify microorganism and cultivation of microorganisms.						L	
26.	Pharmaceutical Quality Assurance	BPL3321	**CLO 01:** Students will understand various types of validation and its employability in quality assurance.			M	M			
			CLO 02: Students will gain knowledge about utilities validation and cleaning validation	H		M	M			
			CLO 03: Students will	H		H	M			

			understand about pharmaceutical quality audits.							
			CLO 04: Students will learn about quality management, complaints and recalls			M	L		H	
			CLO 05: Students will understand about quality control laboratory.			M	M	H		
27.	Medicinal Chemistry-I	BPL3323	**CLO 01:** Students will understand various techniques of drug design, physiochemical properties of drugs and chemistry of vitamins.	L		H			M	
			CLO 02: Students will learn drugs related to adrenergic and cholinergic system.		M		H	M		
			CLO 03: Students will understand medicinal chemistry of antispasmodic-antiulcer, antiparkinson's and neuromuscular blocking agents	L		H	M			
			CLO 04: Students will understand medicinal chemistry of antihistaminic drugs.		L	H			M	
			CLO 05: Students will learn pharmacology of analgesics and non-steroidal anti-inflammatory agents and its employability in medicinal chemistry.		L	M	H			
28.	Pharmaceutical Process-II	BPL3325	**CLO 01:** Students will understand formulation methods of Capsules	M					L	
			CLO 02: Students will gain knowledge about microencapsulation technique and coating methods.	L			H	M		
			CLO 03: Students will gain knowledge about evaluation of micro capsules.	L		M		H	M	
			CLO 04: Students will gain knowledge about formulation of tablets and granulation technology	L					M	

			CLO 05: study about various pre-formulation factors and different routes of drug administration	L	H				M	
			CLO 06: Students will gain knowledge about aseptic areas and importance of pharmaceutical enterpreneurship.	H	M	M		H		
29.	Pharmaceutical Analysis-II	BPL3327	**CLO 01:** Students will learn about non-aqueous titrations.		L	H				
			CLO 02: Students will gain knowledge about various miscellaneous methods of analysis.		M	H				
			CLO 03: Students will understand about electrochemical methods of analysis		L	M	L			
			CLO 04: Students will understand the concept and applications of spectrophotometry		L	H	H			
			CLO 05: Students will gain knowledge about various extraction methods.		L	H	L			
			CLO 06: Students will learn about HPLC and its employability in analysis.	M			H			H
30.	Pharmaceutical Analysis-II Practical	BPP3327	**CLO 01:** Students will gain skills on preparation and standardisation of analytical reagents.		L	H	M			
			CLO 02: Students will learn on estimation of pharmacopoeial products.		M	H				
			CLO 03: Students will gain skills of miscellaneous methods of analysis.		L	M	L			
			CLO 04: Students will gain skills on various separation techniques.		L	H	H			
			CLO 05: Students will learn on various electrochemical methods of analysis. Syllabus		L	H	L			
	Medicinal	BPP3323	**CLO 01:** Students will		L	H	M			

31.	Chemistry-I Practical		learn hands on experience of various *in silico* models for prediction of ADMET and activity							
			CLO 02: Students will have hands on experience on synthesis and spectral analysis of some selected drugs		M	H				
			CLO 03: Students will gain skills on establishing of pharmacopoeial standards of the drugs synthesized.		L	M	L			
			CLO 04: Students will gain skills in determining partition coefficient, dissociation constant and molar constant		L	H	H			
			CLO 05: Students will understand basic concept of chemical synthesis and research applications.	H			M		L	
32.	Measurement and Measuring Instruments	BPL3331	**CLO 01:** Students will understand and develop skills in basic measurements.			M				L
			CLO2: Students will learn the concept of theory of errors.		L				H	
			CLO3: Students will understand the working of Air type level measuring instrument		M	L			M	
			CLO4: Students will be able to measure the pressure and strain using different equipments		M		L		H	
			CLO5: Students will learn how to calibrate and validate the systems followed by records	M		M	H			
33.	Dosage Form Design	BPL3322	**CLO 01:** Students will understand about preformulation studies.	H	H				M	M
			CLO 02: Students will gain knowledge about applications of pro-drugs.		L	H	M			
			CLO 03: Students will gain knowledge about validation and stability		M	H				

			studies.							
			CLO 04: Students will learn about performance evaluation methods and its employability in various quality control methods.		L	M	L			
			CLO 05: Students will understand biopharmaceutics classification scheme and bioavailability.		L	H	H			
			CLO 06: Students will gain knowledge about quality by design and various optimization techniques.		H	H			M	M
34.	Dosage Form Design- Practical	BPP3322	**CLO 01:** Students will understand about various preformulation studies.	H	H			L	H	
			CLO 02: Students will gain skills related to bioavailability improvement through prodrugs.	H		M	H		L	
			CLO 03: Students will learn and gain knowledge on stability studies.	H	H			M	M	
			CLO 04: Students will gain skills on dissolution testing.			H			L	
			CLO 05: Students will learn and analyze bioequivalence studies.			H			M	
35.	Pharmaceutical Operation-II	BPL3324	**CLO 01:** Students will understand gain knowledge about stoichiometry.		L				M	
			CLO 02: Students will gain knowledge about heat transfer.			H			M	
			CLO 03: Students will understand about evaporation techniques.	H	H			L	H	
			CLO 04: Students will gain knowledge about distillation and its applications.	H		M	H		L	
			CLO 05: Students will gain knowledge about various drying methods and basic concept of entrepreneurship.	H	H			M	M	
			CLO 06: Students will learn and gain			H			L	

			knowledge about size reduction, size separation and mixing techniques.							
36.	Pharmaceutical Operation Management-Elective I	BPL3326	**CLO 01:** Students will understand the concept management.			H			M	
			CLO 02: Students will gain knowledge about operations management.			H			M	
			CLO 03: Students will gain knowledge about quality management including TQM.		L			M		
			CLO 04: Students will understand the concept of production management.				H		L	
			CLO 05: Students will understand and gain knowledge about JIT and lean production system and importance of industrial entrepreneurship.			M		M		
			CLO 06: Students will gain knowledge about purchasing management.		M			H		
37.	Pharmaceutical Product Management-Elective II	BPL3329	**CLO 01:**understand the concept of marketing, selling and marketing environment	H			M			
			CLO 02: analyze the competitive and consumer buying behavior.	H		M				L
			CLO 03: study various qualitative and quantitative aspects related to size and composition of market.		H			M		
			CLO 04: study various pharmaceutical marketing channels to become an entrepreneaur	H			L			M
			CLO 05: understand Vertical and Horizontal Marketing concepts.			H		L		
38.	Medicinal Chemistry-II	BPL3328	**CLO 01:** Students will learn and gain knowledge about chemistry of various steroid related drugs.	M						M
			CLO 02: Students will gain knowledge about chemistry of general and				M			

			local anesthetics.							
			CLO 03: Students will gain knowledge about chemistry of sedative & hypnotics, anticonvulsants and antitussives.					M	M	
			CLO 04: Students will understand medicinal chemistry of various psychopharmacological agents.				H			
			CLO 05: Students will understand medicinal chemistry of various diuretics and its employability in SAR.			M				
			CLO 06: Students will gain knowledge about chemistry of various drugs acting on cardiovascular system.			M	M			
39.	Medicinal Chemistry-II-Practical	BPP3328	**CLO 01:** Students will learn and gain skills about various stereo models for drugs.			M	M			
			CLO 02: Students will understand about synthesis of selected drugs.			H	M			
			CLO 03: Students will gain skills on spectral analysis of selected drugs.			M	L			
			CLO 04: Students will understand about pharmacopoeial standards for drugs synthesized.			M	M			
			CLO 05: Students will gain skills on stereochemistry model.	L						L
40.	Project-III	BPPR3219	**CLO 01:** Students will understand the principles of various titrations and solubility analysis		M					
			CLO 02: Students will gain knowledge of chromatography and stereochemistry of organic compounds and proteins.			L				L
			CLO 03: Students will study the properties of colloidal dispersions.	L				H		
			CLO 04: Students will			M		L		

			gain knowledge about stability of emulsion and suspensions.							
			CLO 05: Students will gain knowledge and develop skills about Drug Regulatory Agencies and NDA.		H					L
			CLO 06: Students will understand features of various regulatory and skill requirements in quality management system.			M				H