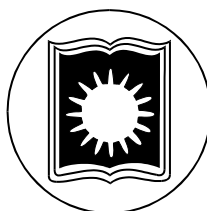


Syllabus for B. Pharm. (Honours)
Session: 2013-2014
Examination- 2017



DEPARTMENT OF PHARMACY
FACULTY OF SCIENCE
UNIVERSITY OF RAJSHAHI
RAJSHAHI-6205, BANGLADESH

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FACULTY OF SCIENCE
DEPARTMENT OF PHARMACY
Syllabus for B. Pharm. (Honours)
Session: 2014-2017

Examination:

B. Pharm. (Honours) Part-I : 2014
B. Pharm. (Honours) Part-II: 2015
B. Pharm. (Honours) Part-III: 2016
B. Pharm. (Honours) Part-IV: 2017

The B. Pharm. (Honours) courses Pharmacy consists of total 160 credits of 4000 marks (40 units) spread over four academic years. No students shall be allowed to stay for more than two academic years in each of the 1st, 2nd and 3rd year of the program. There shall be theoretical, practical, viva-voce, class assessment/ tutorial/ terminal/ home assignment, project/ in-plant training and related subjects.

An honours student, for obtaining the degree, shall have to pass all the examinations within 6 (six) academic years from the date of his/ her first admission and shall not be allowed to stay for more than 2 (two) academic years in each of his/ her first, second, and third year honours classes. The non-credit English course shall have to be passed in 4 (four) academic years from the date of his/ her admission.

The duration of examination of the theory courses shall be 3 and 4 hours for 0.50 and 1.00 unit courses, respectively. The duration of practical examination shall be 6-12 and 12-24 hours (4-6 hours per day) per 0.50 and 1.00 unit practical courses, respectively. For other fractions of a unit, proportionality shall be applied.

The year-wise distribution of marks among the theory, practical, viva-voce, class assessment/ tutorial/ terminal/ home assignment, thesis/ dissertation/ project/ in-plant training, etc. are as follows:

B. Pharm. (Honours) Part- I Examination, 2014

Course	Unit	Marks	Credit
Theory	7	700	28
Practical	1.5	150	6
Viva	0.5	50	2
Class record	0.5	50	2
Total	9.5	950	38

Course	Course Title	Unit	Mark	Credit
101	Inorganic Pharmaceutical Chemistry-I	1	100	4
102	Organic Pharmaceutical Chemistry-I	1	100	4
103	Physical Pharmacy-I	1	100	4
104	Pharmacognosy-I	1	100	4
105	Physiology and Biochemistry-1	1	100	4
106	Pharmaceutical Microbiology and Immunology	1	100	4
107	Biostatistics and Computer Science	1	100	4
108	English (Noncredit) ¹	1	100	0
109	Practical ²	1.5	150	6
110	Viva-Voce (General)	0.5	50	2
111	Class assessment/ tutorial/ home assignment/ attendance ³	0.5	50	2
	Total	9.5	950	38

B. Pharm. (Honours) Part-II Examination, 2015

Course	Unit	Marks	Credit
Theory	7	700	28
Practical	1.5	150	6
Viva	0.5	50	2
Class record	0.5	50	2
Total	9.5	950	38

Course	Course Title	Unit	Mark	Credit
201	Inorganic Pharmaceutical Chemistry-II	1	100	4
202	Organic Pharmaceutical Chemistry-II	1	100	4
203	Physical Pharmacy-II	1	100	4
204	Pharmacognosy-II	1	100	4
205	Physiology and Biochemistry-II	1	100	4
206	Pharmacology-I	1	100	4
207	Pharmaceutical Technology-I	1	100	4
208	Practical ²	1.5	150	6
209	Viva-Voce (General)	0.5	50	2

210	Class assessment/ tutorial/ home assignment/ attendance ³	0.5	50	2
	Total	9.5	950	38

B. Pharm. (Honours) Part-III Examination, 2016

Course	Unit	Marks	Credit
Theory	6 x 1 = 6	600	24
	3 x 0.5 = 1.5	150	6
Practical	2	200	8
Viva	0.5	50	2
Class record	0.5	50	2
Total	10.5	1050	42

Course	Course Title	Unit	Marks	Credit
301	Pharmaceutical Analysis-I	1	100	4
302	Medicinal Chemistry-I	1	100	4
303	Pharmacology-II	1	100	4
304	Biopharmaceutics-I	1	100	4
305	Pharmaceutical Engineering	1	100	4
306	Pharmaceutical Technology-II	1	100	4
307	Cosmetology	0.5	50	2
308	Hospital and Community Pharmacy	0.5	50	2
309	Quality Control, Quality Assurance & Validation	0.5	50	2
310	Practical ²	2	200	8
311	Viva-Voce (General)	0.5	50	2
312	Class assessment/ tutorial/ home assignment/ attendance ³	0.5	50	2
	Total	10.5	1050	42

B. Pharm. (Honours) Part-IV Examination, 2017

Course	Unit	Marks	Credit
Theory	6 x 1 = 6	600	24
	3 x 0.5 = 1.5	150	6
Practical	2	200	8
Viva	0.5	50	2
Class record	0.5	50	2
Total	10.5	1050	42

Course No	Course Title	Unit	Marks	Credit
401	Pharmaceutical Analysis-II	1	100	4
402	Medicinal Chemistry-II	1	100	4
403	Pharmacology-III	1	100	4
404	Biopharmaceutics-II	1	100	4
405	Pharmaceutical Technology-III	1	100	4
406	Molecular Biology and Biotechnology	1	100	4
407	Organic Spectroscopy	0.5	50	2
408	Clinical Pharmacy and Pharmacy Law & Ethics	0.5	50	2
409	Pharmaceutical Marketing and Management	0.5	50	2
410	Practical ²	2	200	8
411	Viva-Voce (General)	0.5	50	2
412	Class assessment/ tutorial/ home assignment/ attendance ³	0.5	50	2
	Total	10.5	1050	42

¹ A Candidate shall not be allowed to continue the B.Pharm. Honours programmed if he/she fails to obtain the letter grade (LG) "S" in the English course in 4(four) academic years from the date of admission. The letter grade "S" corresponds to at least 30% marks.

² 30% of the total practical marks shall be allotted for continuous laboratory assessment.

³ 20% of the assessment marks shall be awarded for attendance in the class on the basis of the following table:

Table: Marks on attendance

Attendance	Marks	Attendance	Marks	Attendance	Marks
95-100%	20%	90-<95%	18%	85-<90%	16%
80-<85%	14%	75-<80%	12%	70-<75%	10%
65-<70%	8%	60-<65%	6%	<60%	00%

Eligibility for Examination:

Percentage of Attendance: In order to be eligible for taking up the B. Pharm. (Honours) examinations, a candidate must have pursued a regular course of study by attending not less than 75% of the total number of classes held (theoretical, practical, class assessment etc.) provided that the academic committee of the department on special grounds and on such documentary evidence that may be necessary, may condone the cases of shortage of attendance not below 60%. A candidate, appearing at the examination under the benefit of this provision shall have to pay in addition to the examination fees, the requisite fee prescribed by the syndicate for the purpose.

Candidates having less than 60% attendance shall not be allowed to fill up the examination form.

Readmission: A candidate, who failed to appear at the examination or fails to pass the examination, may on the approval of the relevant department be readmitted to the immediate following session in the first, second, third or fourth year of the program. A readmitted candidate shall have to reappear at all course examinations.

Medium of Questions and Answers:

Questions shall be made in English. The medium of answers in the examination of all courses shall be either English as directed by the department. However, a mixing of English and Bangla shall never be allowed in an answer-script.

Award of Degree, Promotions and Improvement of Results :

(a) **Award of degree:** The degree of Bachelor of Science with Honours in any subject shall be awarded on the basis of CGPA obtained by a candidate in B. Sc./B. Pharm. Honours Part-1, Part-2, Part-3 and Part-4 examinations. In order to qualify for the B. Sc./B. Pharm. Honours degree a candidate must have to obtain within 6 (six) academic years from the date of admission :

(i) a minimum CGPA of 2.50

(ii) a minimum GPA of 2.00 in the practical courses in each of Part-1, Part-2, Part-3 and Part-4 examinations,

(iii) 144 Credits out of 160 and

(iv) "S" letter grade in English course (in 4 academic years from the date of admission).

The result shall be given in CGPA with the corresponding LG (Table of LG, GP and CP) in bracket. For instance, in the example cited above the result is "CGPA=3.10 (B)".

(b) **Publications of results:** The overall results of a successful candidate covering all examinations of four years shall be declared on the basis of CGPA. The transcript in English shall show the course number, course title, credit, grade and grade point of individual courses, GPA of each year, CGPA and the corresponding LG for the overall result.

(c) **Promotions:** In order to be eligible for promotion from one class to the next higher Honours class, a candidate must secure

(i) at least 2.00 GPA in each of his/her Part-1, Part-2 and Part-3 examinations,

(ii) at least 2.00 GPA in each of his/her Part-1, Part-2 and Part-3 practical and class assessment / tutorial / terminal / home assignment course examinations, and

(iii) (a) minimum 30 credits in his/her Part-1 examinations

(b) minimum 30 credits in his/her Part-2 examinations and 64 credits in total Part-1 and Part-2 examinations.

(c) minimum 34 credits in his/her Part-3 examinations and 102 credits in total Part-1, Part-2

Part-3 examination. (d) minimum 34 credits in his/her Part-4 examination for considering the award of Honours degree.

(d) **Course Improvement:** A promoted student earning a grade less than 3.00 in individual courses shall be allowed to improve the grades on courses, not more than 8 Credits courses including those of "F" grades, if any, of Part-1, Part-2 and Part-3 examinations or their equivalent courses (in case of changes in the syllabus), defined by the departmental academic committee, through the regular examination of the immediate following batch. However, if the candidate fails to clear his/her "F" grades in the first attempt, he/she shall get a second (last) chance in the immediate next year to clear the "F" grades. No improvement shall be allowed in practical course examinations/ viva-voce/ class assessment/ tutorial/ terminal/ home assignment and thesis/ dissertation/ project/

in-plant training courses. If a candidate fails to improve his/her course grade, the previous grade shall remain valid. If a readmitted candidate fails to appear at the regular class assessment/ tutorial/ terminal/ home assignment and thesis/ dissertation/ project/ in-plant training courses, his/her previous grades shall remain valid.

(e) **Result Improvement:** A candidate obtaining a CGPA of less than 3.00 at the end of the Part-4 examinations, within 5 (five) academic years, shall be allowed to improve his/her result, on up to a maximum of 4 (four) full units (16 Credits) of the Part-4 theoretical courses in the immediate next regular examination (within six academic years from the date of admission) after publication of his/her result. The year of examination, in the case of a result improvement, shall remain same as that of the regular examination. His/her previous grades for practical courses/ viva-voce/class assessment/ tutorial/ terminal/ home assignment, thesis/ dissertation/ project/ in-plant training courses shall remain valid. If a candidate fails to improve CGPA, the previous results shall remain valid.

(f) **Pass Degree:** Candidates failing to obtain required CGPA 2.50 and 144 Credit.

(i) For promotion in Honours Part-3 examination in 4 (four) academic years, in case of readmission in Part-3 course year, in 5 (five) academic years, with no readmission in Part-3 course year from the date of 1st year admission. But fulfill the following Conditions.

If a candidate fails to obtain required GPA (2.00) and Credit Point (102) for promotion from Part-3 to Part-4 within 5 academic years from his/her first date of admission in First year but secured CGPA 2.00 and total Credit Point 94 with LG of "S" in the English Course, shall be awarded Pass degree, such candidates shall not be allowed to improve their pass degree.

OR

If a candidate fails to obtain a minimum of 34 Credits and GPA (2.00) in his/her Part-4 examination also fails to obtain 144 Credits and CGPA 2.50 within 6 academic years from his/her first date of admission in first year but secured minimum CGPA 2.00, 128 Credits, with LG of "S" in the English Course, shall be awarded Pass degree and such candidates shall not be allowed to improve their pass degree.

(g) **Dropping out:** Candidates, failing to earn the yearly required GPA after completing regular examinations and subsequently failed again after taking readmission in 1st, 2nd or 3rd year, or to clear required "F" grades in the stipulated period, shall be dropped out of the programme.

The Grading Systems:

(a) **Credit Point (CP):** The credit points achieved by an examinee for 0.50 and 1.00 unit courses shall be 2 and 4, respectively. For other fractions of a unit, proportionality should be applied.

(b) **Letter Grade (LG) and Grade Point (GP):** Letter Grades, corresponding Grade Points and Credit Points shall be awarded in accordance with provisions shown below:

Table of LG, GP and CP for credit courses

Numerical grade	Letter Grade (LG)	Grade Point (GP) / unit	Credit Point (CP) / unit
80% or its above	A ⁺ (A plus)	4.00	4
75% to less than 80%	A (A regular)	3.75	4
70% to less than 75%	A ⁻ (A minus)	3.50	4
65% to less than 70%	B ⁺ (B plus)	3.25	4
60% to less than 65%	B (B regular)	3.00	4
55% to less than 60%	B ⁻ (B minus)	2.75	4
50% to less than 55%	C ⁺ (C plus)	2.50	4
45% to less than 50%	C (C regular)	2.25	4
40% to less than 45%	D	2.00	4
Less than 40%	F	0.00	0
Incomplete	I	--	0

Absence from the final examination shall be considered incomplete with the letter grade "I".

(ii) Table of LG, GP and CP for non-credit courses

Numerical grade	LG	GP / unit	CP / unit
30% and above	S	0.0	0.0

Less than 30%	U	0.0	0.0
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Here S and U refer to “satisfactory” and “unsatisfactory”, respectively.

B. Pharm. (Honours) Part-I
 Course: 101 (Unit – 1)
 Course Title: Inorganic Pharmaceutical Chemistry-I
 Full marks - 100

1. Structure of Atoms: Fundamental particles, origin of spectral lines and elementary treatment of theories of atomic structure, quantum numbers, De-broglies relationship, Heisenburg uncertainty principle, Pauli exclusion principle, Hund’s rule, Aufbau principle, shapes of s, p, d, f orbitals.
2. Classification of Elements: Electronic structure of atoms, modern periodic table and periodic law, variation of periodic properties within periods and groups, ionization potential, electron affinity, electronegativity, usefulness and limitation of periodic table.
3. The Chemical Bonds: Electronic concept of valency, different types and formation of chemical bonds, e.g., ionic, covalent, co-ordinate covalent, metallic, hydrophobic, Vander Waal's force, hydrogen bond, etc., concept of atomic orbital, theories of covalent bonding and hybridization.
4. Oxidation Reduction Reactions: Definition, oxidation number, equivalent weight of oxidant and reductant, decomposition of drugs by redox reaction, ion electron method of balancing equation, importance and determination of redox potential.
5. Co-ordination Compounds: Definition, Werner's theory, electronic interpretation, structures of co-ordination compounds, valence bond theory and hybridization approach.
6. Alkali, Alkaline earth metals and Halogen: Electronic configuration, Physical and chemical properties of alkali, alkaline earth metals and halogens including their pharmaceutical applications.
7. Basic concept on acids, bases, salts and pH : Definitions, various theories of acids & bases, classification of acids, bases & salts, strength of acids & bases, determination of strength gradient of acids & bases.

Recommended Books:

- | | |
|---|--|
| I. S. Z. Haider | : Introduction to Modern Inorganic Chemistry |
| II. Satya Prakash, Tuli, Basu and Madan | : Advanced Inorganic Chemistry |
| III. R.D. Madan | : Modern Inorganic Chemistry |
| IV. B.R. Puri and L.R. Sharma | : Principles of Inorganic Chemistry |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-I
Course: 102 (Unit –1)
Course Title: Organic Pharmaceutical Chemistry-I
Full marks - 100

1. General Concepts: Methods of purification, tests of purity, acids, bases, polarity of bonds, carbonium and carbanions, hydride, protons, free-radicals, hydrogen bonding, etc.
2. Chemistry of Aliphatic Compounds: Introduction, methods of preparation, physical and chemical properties and pharmaceutical applications of alcohols, aldehydes, ketones, hydrocarbons, ester, ethers, amines, amides and carboxylic acids.
3. Chemistry of Aromatic Compounds:
 - a) Aromaticity, mechanism of orientation and substitution and resonance.
 - b) Preparations, reactions and pharmaceutical importance of aldehyde, amine, acid, diazonium compounds, etc.
4. Carbohydrates:
 - a) Monosaccharides and Disaccharides: Nomenclature, classifications, general reactions, configurations and pharmaceutical importance of monosaccharides and disaccharides.
 - b) Polysaccharides: Composition, structure, properties and pharmaceutical importance of starch and cellulose.

Recommended Books:

- | | |
|---------------------------------|---------------------------------|
| I. B.S. Bahl and Arun Bahl | : Advanced Organic Chemistry |
| II. R.T. Morrison and R.N. Boyd | : Organic Chemistry |
| III. I.L. Finar | : Organic Chemistry Vol. I & II |
| IV. Ashutosh Kar | : Medicinal Chemistry |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-I
 Course: 103 (Unit – 1)
 Course Title: Physical Pharmacy-I
 Full marks – 100

1. Properties of Gases: Gas laws, diffusion of gases, kinetic theory of gases, Van der Waal's equation, critical phenomena, continuity of state, principle of corresponding states and the reduced equation of states, liquefaction of gases, uses of liquefied gas.
2. a) Thermodynamics: System, state and state functions, first law of thermodynamics, reversible, irreversible, isothermal and adiabatic changes, enthalpy, internal energy, molar heat capacity, second law of thermodynamics, Carnot's cycle, entropy, Free energy, Gibb's free energy, Gibbs-Helmholtz equation, third law of thermodynamics.
 b) Thermo chemistry: Exothermic and endothermic reactions, thermochemical equation, heat of reaction, Laplac's and Hess's laws and its applications, bond energies.
3. Solutions: Units of concentration, Henry's law and distribution law and colligative properties.
4. Phase rule: Phase, component and degree of freedom, one component system (water and sulfur), two component systems (liquid-liquid, liquid-vapor) eutectic systems and dilution of completely immiscible systems.
5. Ionic Equilibria : Definition, Ostwald's dilution law, dissociation theory, ionization of water, common-ion effect, ionization constants of acid and bases, ionization of polyprotic electrolytes, solubility products and its application in pharmacy.
6. pH, Buffer and salt hydrolysis: Relative strengths of acids and bases, pH scale and its limitations, pH of weak acids and bases, degree of hydrolysis and hydrolysis constant, buffer equation, buffer capacity, buffer in pharmaceutical and biological systems, buffered isotonic solutions, methods of adjusting tonicity and pH, application of pH, buffer and salt hydrolysis in pharmacy.
7. Chemical Equilibria: Law of mass action, criteria of chemical equilibrium, application of law of mass action to homogenous and heterogeneous equilibrium, factors affecting equilibrium, Gibb's free energy change for chemical equilibria, Le-Chatelier principle and its industrial application.

Recommended Books:

- | | |
|---------------------------------------|------------------------------------|
| I. M. M. Haque and M. A. Nawab | : Principles of Physical Chemistry |
| II. A. Martin and J. Swarbrick | : Physical Pharmacy |
| III. P.W. Atkins | : Physical Chemistry |
| IV. K.K. Sharma and L.K. Sharma | : A Textbook of Physical Chemistry |
| V. B.S. Bahl, D.G. Tuli and Arun Bahl | : Essentials of Physical Chemistry |
| VI. N. Kundu and S.K. Jain | : Physical Chemistry |
| VII. S. H. Maron and C.F. Prutton | : Principles of Physical Chemistry |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-I
 Course: 104 (Unit – 1)
 Course Title: Pharmacognosy-I
 Full marks - 100

1. Introduction: Definition, scope, historical background and relation to other disciplines.
2. Drug Literatures and Publications: Pharmacopoeia, pharmaceutical codex, formulary, index, official, non-official, unofficial and INN drugs (new drugs).
3. Crude Drugs: A general view of their origin, distribution, cultivation, collection, drying, storage, commerce and quality control.
4. Phytochemistry: Extraction, separation and detection of plant metabolites; basic principles of chromatography.
5. Lipids: Definition, classification, properties and extraction of
 - a) Plant origin: Castor oil, coconut oil, linseed oil, olive oil, peanut oil and chaulmoogra oil.
 - b) Animal origin: cod liver oil, shark liver oil and halibut liver oil.
 - c) Waxes.
6. Carbohydrate and Related Compounds: Definition, classification, properties and biosynthesis.
 - a) Monosaccharides and oligosaccharides: Sucrose, dextrose, glucose, fructose etc.
 - b) Polysaccharides and polysaccharide-containing drugs: Starch, dextrin, cellulose, etc.
 - c) Gums and mucilages: Tragacanth, acacia, sodium alginate, agar etc.
7. Alkaloids: Definition, nomenclature, classification, distribution, properties, test, extraction and biosynthesis.
 Study of the following alkaloidal drugs: a) areca, conium b) lupinus and c) ephedra and colchicum.
8. Phenolic Compounds and Tannins: Definition, classification, properties and tests. Study of tannin containing drugs such as nutgall, catechu, etc.
9. Resin and Resinous Compounds: Definition, classification and properties. Study of balsam, podophyllum, jalap, cannabis, capsicum, ginger, murrh, tolu balsam, benzoin etc.

Recommended Books:

- | | |
|---|---|
| I. E. P. Claus and V.E. Tylor | : Pharmacognosy |
| II. V.E. Tylor, L.R. Brady & J.E. Robbers | : Pharmacognosy |
| III. W.C. Evans | : Trease and Evan's Pharmacognosy |
| IV. Mohammed Ali | : Textbook of Pharmacognosy |
| V. K. Raghunathan and Roma Mitra | : Pharmacognosy of Indigenous Drugs Vol. I & II |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-I
 Course: 105 (Unit – 1)
 Course Title: Physiology and Biochemistry-I
 Full marks – 100

1. Cell and Tissue
 - a) Cell: Prokaryotic and eukaryotic cells, Structure and function, cell inclusions, division of cells.
 - b) Tissue: Definition, classification, Characteristics, Structure and function of epithelial tissues, Connective tissue, muscular tissue and nervous tissue.
2. I. Blood system
 - a) Blood : composition and function
 - b) Plasma: electrolytes, proteins and other organic constituents.
 - c) Blood cells: Formation and destruction, cell constituents, functions of different blood cells.
 - d) Haemoglobin: Structure and function, haemoglobinopathy, thalassemia.
 - e) Anaemia: Causes and classification
 - f) Blood coagulation and anticoagulants.
 - g) Blood group and transfusion
 II. Lymph: Composition, function, circulation and function, lymph nodes and lymphatics.
3. Cardiovascular System
 - a) Heart: Structure and properties of cardiac muscles, conduction system of heart, cardiac cycle, heart sound, cardiac out put and ECG. Control and requirement of normal heart beat.
 - b) Blood vessels: Type of blood vessels and their function.
 - c) Blood pressure (BP): Measurements and regulation of BP, control of BP (neural and humoral).
 - d) Regional blood circulation: Pulmonary, hepatic, cerebral, capillary and coronary circulation.
4. Digestive System: Structure of the different parts of the alimentary tract; composition, function and regulation of the secretion of different digestive juices; digestion and absorption of food stuffs, movement of alimentary tract.
5. Respiratory System: Functional anatomy of the respiratory system, mechanism of respiration, lung volumes and capacities, gaseous exchange and transport (O_2 and CO_2); regulation of respiration (nervous and chemical); causes and classification of hypoxia; periodic (abnormal) breathing, Chene-stokes breathing, Kussmal breathing and breathing at high altitude.
6. Basic Concept of Nucleic Acid: Definition, classification, structure and function of protein. Protein, DNA, RNA. Importance of nucleic acid study, transcription and translation.

Recommended Books:

- | | |
|------------------------------------|--------------------------------------|
| I. C.C. Chatterjee | : Human Physiology Vol. I & II |
| II. Guyton | : A Textbook of Medical Physiology |
| III. Chakrabarti, Ghosh and Sahana | : Human Physiology |
| IV. W. F. Ganong | : Review of Medical Physiology |
| V. Selim Reza | : The Essentials of Human Physiology |
| VI. K. Meftun Ahmed | : Physiology of Blood |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-I
 Course: 106 (Unit –1)
 Course Title: Pharmaceutical Microbiology and Immunology
 Full marks - 100

1. Introduction: Historical development, scope of microbiology with special reference to pharmaceutical sciences.
2. Microscopy: Bright field, dark field, fluorescence, phase contrast and electron microscopy. Microscopic examination of microorganisms, wet mount and hanging drop techniques. Microbial staining.
3. Industrial microbiology: Microorganisms and industry (prerequisites to practical industrial microbiological processes, major classes of products and processes, microorganisms used in industrial process, industrial uses of bacterial, yeast, molds etc.
4. Bacteria
 - a) General characteristics of bacteria.
 - b) General and cellular morphology - size, shape, fine structures and movement.
 - c) Cultivation of bacteria: Nutritional requirements, factors affecting growth, bacteriological media.
 - d) Reproduction and growth: Modes of cell division, normal growth cycle, growth curve, synchronous growth and measurement of growth.
 - e) Pure culture and cultural characteristics: Methods of isolation, maintenance and preservation of pure cultures, colony characteristics and characteristics of broth culture.
 - f) Microbial metabolisms: Introduction, biogenesis, anabolism, catabolism, metabolic versatility of organisms, enzymes, energy production by aerobic & anaerobic processes, fermentation processes.
5. Virus:
 - a) Definition and general properties, classification and nomenclature, morphology, multiplication and cultivation, viruses and human diseases, treatment of viral diseases, application of virus in life sciences and medicine.
 - b) Bacteriophage: Definition, ICTV classification, morphology and replication cycle of bacteriophages, role of phages in food fermentation.
6. Fungi, rickettsia and actinomycetes
 - a) Fungi- Characteristics, morphology, reproduction (sexual & asexual), cultivation, classification of fungi, some fungi of special interest (Penicillium, Candida, Aspergillus, Rhizopus), diseases caused by fungi, pharmaceutical importance of fungi.
 - b) Brief study on rickettsia and actinomycetes
7. Immunology
 - a) Introduction to immune response: Innate and acquired immunity, complement, self and non-self discrimination and source and chemistry of antigen.
 - b) Cells involved in immune system: Macrophage and other antigen presenting cells, T cells, B cells, etc.
 - c) Antibody: Classification, chemistry and function.
 - d) Hypersensitivity: Immediate and delayed type hypersensitivity reactions.

Recommended Books:

- | | |
|--|---------------------------------------|
| 1. M.J. Pelczar, E.C.G. Chan and N.R. Kreig | : Microbiology |
| 2. Stainer | : General Microbiology |
| 3. R. Ananthanarayan and C. K. J. Paniker | : Textbook of Microbiology |
| 4. M. R. Choudhury | : Modern Medical Microbiology |
| 5. Ivan Roitt, J. Brostoff and David Male | : Immunology |
| 6. Abul K. Abbas, A.H. Lichtman and J.S. Pober | : Cellular and Molecular Immunology |
| 7. W.H. Elliott and D.C. Elliott | : Biochemistry and Molecular Biology |
| 8. S. J. Carter | : Cooper and Gunn's Tutorial Pharmacy |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-I
Course: 107 (Unit – 1)
Course Title: Biostatistics and Computer Science
Full marks - 100
(Biostatistics 60 + Computer Science 40)

Biostatistics

1. **Statistics: Meaning & Scope.** Variables and Attributes, Collection and presentation of Statistical data, Frequency Distribution and Graphical Representation.
2. **Analysis of Statistical Data: Location, Dispersion and their measures.** Skewness, Kurtosis and their measures. Moment, Cumulants and Practical examples.
3. **Probability: Concept of probability, Sample Space, Events.** Union and Intersection of Events. Probability of Events. Laws of probability. Conditional Probabilities. Bose Einstein Statistics. Bay's Theorem, Chebysec's Inequality, and Practical examples.
4. **Random Variables and Probability Distribution: Basic concepts.** Discrete and continuous random variables. Density and distribution functions. Mathematical Expectation and variance. Joint, marginal and conditional density functions. Conditional Expectation and conditional variance. Moments and Cumulant generating functions. Characteristic function. Study of Binomial, Poisson, Normal and Bivariate Normal distribution and Practical examples.
5. **Bivariate Distribution: Bivariate data, Scatter Diagram, Marginal and conditional Distribution, Correlation, Rank correlation.** Partial and Multiple correlation, Contingency, Analysis and Practical applications.
6. **Linear Regression: Linear Regression for two Variables, Principle of Least Squares Method, Lines of best fit, Residual Analysis and examples.**
7. **Test of Significance: Basic idea of Null hypothesis, Alternative hypothesis, Type-1 error Type-II error, level of significance Degree of freedom, Rejection region and Acceptance region.** Test of Single mean, single variance, Two sample means and Variances. Test for 2x2 contingency tables, Independence test and Practical examples.

Computer Science

1. **Computer: History, classification and application in pharmaceutical analysis.**
2. **Organization of computer: A general review of INPUT/OUTPUT media and devices, functional parts and organization of CPU, hardware, software, batch processing, RAM, ROM, maintenance, etc.**
3. **Operating systems: Introduction to Windows, Linux and other operating system.**
4. **Computer packages: Microsoft Office-Word, Power Point, Excel and Outlook; Photoshop and Internet explorer.**
5. **Computer Virus: Definition, Classification, Developing an Effective anti-virus strategy, how anti-virus software works. Brief discussion on computer worms, Adware, Spyware and trojan horse.**

Recommended Books:

- | | |
|---------------------------------|---|
| I. R. N. Shil and S. C. Debnath | : An Introduction to the theory of Statistics |
| II. S. P. Gupta | : Statistical Methods |
| III. S.C. Gupta and V.K. Kapoor | : Fundamentals of Mathematical Statistics |
| IV. Jerrold H Zar | : Biostatistical Analysis |
| V. Aptech | : Computer Books |
| VI. Noel Kalicharan | : An Introduction to Computer Studies |
| VII. H. L. Capron | : Computers |
| VIII. Peter Norton's | : Introduction to computers |
| IX. Mahbubur Rahman | : Office97 / 2000 / XP |

Recommended Books of Biostatistics:

- | | |
|--|---|
| Anderson, A.J.B (1989) | : Interpreting Data, Chapman and Hall, London. |
| Cramer, H. (1955) | : The Elements of Probability Theory, Wiley, N. Y. |
| Gupta, S.C. and Kapoor, V.K.(1.001) | : Fundamentals of Applied Statistics, 3rd Ed. Sultan Chand and Sons, N-Delhi, India. |
| Hoel, P.G. (1993) | : Introductory Statistics, Wiley, N.Y. / Lipschutz, S. (1987): Probability, McGraw-Hill, N.Y. |
| Mosteller, F., Rourke and Thomas (197(1) | : Probability with Statistical Applications, 2nd Ed., Addison-Wesley, N. Y. |
| Ross, S.M. (2002) | : Introduction to Probability Models. 3rd 4 Academic Press, N.Y. |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-I

Course: 108 (Unit –1)

Course Title: English

Full marks – 100

1. A brief introduction on the popular English language tests and implications of these tests for higher studies. Importance of learning English.
2. IELTS and TOEFL: Practice of the different modules: Listening, Reading, Writing and Speaking
3. GRE: Verbal Reasoning, Quantitative Reasoning and Analytical Writing
4. Functional English:
Parts of Speech, Articles, Sentence Structures, Verb, Tense, Punctuations, Structure of simple, compound and complex sentences; Voice; Narrations; Modal verbs; Phrasal verbs; Translations.
5. Differences between American and British English.
6. Vocabulary Building: Commonly used words in pharmaceutical and health sciences, newspapers and scientific articles; synonyms and antonyms.
7. Writing cover letter, curriculum vitae/resume, application for jobs etc.

Recommended Books:

- Raymond Murphy : Intermediate English Grammar
- Cambridge University press :Cambridge IELTS
- E Van Bemmell : IELTS to Success
- S. Ahmed : Learning English, The Easy Way
- A.J. Thomson and A.V. Martinet : A Practical English Grammar.
- J. Swales : Writing Scientific English
- Wren and Martin : English Grammar and Composition
- G.H. Vallins : Good English
- A.S. Hornby : The Teaching of Structural Words and Sentences

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-I
Course: 109 (Unit –1.5)
Course Title: Practical
Full marks – 150

101. Inorganic Pharmaceutical Chemistry-I (Marks-25)

Inorganic qualitative analysis of radicals of elements Na, K, Ca, Ag, Mn, Fe, Co, Mg, Al, Cu and acid radicals: CO₃, halides, citrates, SO₄, SO₃, NO₃, etc.

102. Organic Pharmaceutical Chemistry-I (Marks-25)

Qualitative analysis of organic compounds a) Detection of elements b) Identification of functional groups c) Determination of melting points. d) Test of purity (e) Solubility test and classification of the compound.

103. Physical Pharmacy-I (Marks-25)

(i) Laboratory procedures, safety regulations, scientific notations, plotting of data and finding of slope and intercept.

(ii) Determination of formula and composition of a suitable hydrate (CuSO₄ 5H₂O, NiSO₄ 7H₂O etc)

(iii) Determination of the density of a liquid / solution by density bottle / pycnometer method.

(iv) Determination of molecular weight of substances like CHCl₃, CCl₄ by Victor Meyer's method.

(v) Determination of molecular weight of organic salts by chemical method.

(vi) Determination of heats of solution of simple salts by calorimeter.

(vii) Determination of heats of solution of sparingly soluble samples in water by measuring solubility as a function of temperature (application of Vants-Hoff equation).

(viii) Determination of distribution coefficients of benzoic acid between (i) hexane and octane (ii) ether and water.

(ix) Determination of heat of neutralization of HCl with NaOH.

(x) Preparation of primary and secondary standard solutions.

(xi) Standardization of HCl acid solution by sodium carbonate solution

(xii) Standardization of NaOH solution by potassium hydrogen phthalate / oxalic acid

(xiii) Standardization of NaOH solution by potassium hydrogen phthalate / oxalic acid

(xiv) Standardization of KMnO₄ solution by sodium oxalate

104. Pharmacognosy-I (Marks-25)

a) The cell, cell contents and cell types:

(i) The cell: Some cellular organism (Cork and diatomites), Fungi, mucor or rhizomes, aspergillus, penicillin, ergot and yeast. (ii) Cell contents: Starches and derivatives, calcium carbonate, silica.

(iii) Cell types: Parenchyma and modifications colocynth nux-vomica, endosperm, cinnamon, powder, tea, liberated-stem, prosenchyma pericyclic fibers-jute: xylem fibers and vessels-liquorice: tracheids-pinus wood.

b) Epidermal cells and associated structures (trichomes stomata etc.), leaves of belladonna, menthe, rosemary, sienna, Indian hemp, digitalis, etc. Seed trichomes cotton and nux vomica seeds; cork, cells-cascara sagrada.

c) Study of some groups of unorganized white and off white powdered and whole drugs

i) General tests for carbohydrates. ii) Preparation examination of starches and related products.

iii) Examination of gums: Acacia, tragacanth, sterculia, agar and alginates.

d) Examination of fibers and surgical dressing

e) Study of some medicinal plants of Bangladesh

105. Physiology and Biochemistry-I (Marks-25)

a) Hematology

i) Study of compound microscope ii) Microscopically study of blood cells iii) Different types of WBC, erythrocytes and platelets iv) Examination of hemoglobin v) Differential count of WBC vi) Total count of RBC and WBC vii) Determination of clotting and bleeding time viii) Examination of clot under the microscope ix) Effect of chemical agents of RBC x) Fragility test of RBC. xi) Determination of erythrocytes sedimentation rate xii) Examination of haemin crystals

b) Histology: Histology of muscle, liver, spleen, stomach, duodenum, pancreas, lung, kidney, skin and endocrine glands.

c) Chemical physiology:

i) Qualitative test of carbohydrates, proteins and fats ii) Qualitative and quantitative experiments on digestive juice. iii) Examination of urine, estimation of main constituents and detection of abnormal constituents.

106. Pharmaceutical Microbiology and Immunology (Marks-25)

1. (a) Preparation of bacterial media b) Culture of Bacteria c) Isolation of bacteria from natural habitat d) Identification and characterization of bacteria e) Staining of bacterial cells and spores f) Preparation of pure cultures and its identification g) Bacterial counts h) Identification and characterization of fungus
2. (a) Isolation of pure culture by serial dilution method (b) Determination of bacterial growth curve

B. Pharm. (Honours) Part-II

Course: 201 (Unit – 1)

Course Title: Inorganic Pharmaceutical Chemistry-II

Full marks - 100

1. General Properties, Preparation and Uses of Pharmaceutically important salts of Sodium, Potassium, Magnesium, Calcium, Iron, Copper, Aluminium and Zinc Ions.
2. Gastrointestinal Agents: Antacids, preparations and applications (Al and Mg), protective and adsorbents; saline cathartics; their preparations with applications.
3. Radioactive Elements: Chemistry, types, properties, their uses in pharmaceutical and medical sciences.
4. Environmental Chemistry
 - a) Environmental pollutants: Gases (SO_2 , SO_3 , CO, NO, HCl, NO_2 etc.), hydrocarbons, cigarettes, smokes, suspended particulate, pesticides, gasoline and industrial waste. The detrimental effects of pollutants.
 - b) Heavy metal toxicity: Mercury, arsenic, lead, iron and copper poisoning - prevention and treatment.
5. Preparation and Application of the Followings: Fluoride, Zinc, iodine, sulfur, boric acid, selenium and cadmium sulfides.
6. Impurities in Medicinal Substances: Source, principles, qualitative and quantitative analysis and test of purity.

Recommended Books:

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|-------|--------------------------------|---|
| (i) | A. R. Gennaro | : Remington, The Science and Practice of Pharmacy |
| (ii) | Block, Roche, Soine and Wilson | : Inorganic, Medicinal and Pharmaceutical Chemistry |
| (iii) | L. M. Atherden | : Bentley and Driver's Textbook of Pharmaceutical Chemistry |
| (iv) | H. S. Storker and S. L. Seager | : Environmental Chemistry, Air and Water Pollution |
| (v) | A. K. De | : Environmental Chemistry |
| (vi) | Colin Baird | : Environmental Chemistry |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-II
Course: 202 (Unit – 1)
Course Title: Organic Pharmaceutical Chemistry-II
Full marks - 100

1. Heterocyclic Compounds
Aromaticity, general methods of preparation and properties of furan, thiophene, pyrrole, quinoline, isoquinoline, pyridine, thiazole, imidazole, pyrimidine, indole and their pharmaceutical importance.
2. Synthesis and Applications of Drugs: Paracetamol, aspirin, phenacetin, para-amino benzoic acid (PABA) and sulph drugs.
3. Stereochemistry: A general concept of different types of isomerism, tautomerism, asymmetric synthesis, Walden inversion and resolution of racemic mixture.
4. Reaction Mechanism
 - a) Addition reaction: Electrophilic, nucleophilic and free radical (1, 2 and 1, 4) addition.
 - b) Substitution reaction: Unimolecular and bimolecular.
 - c) Elimination reaction: Unimolecular and bimolecular.
 - d) Rearrangement reaction: Hoffman, Claisen, Sigmatropic and Fries rearrangement.
5. Lipids: Definition, classification, properties and pharmaceutical importance of Fats, oils and Phospholipids
6. Proteins: Introduction, structure, acidity and basicity, isoelectric point, reactions and chemical synthesis of amino acids. Essential and nonessential amino acids, peptide synthesis and denaturation.

Recommended Books:

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| (i) B.S. Bahl and Arun Bahl | : Advanced Organic Chemistry |
| (ii) R.T. Morrison and R.N. Boyd | : Organic Chemistry |
| (iii) I.L. Finar | : Organic Chemistry Vol. I & II |
| (iv) O.P. Agarwal | : Chemistry of Organic Natural Products Vol I & II |
| (v) Raj K. Bansal | : Organic Reaction Mechanisms |
| (vi) N. Evers and D. Caldwell | : The Chemistry of Drugs |
| (vii) Norman and Coxon | : Principles of Organic Synthesis |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-II
 Course: 203 (Unit – 1)
 Course Title: Physical Pharmacy-II
 Full marks - 100

1. Properties of liquids:
 - a) Vaporization and vapor pressure, measurement of vapor pressure.
 - b) Surface tension, Clausius-Clapeyron equation, measurement, application in pharmacy;
 - c) Viscosity, Poiseuillies's equation and measurement of viscosity, application in pharmacy.
2. Properties of Solids: Types of solid, band theory of solids, conductors, semiconductors, superconductors and insulators, crystals, types of crystal including according to type of bonding, mechanical properties of crystals, lattice energy of ionic crystals, Madelung constant and energy, Born-Lande equation and Born-Haber cycle, space lattice, unit cells, Weiss and Miller indices, crystal of symmetry, polymorphism and dilatometric analysis of compounds, isomorphism, crystal defects, liquid crystal.
3. Chemical Kinetics: Rate laws and rate constants, order and molecularity, order of reactions and its determination, integrated rate laws, half lives and shelf lives, theories of reaction rates, factors affecting reaction rates; catalysis : types, characteristics of catalysts, promoters and catalytic poisoning, theory of catalysis, enzyme catalysis.
4. Rheology: Newtonian and non-Newtonian systems, yield value, plastic, pseudoplastic and dilatant flow, thixotropy. Determination of rheologic properties, viscoelasticity, psychorheology, rheologic properties of suspension and emulsions, application in pharmacy.
5. Adsorption and Interface: Freundlich and Langmuir isotherm, BET isotherm, electrical properties of interfaces, characteristics of adsorption, electrical double layer, Nernst and zeta potential, Gibb's equation, spreading, surfactants, emulgents, detergents and antifoaming agents and their uses in pharmacy. Application of adsorption in pharmacy.
6. Electrochemistry:
 - a) Conductance of electrolytes, concept of E. M. F and its measurements, electrode, various types of electrochemical cells, relation between electrical and chemical energies, oxidation-reduction systems, solutions of electrolytes.
 - b) Electrochemical cells and cell reactions, Electrode and cell potentials, energies involved in electrode processes; reference electrodes, concentration cell, stoichiometry of electrolysis.
7. Colloid: Classification, preparation, electrical and optical properties, sedimentation, Stoke's law, stability of colloidal dispersion, protective colloid, sensitization, dialysis, Donnan membrane equilibrium, application and uses of colloidal preparation in pharmacy.

Recommended Books:

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| (i) | M. M. Haque and M. A. Nawab | : Principles of Physical Chemistry |
| (ii) | A. Martin and J. Swarbrick | : Physical Pharmacy |
| (iii) | Gordon M. Barrow | : Physical Chemistry |
| (iv) | C.V.S. Subrahmanyam | : Textbook of Physical Pharmaceuticals |
| (v) | S. P. Agarwal and Rajesh Khanna | : Physical Pharmacy |
| (vi) | S. Glasstone and D. Lewis | : Elements of Physical Chemistry |
| (vii) | N. Kundu and S.K. Jain | : Physical Chemistry |
| (viii) | K. J. Iaidler | : Chemical Kinetics |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-II
 Course: 204 (Unit – 1)
 Course Title: Pharmacognosy-II
 Full marks - 100

1. Phytochemistry and Pharmaceutical Uses of the Following Plant Constituents:

I. Glycosides and glycoside-containing drugs: Classification and biosynthesis of glycosides.

a) Phenols and phenolic glycosides.

- i) Simple phenols: Vanilla and vanillin, capsicum
- ii) Tannins: Galls or nutgall, hamamelis.
- iii) Anthraquinone glycosides: Cascara sagrada, aloe, senna, rhubarb.

b) Saponins, cardioactive drugs and other steroids.

- i) Steroidal saponin: Sarsaparilla root, ginseng, glycerhizia.
- ii) Pentacyclic triterpenoid saponin.
- iii) Cardioactive glycosides: Digitalis, strophanthus, squill.
- iv) Cyanogenic glycoside: Wild cherry, mustard.
- v) Miscellaneous isoterpenoids: Gentain, valerian root, quassia, fish berries, santonica flower, saffron.

II. Alkaloids:

- a) Classification and biosynthesis of tropane, quinoline, isoquinoline and indole alkaloids.
- b) Tropane: Belladonna, stramonium, hyoscyamus and coca leaf.
- c) Quinoline: Cinchona, cusparia bark.
- d) Isoquinoline: Ipecac, opium, sanguinaria, curare.
- e) Indole: Rauwolfia, nux vomica, ergot, catharanthus.
- f) Imidazole: Pilocarpine.
- g) Steroidal : Veretrum viride, aconite.
- h) Norlupinane: Lupinus sp.
- i) Purine base: Coffee, tea and cocoa.

III. Volatile oils and related terpenoids: Methods of obtaining volatile oils, chemistry, their medicinal and commercial uses, biosynthesis of some important volatile oils.

- a) Terpenes or sesquiterpenes: Turpentine, juniper, cade.
- b) Alcohol's: Coriander, sandalwood, rose.
- c) Ester: Peppermint, lavender, rosemary.
- d) Aldehydes: Cinnamon bark, lemon peel, lemon grass.
- e) Ketones: Spearmint, caraway, dill, camphor.
- f) Phenols: Clove, thyme, cinnamon leaf, ajowan
- g) Ethers: Fennel, nutmeg, eucalyptus, anise, cajunut.
- h) Peroxides: Chenopodium.
- i) Others: Wintergreen, bitter almond.

- 2. Poisonous Plants and Natural Pesticides: Datura, poison hemlock, water hemlock, ipomoea, tobacco, pyrethrum flower, derris and lonchocarpus, strychnine, neem, etc.
- 3. Hallucinogens: Fungi, Indian hemp.

Recommended Books:

- (i) E. P. Claus and V.E. Tyler : Pharmacognosy
- (ii) V.E. Tylor, L.R. Brady & J.E.Robbers : Pharmacognosy
- (iii) W.C. Evans : Trease and Evan's Pharmacognosy
- (iv) Mohammed Ali : Textbook of Pharmacognosy
- (v) K. Raghunathan and Roma Mitra : Pharmacognosy of Indigenous Drugs Vol. I & II

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-II
Course: 205 (Unit – 1)
Course Title: Physiology and Biochemistry-II
Full marks - 100

1. Nervous System: Properties of nerve cells, nerve impulses and their transmission. Reflex action, principal afferent and efferent paths of CNS. Functions of spinal cord and brain. The autonomic nervous system. Properties of synapses and synaptic transmission.
2. Metabolism: Metabolism of fats, carbohydrates, protein and nucleoprotein. Vitamins and minerals, their physiological properties and functions.
3. Excretory System: Structure and function of kidney, composition and formation of urine, renal circulation, renal regulation of acid base balance, renal diseases and kidney function tests, physiology of micturition. Artificial kidney: basic principles, method and applications.
4. Temperature Control: Heat production and heat dissipation, hypothalamus and nervous factors involved in body temperature regulation, function of skin.
5. Endocrine Glands: Structure and function of pituitary, thyroid, parathyroid, suprarenal and pancreas glands. Functions and regulation of secretion of hormone, disorders of abnormal hormone secretion.
6. Reproduction: Structure and function of testis, ovary, uterus and placenta. Male and female sex hormones and their functions. Spermatogenesis and its hormonal regulation. Menstruation cycle, different phases and its regulation. Ovogenesis & ovulation and its control. Pregnancy and lactation and their hormonal control.
7. Enzymes & Coenzymes :
 - a) Enzymes: Chemical nature, classification, enzyme kinetics, enzyme specificity, characteristics of active sites, factors affecting enzyme activity, enzyme activation, enzyme inhibition, irreversible inhibition of poisons and toxins, enzyme catalyst and chemotherapy.
 - b) Coenzymes: Thiamine pyrophosphate, flavin coenzyme, TH₄, pantothenic acid, NAD⁺, NADPH⁺ pyridoxal pyrophosphate, biotin, vitamin B₁₂ coenzyme, etc.

Recommended Books:

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| (i) C.C. Chatterjee | : Human Physiology Vol. I & II |
| (ii) Guyton | : A Textbook of Medical Physiology |
| (iii) Chakrabarti, Ghosh and Sahana | : Human Physiology |
| (iv) W. F. Ganong | : Review of Medical Physiology |
| (v) S. Wright | : Applied Physiology |
| (vi) Selim Reza | : The Essentials of Human Physiology |
| (vii) Stryer | : Biochemistry |
| (viii) Lehninger, Nelson and Coss | : Principles of Biochemistry |
| (ix) A.C. Dev | : Fundamental of Biochemistry |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-II
 Course: 206 (Unit – 1)
 Course Title: Pharmacology-I
 Full marks - 100

1. History and Scope of Pharmacology
2. General Pharmacology: Methods of drug administration, biological half life, drug absorption, bioavailability, distribution of drugs, protein binding, accumulation and storage in body, drug dilution in the body fluid, metabolism of drugs and excretion. Drug allergy, idiosyncrasy, drug toxicity and drug interaction.
3. Drugs Acting on CNS
 - a) Analgesic and antipyretics. (i) Non-opioids (NSAID): salicylates and congeners. (ii) Opioids: natural and synthetic.
 - b) Hypnotic-sedatives: Benzodiazepines, barbiturates, etc.
 - c) C.N.S. stimulants: Amphetamine, caffeine, strychnine, xanthine derivatives.
4. Gastric Antacids: General consideration, chemistry, absorption, modification, distribution and excretion. Action and adverse effects of gastric antacids. Classification of antacids-aluminums hydroxide, aluminum carbonate, calcium carbonate, magnesium hydroxide and oxide, magnesium carbonate, megaldrate, magnesium trisilicate, sodium bicarbonate, antacid mixtures, colloidal bismuth, H-2 receptor antagonists (cimetidine, ranitidine and famotidine) etc.
5. Autacoids
 - a) Histamines: Mode of action, action on cardiovascular system, smooth muscle, gastric secretion, anaphylactic shock, histamine-releasing drugs, allergic disorder.
 - b) Antihistamines: Classification, pharmacological, therapeutic uses, absorption, distributions, excretion, adverse reactions, etc.
 - c) Serotonin and serotonin antagonists: Occurrence, pharmacological action, serotonin antagonist, prostaglandins, prostacyclins and thromboxane.
 - d) The kinins: Kallidins and bradykinin.
6. Anesthetics: Introduction and classification.
 - a) Local anesthetics: general properties, chemistry and SAR, mechanism of action, pharmacological action, clinical use and fate of cocaine, procaine, benzocaine, lignocaine, lidocaine, etc.
 - b) General anesthetics. (i) Inhalation anesthetics: Halothene, enflurane, methoxyflurane, nitrous oxide, diethyl ether, cyclopropane and ethylene, etc. (ii) Intravenous anesthetics: Barbiturates, opioids, etc.
7. Drugs Used in Haemopoietic System: (a) Anticoagulants: Heparin, warfarin, dicumarol, Na- and K-oxalates and citrates. (b) Iron, folic acid and vitamin B₁₂.
8. Drugs Affecting Renal Function: Osmotic diuretics, carbonic anhydrase inhibitors, potassium sparing diuretics, high ceiling diuretics.

Recommended Books:

- (i) H. P. Rang, M. M. Dale and J. M. Ritter : Pharmacology
- (ii) A. Goodman Gilman, T. W. Rall, A. S. Nies and P. Taylor : Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II
- (iii) R. S. Satoskar and S. D. Bhandarkar : Pharmacology and Pharmacotherapeutics Vol. I & II
- (iv) K. D. Tripathi : Essentials of Medical Pharmacology
- (v) Andres Goth : Medical Pharmacology
- (vi) R. A. Harvey and P. C. Champe : Lipponcott's Illustrated Reviews Pharmacology
- (vii) B. G. Katzung : Basic and Clinical Pharmacology

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-II
Course: 207 (Unit -1)
Course Title: Pharmaceutical Technology-I
Full marks - 100

1. **Pharmaceutical Calculations:** Different systems weights & measures used in pharmacy and their conversions, weighing and measuring for large and small quantities, density & specific gravity, strength and its units, mathematical principles and their rules (significant figures, fractions, exponents, power and roots, logarithms and anti-logarithms), percentage preparations, dilution and concentrations, isotonic solutions, dosage calculation for children and adult, reducing and enlarging formulas, parts per million, milliequivalents.
2. **Basic Principles of Compounding and Dispensing:** Fundamental operation in compounding, current good pharmaceutical practices in compounding and dispensing, containers and closures for dispensed products, responding to the prescription and labeling of dispensed medications.
3. **Micromeritics:** Importance of particle size determination, different means of expressing particle size, methods of particle size determination: Optical and electron microscope studies, Coulter counter methods, laser beam technique, sieve analysis, sedimentation methods; particle shape and surface area. Measurement of particle surface area.
4. **Pharmaceutical Excipients:** Chemistry, physical properties and uses of antimicrobial preservatives, antioxidants, buffering agents, coloring agents, complexing agents, suspending agents, emulsifying agents, flavoring agents, humectants, ointment bases, solvents and co-solvents stiffening agents, wetting and solubilizing agents.
5. **Liquid Dosage Forms:** Solution and elixirs, theory of solution, different factors affecting solution process, advantages and disadvantages, formulation and manufacturing considerations, packaging of liquids, preservation and stability aspects and quality control systems of liquids.
6. **Dispersed System**
 - a) Properties of dispersed systems: Theoretical aspects of suspension, emulsion and colloids, surface characteristics and zeta potential, inter-particle force, crystal growth, wetting, adsorption at solid-liquid interface, surface and interfacial tension, flocculation and coalescence.
 - b) Suspension: Definition and application, advantage and disadvantages, aggregated and dispersed system, formulation, manufacturing and stability, evaluation, rheological consideration, illustrative examples.
 - c) Emulsion: Definitions and applications, advantage and disadvantages, theory of emulsion, formation of emulsion, classification of emulsifying agents, HLB values of surface active agents, formulation manufacturing, stability and evaluation, rheological considerations.
6. **Semisolids (ointments, paste, gels, etc.):** Structure of skin, percutaneous absorption of drugs, definition and classification of semisolid, classification of ointment bases, formulation and manufacturing, rheological considerations, evaluation and quality analysis.
7. **Drug Decomposition:** Decomposition of drugs and pharmaceutical product, stabilization of pharmaceutical products, accelerated stability testing.
8. **Sterilization:** Principle of sterilization, classification, factors affecting thermal sterilization, sterilization by heat, gas, radiation and filtration, aseptic technique and sterility testing.

Recommended Books:

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| (i) A. Martin and J. Swarbrick | : Physical Pharmacy |
| (ii) E. W. Martin | : Husa's Pharmaceutical Dispensing |
| (iii) E. A. Rawlins | : Bentley's Textbook of Pharmaceutics |
| (iv) L. Lachman, H.A. Liebernan, J.L. Kanig | : The Theory and Practice of Industrial Pharmacy |
| (v) S. J. Carter | : Cooper and Gunn's Dispensing for Pharmaceutical Students |
| (vi) M. E. Aulton | : Pharmaceutics, the Science of Dosage Form Design |
| (vii) H. C. Ansel and N. G. Popovich | : Pharmaceutical Dosage Forms and Drug Delivery Systems |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-II

Course: 208 (Unit – 1.5)

Course Title: Practical

Full marks - 150

201. Inorganic Pharmaceutical Chemistry-II (Marks-20)

1. Quantitative analysis: (i) Estimation of iron (ferrous and ferric) in solution by titration with KMnO_4 / $\text{K}_2\text{Cr}_2\text{O}_7$ / Ce(IV) solution (ii) Standardization of thiosulfate solution against KMnO_4 / $\text{K}_2\text{Cr}_2\text{O}_7$ solution
2. Limit test for As, Pb and Hg.
3. Preparation of inorganic compounds of medicinal importance such as KMnO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$, Mohr's salt, $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ etc.

202. Organic Pharmaceutical Chemistry-II (Marks-20)

1. Determination of physical constants and criteria of purity including melting point, boiling point, refractive index, specific rotation and viscosity.
2. Identification of organic compounds: Solids and liquids, detection and identification of impurities, tests for carbohydrates, proteins and fats.
3. Organic preparations involving typical reactions e.g. Perkin reaction, Grignard reaction, Friedel-Craft reactions, esterification etc.

203. Physical Pharmacy-II (Marks-25)

1. Determination of viscosity of pure liquids such as glycerin, alcohol and nitrobenzene using Ostwald viscometer.
2. Determination of viscosity coefficient of a liquid at two different temperatures and finding out the temperature coefficient for the given liquid.
3. Determination of viscosity coefficient of the water-alcohol mixtures and comment on the structure of the solutions.
4. Determination of viscosity coefficient of a liquid at different temperatures and estimation of the activation parameters of viscous flow.
5. Determination of partition coefficient of (i) salicylic acid between water and chloroform, (ii) benzoic acid between toluene and water, (iii) iodine between methylene chloride and water
6. Determination of velocity constant of the hydrolysis of methyl/ethyl acetate catalyzed by HCl.
7. Determination of absorption isotherm of oxalic (or acetic) acid from aqueous solution by charcoal and calculation of the constant in Freundlich's equation.
8. Determination of the equilibrium constant of the reaction $\text{KI} + \text{I}_2 = \text{KI}_3$.
9. Determination of titration curve for the titration of a weak base with a strong acid and a strong base with a weak acid pH metrically and hence finding their strengths.
10. Determination of solubility of a sparingly soluble salt in water by conductance measurement.
11. Determination of velocity constant for the hydrolysis of an ester in the basic medium by conductance measurement.
12. Determination of the molecular weight of an organic solid like camphor by cryoscopy.
13. Determination of the molecular weight of a solid like naphthalene by ebullioscopy.
14. Determination of dissociation constants of some organic weak acids by potentiometric method.
15. Determination of heat of solution by solubility methods

204. Pharmacognosy-II (Marks-20)

1. Pharmacognostic study of a few selected powdered drugs
2. Chromatographic techniques: Analysis of plant extracts by thin layer chromatography.
3. Study of volatile oils and some volatile-oil containing drugs: Caraway, clove, cinnamon, peppermint, etc.
4. Detection of adulterants, (i.e. cotton seed, sesame-and arachis-oils) in olive oil
5. Examination of cod liver oil and detection of vitamin A in cod liver oil .
6. Extraction and isolation of anthraquinone glycosides from cascara sagrada , aloe, senna and rhubarb.
7. Isolation of lycopene from tomato.
8. Isolation of β -carotene from carrot.
9. Examination of some saponin containing drugs: Sarsaparilla, dopscorea, etc.
10. Study of few important cardio active drugs: Digitalis, strophanthus and squill.
11. Study of alkaloids and some alkaloid-containing drugs: Belladonna, strammonium, cinchona, rauwolfia, tea, coffee, tobacco, ergot, ephedra, nux vomica and areca.
12. Isolation of lactose from cow's milk.
13. Physical and chemical tests for honey.
14. Study of some Important medicinal and poisonous plants of Bangladesh

205. Physiology and Biochemistry-II (Marks-20)

1. Demonstration of the effects of temperature on toad heart.
2. Demonstration of the effect of stannous ligature on frog's heart.
3. Demonstration of the effects of drugs on toad heart.
4. Demonstration of the effect of electrolytes (Na^+ , K^+ , Ca^{++} etc.) on toad heart.
5. Recording of respiration by stethograph.
6. Measurement of blood pressure (B. P.) by sphygmomanometer. Effects of physical exercise on B. P. and heart rate.
7. Effect of ptyalin of saliva on starch
8. Collection of gastric juice: Tests for gastric acidity.
9. Estimation of blood sugar in normal person.
10. Properties of frog muscle and nerve preparation.

206. Pharmacology-I (Marks-20)

1. Study of drugs acting on CNS a) CNS stimulants (strychnine/ ephedrine /amphetamine) b) CNS depressants (barbiturate-induced sleeping time)
2. Local anesthetics a) Action of local anesthetics on human skin b) Rabbit's corneal test for surface anesthetics
Drug antagonism: Effects of histamine and antihistamine on guinea pig.
Study of the effects of diuretics and antidiuretics on the rate of urinary flow in dogs.

207. Pharmaceutical Technology-I (Marks-25)

1. General dispensing: Receiving a prescription and writing up in detail. b) Wrapping powdered drug: dispensing of a sample. c) Dispensing of a prescription containing powders which form eutectic mixture. d) Dispensing of a prescription containing efflorescent powders. e) Dispensing of a prescription containing a small dose powdered drugs. f) Dispensing of a prescription containing hygroscopic and deliquescent powders.
2. Preparation of percent solution and calculation
3. Preparation of granular effervescent powder
4. Preparation of aromatic water
5. Preparation of syrup a) Phenobarbitone- Na syrup b) Chlorpheniramine maleate syrup c) Promethazine- HCl syrup d) Iron syrup.
6. Preparation of suspension a) Paracetamol suspension b) Antacid suspension c) Chalk powder suspension.
7. Preparation of emulsion and identification of type of emulsion. a) Primary emulsion by dry gum method and wet gum method b) Castor oil emulsion.

B. Pharm. (Honours) Part-III
 Course: 301 (Unit -1)
 Course Title: Pharmaceutical Analysis-I
 Full marks- 100

1. Introduction and Techniques of Pharmaceutical Analysis.
 - a) Introduction: Selection of samples, selection of chemicals.
 - b) The Art and Science of Pharmaceutical Analysis: Choosing the tools, identification of containers, filtration, ignition of precipitates, drying of samples, recording results.
2. Titrimetric Analysis:
 - a) Aqueous Acid-Base Titrations: Definitions, distribution of acid base species with pH of the medium, acid-base titration for determination of acidic and basic pharmaceuticals.
Indicators: theories, selection and applications.
 - b) Oxidation-Reduction Titrations: Principles and concepts, determination involving potassium permanganate, potassium dichromate and potassium bromide. Iodimetric determination, miscellaneous oxidation and reduction titrations, indicators and applications.
 - c) Complexometric Titrations: Introduction, complexes and chelates, stability of complex ions, titrations based on complex formation, types of complexometric titrations, techniques employed in chelometric titration, methods of end point detection, titration selectivity and masking reagents.
 - d) Non-aqueous Acid Base Titrations: Theoretical considerations and principles of Bronsted-Lowry theory of acids and bases, non aqueous solvents, titration of weak acids and weak bases, applications and scope of non aqueous titration.
3. Determination of Moisture Content in Pharmaceutical Products: Principle and scope, physical and chemical methods of water determination, Karl-Fischer principle, procedure, chemistry, methodology, equipment, end point detection and limitations.
4. Separation Technique:
 - a) Introduction, principles, procedures and theories of column chromatography, size exclusion chromatography and gel filtration techniques, thin layer chromatography, ion exchange chromatography, methods of detection and applications.
 - b) HPLC: Introduction, theory and principle, instrumentation, characteristics of stationary and mobile phases, reversed phase HPLC and application.
5. Instrumental Methods of Analysis:
 - a) Molecular absorption spectroscopy: Definition, properties and spectrum of EMR, theory, Instrument, chromophore & auxochrome concept, solvent effect, drug identification, potency determination etc.
 - b) Polarimetry: Introduction, origin of optical rotation, molecular requirements for optical rotatory power, methods used in polarimetry instrumentation and application.
Optical rotatory dispersion (ORD) and circular dichroism (CD): theory, measurement, interpretation of curves and application of ORD and CD in pharmacy.
 - c) Fluorometry: Introduction, theory of fluorescence & phosphorescence, instrumentation for measuring fluorescence, factors influencing intensity of fluorescence, comparison of fluorometry and spectrophotometry, application of fluorometry in pharmaceutical analysis.

Recommended Books:

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| (i) | A.H. Beckett, and J. B. Stenlake | : Practical Pharmaceutical Chemistry Vol. I & II |
| (ii) | K. A. Connors | : A Textbook of Pharmaceutical Analysis |
| (iii) | L.G. Chatten | : Pharmaceutical Chemistry Vol. I & II |
| (iv) | A.M. Knevel and F.E. DiGangi | : Jenkins Quantitative Pharmaceutical Chemistry |
| (v) | T. Higuchi and E. Brockman-Hanssen | : Pharmaceutical Analysis |
| (vi) | A. I. Vogel | : Textbook of Quantitative Analysis |
| (vii) | V. Alexeyev | : Quantitative Analysis |
| (viii) | Douglas A Skoog | : Principles of Instrumental Analysis |
| (ix) | B.K. Sharma | : Instrumental Methods of Chemical Analysis |
| (x) | R.M. Verma | : Analytical Chemistry, Theory and Practice |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-III
 Course: 302 (Unit -1)
 Course Title: Medicinal Chemistry-I
 Full marks- 100

1. Stereochemistry:
 - a) Geometric isomerism of alkenes and cyclic compounds, cis, trans and (E), (Z) systems of nomenclature.
 - b) Conformational isomers, conformation of open chain and cyclic compounds.
 - c) Chirality of molecules, enantiomer, diastereomer, racemic modification, meso compound, (R) and (S) configuration, sequence rule, and optical rotation.
 - d) Stereoselective and stereospecific reaction.
 - e) Pharmaceutical importance of stereochemistry study.
2. Name Reactions: Baeyer-Villiger reduction, Cannizzaro reaction, Clemmensen reduction, Diels Alder reaction, Friedel-Crafts alkylation and acylation reaction, Gabriel synthesis, Gattermann-Koch and Sandmeyer reaction, Grignard reaction, Hoffman degradation reaction, Mannich reaction, Michael and Meerwin Ponderf-Verley reduction, Oppenauer oxidation, Perkin reaction, Reformatsky reaction, Reimer-Tiemann reaction, Wittig and Wolf-Kishner reduction.
3. Chemistry of Natural Products :
 - a) Alkaloids: Occurrence, isolation, classification and properties of alkaloids, structure determination, synthesis and physiological activities of ephedrine, nicotine, atropine and morphine.
 - b) Terpenoids: Occurrence, isolation and classification, synthesis of geraniol, citral, ionones and amyryl.
 - c) Vitamins: Occurrence, classification and general methods of isolation of vitamins, structure determination, synthesis and biological functions of vit-A, vit-B and vit-C.
 - d) Hormones: Occurrence, classification, synthesis and functions of male & female sex hormones and thyroid hormone.
 - e) Antibiotics: Occurrence, isolation, structure determination, synthesis and clinical properties of penicillin, streptomycin, chloramphenicol and tetracycline.
 - f) Natural pigments: (i) Carotenoids : Occurrence, isolation, classification and properties of carotenoids, structure determination, synthesis and physiological activities of carotenes and carotenols
 (ii) Flavonoids: Occurrence, isolation, classification and properties of flavonoids, structure determination, synthesis and physiological activities of flavonols and isoflavones.
4. Nucleic Acid: Chemistry of nucleic acids, bases, nucleosides, nucleotides, polynucleotides, nucleoproteins, RNA and DNA. Structure determination & synthesis of adenine, guanine, cytosine, uracil & thymine.

Recommended Books:

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| (i) B.S. Bahl and Arun Bahl | : Advanced Organic Chemistry |
| (ii) I.L. Finar | : Organic Chemistry Vol. I & II |
| (iii) O.P. Agarwal | : Chemistry of Organic Natural Products Vol. I & II |
| (iv) Raj K. Bansal | : Organic Reaction Mechanisms |
| (v) Lehninger, Nelson and Coxs | : Principles of Biochemistry |
| (vi) Alfred Burger | : Medicinal Chemistry Vol. I & II |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-III
 Course: 303 (Unit -1)
 Course Title: Pharmacology-II
 Full marks- 100

1. Mechanism of Drug Action: a) Basic concept of drug action. b) Physico-chemical nature of drugs. c) Drug receptors. d) Binding forces in drug-receptor interaction e) Receptor and non receptor mechanisms of drugs. f) Macromolecular nature of drug receptors. g) Relationship between drug concentrations versus response: Concentration-effect curve and receptor binding of agonists, competitive and irreversible antagonism, partial agonists, receptor-effector coupling and spare receptors, other mechanisms of drug antagonism.
2. Antibiotics and Chemotherapeutic Agents: Introduction, classification, chemistry, mode of action, structure-activity relationship, pharmacokinetics, indications, contraindications. Dose, adverse effects and drug interactions of the following individual class of drugs: i) Sulfa drugs. ii) Penicillins and Cephalosporins. iii) Tetracyclins, Chloramphenicol, Aminoglycosides and Macrolides. iv) Antifungal agents. v) Antileprosy drugs. vi) Miscellaneous antibacterial agents: a) Glycopeptide antibiotics. (b) Polymixin antibiotics. (c) Bacitracin. (d) Nitrofurantoin.
3. Cardiovascular Drugs: 1) Functioning and diseases of the heart, arrhythmia, ischemia, angina pectoris, coronary thrombosis, myocardial infarction, arteriosclerosis, atherosclerosis, hypertension and congestive heart failure. 2) Introduction, classification, chemistry, mode of action, structure activity relationship, pharmacokinetics, indications, contra indications, dose, adverse effects and drug interactions of the following individual class of drugs: a) Digitalis and allied drugs b) Antihypertensive drugs: (i) -Blockers, Prazosin, etc. (ii) -Blockers, Propanolol, etc. (iii) M.A.O. inhibitors, Methyldopa, Rauwolfia alkaloids. (iv) Ca-channel blocking agents. (v) Vasodilators: Nitrites and nitrates. 3) Diuretics: Cardiac anhydrase inhibitors, low and high ceiling diuretics, potassium sparing diuretics and osmotic diuretics. 4) Antiarrhythmic drugs: Quinidine, Procaine amide.
4. Antidiabetic Drugs: a) Introduction and classification of diabetes. b) Hyperglycemia and hypoglycemia. c) Introduction, classification, chemistry, mode of action, structure activity relationship, pharmacokinetics, indications, contraindications, dose, adverse effects and drug interaction of the following individual class of drugs: Oral hypoglycemic agents: (i) Sulfonylureas (ii) Biguanides. Hormone preparation: insulin. Management of diabetes mellitus.
5. Drug Acting on ANS:
 - a) (i) Parasympathomimetic agents: Acetyl choline, Methacoline, Carbachol. (ii) Sympathomimetic drugs: Epinephrine, norepinephrine. (iii) Anticholinesterase agents: Physostigmine, Edrophonine. Organophosphorous compounds.
 - b) (i) Antimuscarinic Agents or Atropine Drugs: atropine sulfate, scopolamine hydrobromide, homatropine hydrobromide. (ii) Drugs inhibiting adrenergic nerves and structures innervated by them, Adrenergic blocking agents.
 - c) Ganglion Stimulating and Blocking Agents.

Recommended Books:

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| (i) H. P. Rang, M. M. Dale and J. M. Ritter | : Pharmacology |
| (ii) A. Goodman Gilman, T. W. Rall, A. S. Nies and P. Taylor | : Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II |
| (iii) R. S. Satoskar and S. D. Bhandarkar | : Pharmacology and Pharmacotherapeutics Vol. I & II |
| (iv) A. Goldstein, L. Aronow and S.M. Kalman | : Principles of Drug Action, The Basis of Pharmacology |
| (v) M. Misbahuddin and M.R. Islam | : General Principles of Pharmacology |
| (vi) B. G. Katzung | : Basic and Clinical Pharmacology |
| (vii) F..H. Meyers, E. jawelz and A. Goldfien | : Review of Medical Pharmacology |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-III
 Course: 304 (Unit –1)
 Course Title: Biopharmaceutics-I
 Full marks- 100

1. Introduction to Pharmaceutics and Biopharmaceutics: Biopharmaceutics, pharmacokinetics, clinical pharmacokinetics, pharmacodynamics, toxicokinetics, measurement of drug concentrations, interpretation of drug-plasma level curve.
2. Mathematic Fundamentals in Pharmacokinetics: Graphs, units in pharmacokinetics, measurement and use of significant figures, units for expressing blood concentrations, statistics, rates and orders of reactions.
3. Gastrointestinal Absorption of Drugs:
 - a) Route of drug administration, membrane physiology, passage of drugs across cell membranes, gastrointestinal physiology and oral drug absorption.
 - b) Factors affecting drug absorption: pKa and gastrointestinal absorption, pH-partition theory and other physicochemical factors, effects of disease states on drug absorption.
 - c) Dosage form consideration: Role of different dosage form like solution, suspension. tablet, capsule, emulsion etc. on gastrointestinal absorption.
 - d) Dissolution and drug absorption: Dissolution process, Noyes-Whitney equation, Hixson-Crowell Cube Root Law, factors influencing dissolution, dissolution test apparatus, in-vitro & in-vivo correlations of dissolution, drug release patterns.
4. Distribution of Drugs:
 - a) Important Pharmacokinetic Parameters: Biological half-life, apparent volume of distribution, area under the curve, absorption and elimination rate constant etc.
 - b) Drug-Protein Interaction: Theoretical aspect of protein-drug interaction, methods used for protein binding, identification of drug binding sites, kinetics of protein binding, determination of bindings sites and association constant, factors affecting protein binding, effects of protein binding on drug distribution, elimination and pharmacological effects of drugs.
5. Drug Clearance:
 - a) Theoretical aspects of drug elimination, excretion and biotransformation.
 - b) Renal Elimination: Glomerular filtration, active tubular secretion, tubular reabsorption. Determination of renal clearance.
 - c) Biotransformation of Drugs: Definition, drug biotransformation reactions, pharmacokinetics of drugs and metabolites (Michelis-Menten equation), hepatic elimination, first pass effect, liver excretion ratio, relation between absolute bioavailability and liver excretion, hepatic clearance-relationship between blood flow, intrinsic clearance and hepatic clearance, hepatic clearance of a protein bound drug (effect of protein binding on hepatic clearance).
 - d) Biliary excretion of drug.
6. Bioavailability and Bioequivalence: Definitions of different parameters relative to bioavailability, purpose of bioavailability, relative and absolute to bioavailability, methods of assaying bioavailability, criteria for bioequivalence studies, method and determination of bioavailability
7. Drug product selection on the basis of bioavailability testing.

Recommended Books:

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| (i) | Leon Shargel and Andrew B.C. Yu | : Applied Biopharmaceutics and Pharmacokinetics |
| (ii) | Milo Gibaldi | : Biopharmaceutics and Clinical Pharmacokinetics |
| (iii) | Donald E. Cadwallader | : Biopharmaceutics and Drug action |
| (iv) | Bourne, Triggs and Eadie | : Pharmacokinetics for the Non-mathematical |
| (v) | CVS Subrahmanyam | : Textbook of Physical Pharmaceutics |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-III
Course: 305 (Unit -1)
Course Title: Pharmaceutical Engineering
Full marks- 100

1. Drying: Definition, importance of drying, terminology, theory & fundamental concepts, periods of drying, constant rate period, falling rate period, critical moisture content, equilibrium moisture content, classification : direct, indirect, radiation, dielectric, batch and continuous, dryers, types of beds: static, moving, fluidized, pneumatic bed systems, different drying equipments(construction, operation, merits, demerits): tray dryer, through-circulation dryer, pneumatic conveying dryer, rotary dryer, spray dryer, tunnel dryer, steam tube rotary dryer, agitated pan dryer, vacuum rotary dryer and freeze dryer, selection of drying equipment, preliminary dryer selection, drying tests, final selection.
2. Filtration: Definition, importance of filtration, difference with expression, sedimentation and drying. Classification of filters, theory of filtration, filter media, filter aids, filter thickeners, different filtration equipment :(construction, operation, merits and demerits) the gravity nutsche, delpark industrial filter, bag filters, sand filters, plate and frame press, recessed plate filter press, Eimco-Burwell plates and frames, Readco short cycle filter, vertical pressure leaf filter, horizontal plate filter, industrial tubular filter, Rodney Hunt pressure filter, Moore filter, vacu-flow suction leaf filter, string discharge filter, clarifying filters, selection of filtration equipment.
3. Centrifuges: General principles, magnitude of centrifugal force, materials of construction, critical speed, sedimentation centrifuges, filtering centrifugal, centrifuge auxiliaries, drive mechanisms, feed and discharge lines, feed treatment, selection of centrifugal separators.
4. Mixing:
 - a) Solid-Solid Mixing: Importance, fundamentals, batch homogeneity, types of solids-mixing machines: (mixing mechanisms and operations) double cone, twin shell, horizontal drum, double-cone revolving around long axis, ribbon, vertical screw, batch muller, continuous muller, twin rotor. Performance, characteristics, selection of machines.
 - b) Paste Mixing: Definition, importance, simple blending, dispersion operations and general equipment design. Standard types of equipment and operations, change-can mixer, change-can mixer with planetary motion, change-can mixer with rotating turntable, troy angular mixer, duplex mixer, stationary-tank mixer, kneader, mullers, three-roll mill, selection of process and mixer.
 - c) Liquid Mixing: Definition, importance, mixing equipment, axial and radial flow impellers, mechanisms, flow patterns, impellers, flat-blade and curved blade turbines, spiral turbines, paddles, gate impellers, anchor impellers, different fixed-mounted and portable positions, shaft lengths, baffled and unbaffled tanks, vortex formation and its control, selection of impeller.
5. Milling: Definition, application and limitations, factors affecting milling operation, mechanisms of size reduction process, methods of size reduction by cutter mill, roller mill, hammer mill, ball mill, vibration mill, edge runner mill, end runner mill, fluid energy mill, hand mill, colloid mill (principle, design, operation and advantages) and selection of a mill.
6. Air conditioning, Refrigeration & Humidity Control:
 - a) Air conditioning: Definition, importance, pharmaceutical application, differences between air conditioner & air cooler, comfort zone, different types of air conditioners, selection of an air conditioner, design of an air conditioned room, pharmaceuticals needing air conditioning.
 - b) Refrigeration: Definition, pharmaceutical application, refrigerators design, mechanism of cooling, refrigerants, brine selection, pharmaceuticals needing refrigerated storage.
 - c) Humidity control: Terminology (psychometry, absolute humidity, relative humidity, dew point, humid heat, humid volume, wet bulb temperature and adiabatic saturation temperature), relationship between wet bulb and adiabatic saturation temperatures, humidifier, dehumidifier, uses of psychometric charts, measurement of humidity and applications of humidity control.

Recommended Books :

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| (i) E. A. Rawlins | : Bentley's Textbook of Pharmaceutics |
| (ii) L. Lachman, H.A. Liebernan, J.L. Kanig | : The Theory and Practice of Industrial Pharmacy |
| (iii) S. J. Carter | : Cooper and Gunn's Dispensing for Pharmaceutical Students |
| (iv) M. E. Aulton | : Pharmaceutics, the Science of Dosage Form Design |
| (v) H. C. Ansel and N. G. Popovich | : Pharmaceutical Dosage Forms and Drug Delivery Systems |
| (vi) A. R. Gennaro | : Remington, The Science and Practice of Pharmacy |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-III
 Course: 306 (Unit-1)
 Course Title: Pharmaceutical Technology-II
 Full marks- 100

1. Formulation & Manufacturing of Tablets: Manufacturing of tablets by wet granulation, dry granulation & direct compression. Granulation of powders for tableting. Advantages and disadvantages of different processes, processes and machineries used in tablet manufacturing.
2. Common Tableting Problems and Evaluation of Tablets: Hardness measurement, weight variation tests, thickness and diameter, friability, disintegration time, dissolution time, mechanism of tablet disintegration and dissolution. In-process quality control, study of common tableting problems.
3. Tablet Coating: Definitions and classification of coating methods, advantages and disadvantages of coated tablets. Different methods of coating: Sugar coating: different stages of sugar coating, problems of sugar coating. Film coating: Theory of film coating, film formers, plasticizer, solvents. Enteric coating: Enteric coating polymers, formulations of enteric coating. Dry coating (compression coating). Comparison between sugar coating and film coating. Aqueous film coating techniques. Modern film coating materials and coating formulations. Problems of organic and aqueous film coating. Coating machines: Conventional coating machines, perforated coating machines, fluidized coating machines.
4. Capsules:
 - a) Hard Gelatin Capsules: Definition and classification, advantages and limitations of capsule dosage form, gelatin and its manufacture, manufacture of hard capsule shells, properties of capsules, formulation of capsules, capsule filling machines, tooling and accessories. Problems in capsule manufacturing, quality control methods of capsules, packaging of capsules.
 - b) Soft Gelatin Capsules: Definitions and classifications, advantages and limitations, properties, formulation, manufacturing, quality control and packaging of soft capsules. Problems and remedy of soft capsule manufacturing.
5. Microencapsulation Technology: Purpose, methods of preparation, evaluation, pharmaceutical and biological applications of microencapsulation process.
6. Suppositories: Definition, advantages & disadvantages, Classification of suppositories, Suppository bases, formulation of suppositories, manufacturing of suppositories, Displacement value of testing of suppositories, Mechanism of absorption of medicaments from suppositories.

Recommended Books :

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|---|--|
| (i) E. A. Rawlins | : Bentley's Textbook of Pharmaceutics |
| (ii) L. Lachman, H.A. Liebernan, J.L. Kanig | : The Theory and Practice of Industrial Pharmacy |
| (iii) S. J. Carter | : Cooper and Gunn's Dispensing for Pharmaceutical Students |
| (iv) M. E. Aulton | : Pharmaceutics, the Science of Dosage Form Design |
| (v) H. C. Ansel and N. G. Popovich | : Pharmaceutical Dosage Forms and Drug Delivery Systems |
| (vi) A. R. Gennaro | : Remington, The Science and Practice of Pharmacy |
| (vii) L.W. Dittert | : Sprowl's American Pharmacy |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-III
Course: 307 (Unit –0.5)
Course Title: Cosmetology
Full marks- 50

1. The skin and skin creams: (A) Introduction, epidermis and keratinizing system, pigmentary system, exocrine sweat glands, hair follicles, sebaceous glands, apocrine glands, common disorders of the skin. (B) Skin creams: Introduction, classification of skin creams, cold cream, vanishing creams, emollient cream & lotion.
2. Hair Preparations:
 - (A) Hair products: Introduction, shampoos; hair setting lotions, hair tonic, conditioners.
 - (B) Shaving preparations: Introduction, lather shaving cream, brushless or non-lathering cream, aerosol shaving foams, after shave preparations.
 - (C) Depilatories: Introduction, formulation and manufacture of chemical depilatories: perfuming, packaging, assay and toxicities of depilatories.
3. Teeth and dental products: Physiology and common diseases of teeth; introduction, formulation and manufacture of dentifrices, quality control of dentifrices, toothpastes, tooth powder, mouthwash and gargles.
4. (A) Lip-products: Introduction, Lip skin, Characteristics of an ideal lip sticks, colors, pigments, bases, perfumes antioxidants used in lipsticks, formulations, manufactures, toxicities, analysis and quality control of lipsticks. (B) Brief study on deodorant: Introduction, perspiration and its control, formulation, manufacture, labeling of antiperspirants, deodorants, Talcum powder, perfume, etc.
5. Eye makeup: Introduction, formulation, manufacture and evaluations of eye shadow, mascara, eye brow pencils, eye liners etc.
6. Nail lacquers and removers: Introduction, raw materials, formulations, manufactures and evaluations of nail lacquers and nail lacquer removers.
7. Herbal preparations

Recommended Books:

- (i) M. S. Balsam and E. Sagarin : Cosmetics, Science and Technology Vol. I & II
- (ii) Pulok K. Mukherjee : Quality control of herbal drugs
- (iii) M. Vimaladevi : Text book of Cosmetics
- (iv) J.B. Wilkinson : Harry's cosmetology
R.J. Moore

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-III
 Course: 308 (Unit –0.5)
 Course Title: Hospital and Community Pharmacy
 Full Marks - 50

1. Hospital Pharmacy:

- A) Introduction: Goals, minimum standards, abilities required for a hospital pharmacist. Hospital as an organization, classification, organizational patterns, management and administration, different departments and services, role of a pharmacist in the hospital. Hospital pharmacy, organizational and personnel, supportive personnel, pharmacy education, job descriptions.
- B) Pharmacy and Therapeutics Committee: Description and purpose, membership and functions. Hospital formulary, guiding principles, legal basis, principles for admission or deletion of drugs, selection of text.
- C) Investigational Use of Drugs: Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.
- D) Purchasing and Inventory Control: Purchasing agent, purchasing procedure, control on purchases, storage, perishable inventory, physical inventory, perpetual inventory.
- E) Control of Special Classes of Drugs: Use of samples, in-patient drug orders, out-patient prescriptions, ward stock drugs, label symbols. Narcotics and their control, classes, procurement and execution of order forms, dispensing, hospital narcotic regulations, new systems. Floor stock drugs, selection, charge and non-charge, labeling, regulations concerning narcotics, inspection of nursing drug cabinets.
- F) Dispensing to In-and Out Patients: Drug distribution systems, dispensing of charge, non- floor stock drugs, mobile dispensing unit, unit dose dispensing, new concepts. Dispensing to out patients, locality of out-patient dispensing area, dispensing routine, record keeping. Dispensing during off-hours, use of nursing supervisors, emergency boxes and night drug cabinets, pharmacist-on-call. Drug charges in hospitals, pricing, break- even point pricing.
- G) Manufacturing-Bulk and Sterile: Control and budget, manufacturing facility and capacity, operating costs, quality control.
- H) Drug Information Centre and Library: Physical facilities, selection of contents, methods of dissemination, role in educational and training programmes, professional education, internal teaching programmes, external teaching programmes.

2. Community Pharmacy:

Concept of community health care, health needs of the community, different levels of health care, elements of primary health care. Principles of primary health care: Equitable distribution, community participation, intersectoral coordination, appropriate technology, health manpower, health care delivery at different levels, community pharmacy in dealing with communicable diseases problem, nutritional problems, environmental sanitation problems and indigenous systems of medicine, development of community pharmacy infrastructure, participation of non-governmental voluntary health agencies.

Recommended Books:

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|---------------------------------------|--|
| (i) W.E. Hassan | : Hospital Pharmacy |
| (ii) Pratibha Nand and R.K. Khar | : A Textbook of Hospital and Clinical Pharmacy |
| (iii) Anees Ahmed Siddiqui and M. Ali | : Hospital and Clinical Pharmacy |
| (iv) Rashid, Khabiruddin and Hyder | : Textbook of Community Medicine and Public Health |
| (v) Selim Reza | : The Essentials of Community Medicine |
| (vi) K. Park | : Textbook of Preventive and Social Medicine |
| (vii) A. R. Gennaro | : Remington, The Science and Practice of Pharmacy |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-III

Course: 309 (Unit - 0.5)

Course Title: Quality control, Quality Assurance & Validation

Full marks- 50

1. Introduction: Importance of pharmaceutical analysis in the quality control of drugs, sources of quality variation, control of quality variation. Set up of a quality control laboratory for pharmaceutical analysis, personnel, equipment, environments, etc. Types of specifications, sampling, testing program and methods.
2. In Process Quality Assurance Method: Concept of quality assurance, selection and testing of major raw materials input. Methods of drug sampling, statistical quality control of major categories of dosage forms, QA activities, GMP.
3. Pharmaceutical Validation:
 - i. Pharmaceutical room and equipment validation: Importance and process of room and equipment validation.
 - ii. Pharmaceutical process validation: Importance, type of process validation, validation of dissolution process, mixing process, granulation process, tablet compression process, tablet coating process, capsule filling process, injection vial filling process.
 - iii. Pharmaceutical analytical method validation: Importance, linearity, accuracy, precision, limit of detection, limit of quantification, heat sensitivity and system suitability.
4. Management of Quality Assurance: Quality management consideration, quality motivation, total quality management.
5. International standard organization and BSTI (DA) policies for quality in pharmaceutical industries.
6. Concept of Statistical Quality Control: Normal frequency distribution, Q.C. charts, sampling and sampling plan, binomial distribution, tests of significance, consumer acceptance testing, analysis of variance (ANOVA) and experimental design, bio-availability and crossover design, regression correlation, Wilcoxon rank sum test
7. Quality of packaging materials.
8. Quality of analytical methodologies, automated continuous system for assay procedure, associated activities.
9. Quality control of herbal drugs: safety & toxicity profile, development of standardization parameters, extraction, pharmacological screening, quality assurance and stability study of herbal drugs.

Recommended Books

- (i) M. Shah Nawaz Khan : Assurance of Quality Pharmaceuticals
(ii) Pulok K. Mukherjee : Quality control of herbal drugs

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-III
Course: 310 (Unit-2)
Course Title: Practical
Full marks- 200

1. Analytical Pharmacy: (Marks –40)
 - I. Assay of acetyl salicylic acid in aspirin tablets.
 - II. Assay of sodium salicylate tablets
 - III. Determination of potency of penicillin tablets.
 - IV. Non- aqueous assay of phenobarbitone tablets.
 - V. Determination of calcium in solid & liquid dosage form by complexometric titration.
 - VI. Assay of promethazine hydrochloride.
 - VII. Assay of methamphetamine hydrochloride
 - VIII. Assay of aluminum hydroxide gel.
 - IX. Assay of milk of magnesia
 - X. Assay of magnesium and aluminum from antacid preparation.
 - XI. Determination of iodine value, saponification value, acid value and R.M. value of oils and fats.
2. Medicinal Chemistry: (Marks –40)

Synthesis of drug and drug intermediates: a) Paracetamol b) Benzocaine c) Aspirin d) Phenacetin e) PABA (Para amino-benzoic acid f) Meta Nitro-benzaldehyde g) Ethyl para hydroxy-benzoate h) Para Amino phenol i) Methyl salicylate.
3. Pharmacology-II: (Marks –40)
 - I. Estimation of blood glucose by enzymatic method.
 - II. Estimation of blood glucose by chemical method.
 - III. Estimation of aspirin after oral administration by UV spectrophotometric method.
 - IV. Estimation of aspirin after oral administration by calorimetric method.
 - V. Estimation of plasma protein by enzymatic method.
 - VI. Estimation of plasma protein by burette method.
 - VII. Estimation of blood uric acid level by enzymatic method.
 - VIII. Estimation of Paracetamol after oral administration by UV/Visible spectrophotometric method.
 - IX. Handling of experimental animals: mice and rat.
 - X. Different routes of administration of drugs in experimental animals.
 - XI. Assay of serum SGOT and SGPT activities in mice and rat.
 - XII. Assay of serum alkaline phosphatase activity
 - XIII. Isolation and determination of cholesterol content of biological samples.
4. Pharmaceutical Engineering & Technology: (Marks –40)
 - I. Formulation and compounding of different syrups.
 - II. Formulation and compounding of different suspensions.
 - III. Formulation and compounding of different emulsions.
 - IV. Formulation and compounding of ointments.
 - V. Study of different compounds of a 16- station rotary tablet press.
 - VI. Formulation and manufacturing of antihistamine tablets.
 - VII. Formulation and manufacturing of dispersible aspirin tablet.
5. Biopharmaceutics-I: (Marks –40)
 - I. Tablet weight variation test.
 - II. Tablet hardness test.
 - III. Tablet friability test.
 - IV. Tablet disintegration test.
 - V. Tablet dissolution test.
 - VI. Leakage test of packaging of tablets / capsules.
 - VII. Capsule weight variation test
 - VIII. Determination of binding sites and association constant.

B. Pharm. (Honours) Part-IV
 Course: 401 (Unit-1)
 Course Title: Pharmaceutical Analysis-II
 Full Marks – 100

1. Conductometry: Principle, important laws, definition & relations, mobility of ions governing forces, applications. Kohlrausch's Law, apparatus and measurements, experimental details of conductometric titration, high frequency titration, application and limitations.
2. Potentiometry: Terminology, potentiometer, principle, various half cells & electrodes, relation p^H to potential, types and curves of potentiometric titration, methods, applications and advantages.
3. Amperometry: Definition, classification, theory, technique and applications of amperometric titration, titration curve shapes, factor affecting current flow during analysis.
4. Polarographic Analysis: Principle, component of polarogram, Ilkovic equation, diffusion current, factor affecting diffusion current and half wave potential, quantitative analysis and applications. Polarographic maxima suppressor, oxygen wave, supporting electrolyte.
5. Coulometry: Definition, principle, coulometers, current efficiency, background current, various types of coulometric analysis, detection of end-points, advantages, applications and chronopotentiometry.
6. Gas Chromatography: Introduction and principles GLC & GSC, theoretical consideration, component of instruments, column technology, detectors, analytical application of gas chromatography.
7. X-ray Crystallography: Generation and properties of X-ray, diffraction of X-ray by crystals, Bragg's equation, X-ray diffraction methods, powder diffraction patterns, methods of measurement, analysis, indexing of X-ray reflections and determination of space groups, Fourier and Patterson syntheses and application of X-ray analysis in pharmacy.
8. Radiochemical Methods of Analysis: Origin and nature of radioactive isotopes, natural and induced radioactivity, radioactive decay, different type of radiation, radiation detection and their measurement, principles of Geiger-Muller, Scintillation and proportion counters, radio-activation analysis, isotope dilution analysis, characterization, methodology and use of radiometric titrations in pharmaceutical research.
9. a) Bioassay: Prerequisites and development, errors in bioassay and how to overcome them. Statistical design of bioassay.
 b) Principles of Microbiological Analysis (diffusion method) of the Following Drugs:
 - (i) Microbiological Assay: Antibiotics, vitamins, sulfa drugs
 - (ii) Microbial counts: Antacids and water.

Recommended Books:

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| (i) | Gurdeep R. Chatwal and Sham K. Anand | : Instrumental Methods of Chemical Analysis |
| (ii) | A.H. Beckett, and J. B. Stenlake | : Practical Pharmaceutical Chemistry Vol. I & II |
| (iii) | K. A. Connors | : A Textbook of Pharmaceutical Analysis |
| (iv) | L.G. Chatten | : Pharmaceutical Chemistry Vol. I & II |
| (v) | Douglas A Skoog | : Principles of Instrumental Analysis |
| (vi) | B.K. Sharma | : Instrumental Methods of Chemical Analysis |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-IV
 Course: 402 (Unit-1)
 Course Title: Medicinal Chemistry -II
 Full Marks – 100

1. Drug Design and Discovery:

- (i) Drug design: Definition, purposes and factors governing of drug design, Interpretation of SAR of small molecules (sulfa drugs), Design of pharmaceutical dosage forms.
- (ii) Drug discovery: Discovery of new drugs without leads, Lead discovery strategies, Requirements for identification of lead compounds, Principle and development of rational drug design (Cimetidine) and Role of biotechnology in drug design.
- (iii) Drug Development: Objectives, Pharmacophore, Patterns and SAR of drug development from natural sources, Modification synthetic analogues (Variation of Substituents, Bioisosterism, Homologation, Chain Branching and Ring variation).
- (iv) Drug Design for Pharmacokinetics Problems: Metabolic blockers, Prodrugs, Sentry drugs, 'Search and destroy' drugs, Self-destruct drugs, Drug distribution and survival of drugs.
- (v) Introduction of Computational Molecular Modeling of Drug Design: a) Quantitative Structure Activity Relationships (QSAR): Physicochemical properties (hydrophobicity, electronic effects, steric factors, solvent accessible surface area etc), Application of QSAR (Hansch equation, Hammett relationships) on biological systems.

2. Combinatorial Chemistry and Rapid Parallel Syntheses:

- (i) Introduction, various drug discovery processes, design, diversity, expression, methods & techniques, and applications of combinatorial syntheses on drug discovery.
- (ii) Solid phase syntheses: Introduction, various linkers, solid phase peptide synthesis (SPPS): principle, mechanism and application; heterocyclic synthesis.
- (iii) Liquid phase combinatorial synthesis, Dendrimer: supported combinatorial chemistry.

3. Biosynthetic Pathways of Natural Products:

- (i) Alkaloids–I (ii) Terpenoids (iii) Flavonoids (iv) Vitamins (v) Eicosanoids

4. Chemistry, Synthesis and Therapeutic Uses of the Following Drugs:

- (i) Psychotropic drugs : TCA compounds, MAOIs, Phenothiazine derivatives.
- (ii) Antineoplastic drugs : Alkylating agents, Antimetabolites, Plant products.
- (iii) Sedatives & Hypnotic agents : Benzodiazepines, Barbiturates.
- (iv) Antihistaminics : H₁ and H₂ antagonists.
- (v) NSAIDs : Indomethacin, Ibuprofen, Naproxen and Probenecid.
- (vi) Antipyretic Analgesics : Phenacetin, Phenylbutazone, Mefenamic Acid.
- (vii) Cardiovascular Drugs : Hydralazine , Propranolol, Procainamide, Prenylamine.
- (viii) Local Anaesthetics : Benzocaine, Procaine , Lignocaine.
- (ix) Antimalarials : Chloroquine, Pamaquine, Trimethoprim.
- (x) Diuretics : Chlorothiazide , Acetazolamide , Triamterene.
- (xi) Non-steroidal Oestrogens : Stilbesterol, Hexestrol, Dienestrol.

Recommended Books:

- i. Wilson and Gisvolds : Textbook of Organic, Medicinal and Pharmaceutical Chemistry
- ii. Ashutosh Kar : Medicinal Chemistry
- iii. Graham L. Patrick : An Introduction to Medicinal Chemistry
- iv. Alfred Burger : Medicinal Chemistry Vol. I & II
- v. E. J. Ariens : Drug Designs Vol. I, II & III
- vi. O.P. Agarwal : Chemistry of Organic Natural Products Vol. I & II
- vii. W.O. Foye : Principles of Medicinal Chemistry

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-IV
 Course: 403 (Unit -1)
 Course Title: Pharmacology-III
 Full marks- 100

1. Molecular Mechanism of Drug Action: Signaling mechanisms and drug action: Regulation of gene expression by intracellular receptors, Ligand regulated transmembrane enzymes, Ligand gated channels, G-proteins and secondary messengers, such as cyclic-AMP, calcium and phosphoinositides and cyclic-GMP interplay among signaling mechanisms.
2. Drug Metabolism: Various pathway of drug metabolism, metabolism of various group of drugs, factors affecting drug metabolism with special emphasis on aging, methods of studying drug metabolism, new aspects of drug metabolism. cytochrome p-450, induction and inhibition
3. Psychotropic Drugs: Theories of psychosis, Classification, mode of action, SAR, pharmacological actions, indications, toxicities and contraindications of chlorpromazine, TCA, MAO inhibitors, etc.
4. Hormonal Drugs: Biochemistry and mode of action of hormones. Hormones as drugs. Selective serotonic uprke inhibitor. Types of chemical signal, Rule of hormone, mechanism of hormone action, Interaction between hormones, hormone therapy. bioidentical hormones, hormones replacement therapy, Risk, benefits and alternative of hormone replacement therapy.
5. Enzymes in Therapy: General properties of enzymes and their mode of actions, activators, inhibitors and cofactors, enzymatic basis of drug action. Enzymes of pharmaceutical importance, their production, preparation, formation, use and assay methods. fibrinolytic drugs, LHD.
6. Anticancer Agents: (a) Alkylating agents: Nitrogen mustard, alkyl sulphonates and nitrosoureas. (b) Anti-metabolites: (i) Folic acid analog (ii) Pyrimidine analog (iii) Purine analog and related inhibitors. (c) Natural products: (i) Vinca alkaloids (ii) Antibiotics (iii) Miscellaneous agents (metal complexes, radioisotopes, hormones, etc.)
7. Pharmacological Studies of Various Groups of Drugs:
 - I. Drugs used in the treatment of tuberculosis: (a) Chemotherapeutics: INH, para-aminosalicylic acid, ethambutol, pyrazinamide, etc. (b) Antibiotics: gentamicin, rifampicin, streptomycin, etc.
 - II. Antidiarrhoeal agents: ORS, tetracycline, streptomycin, sulfonamide, loperamide and spasmodic drugs, etc.
 - III. Anti-fertility drugs: Oral contraceptives, mechanical barriers, implants, foams, etc.
 - IV. Drugs used in Acquired Immune Deficiency Syndrome (AIDS)
8. Toxicology:
 - a) Principles, evaluation in animals, determination of LD₁₀, LD₅₀, ED₅₀, therapeutic index, etc.
 - b) Adverse drug reactions, causes of adverse reactions, factors affecting side effects of drugs.
 - c) Drug allergy, tests for prediction of drug allergy.

Recommended Books:

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| (i) | Wilson and Gisvolds | : Textbook of Organic, Medicinal and Pharmaceutical Chemistry |
| (ii) | A. Goldstein and L. Aronow | : Principles of Drug Action, The Basis of Pharmacology |
| (iii) | R. A. Harvey and P. C. Champe | : Lipponcott's Illustrated Reviews Pharmacology |
| (iv) | R. S. Satoskar and S. D. Bhandarkar | : Pharmacology and Pharmacotherapeutics Vol. I & II |
| (v) | Craig and Stitzel | : Modern Pharmacology |
| (vi) | Laurence and Bennett | : Clinical Pharmacology |
| (vii) | Davidson | : Principles and Practice of Medicine |
| (viii) | S. Vincent, T. Devita, S. Hellman and S.A. Rosenberg | : Cancer, Principles and Practices of Oncology |
| (ix) | Pratti | : Anticancer Drugs |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-IV
 Course: 404 (Unit -1)
 Course Title: Biopharmaceutics-II
 Full marks- 100

1. Compartmental Analysis: Introduction:
 - a) One compartment open model, determination of plasma concentration from one compartment open model, calculation of apparent volume of distribution, calculation of K from urinary excretion data.
 - b) Multiple-Compartment models: (i) Two compartment open model, method of residuals, apparent volumes of distributions, drug in tissue compartment, elimination rate constant (ii) Three compartment open model: method of residuals, determination of area under curve, apparent volumes of distribution, elimination rate constant.
2. Pharmacokinetics of Drug Absorption: Zero order absorption model, first order absorption model, determination of absorption rate constants from oral absorption data: method of residuals Wagner Nelson method, determination of k_a from two compartment oral absorption data, Loo Riegelman method.
3. Multiple Dosage Regimens (MDR): Drug accumulation, repetitive intravenous injection, multiple oral dosage regimens, loading dose and determination of bioavailability and bio-equivalency from MDR.
4. Intravenous Infusion: One compartment model drugs, two compartment model drugs, infusion plus loading dose.
5. Dosage Adjustment in Renal Disease:
 - a) Pharmacokinetic considerations, general approaches for dose adjustment in renal disease, dose adjustment based on drug clearance, method based on changes in the elimination rate constant, measurement of glomerular filtration rate (GER), calculation of creatinine clearance from serum creatinine concentration. Dose adjustment based on Nomogram. Giusti Hayton method, Wagner method.
 - b) Extracorporeal removal of drugs, dialysis.
6. Relationship between pharmacokinetic and therapeutic responses: Pharmacokinetics and pharmacodynamics, relation of dose to pharmacologic effect, relation between dose and duration of activity, effect of dose and elimination half-life on the duration of activity, rate of drug absorption and pharmacodynamic response, drug tolerance and physical dependency, drug distribution and pharmacologic response,
7. Impact of drug product quality and Biopharmaceutics on clinical efficacy: Risks from medicines, drug product quality, Good Manufacturing Practices(GMP), cGMP; drug manufacturing requirements, Scale-up and post-approval changes (SUPAC), postmarketing surveillance.

Recommended Books:

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| (i) Leon Shargel and Andrew B.C. Yu | : Applied Biopharmaceutics and Pharmacokinetics |
| (ii) Milo Gibaldi | : Biopharmaceutics and Clinical Pharmacokinetics |
| (iii) Donald E. Cadwallader | : Biopharmaceutics and Drug action |
| (iv) Bourne, Triggs and Eadie | : Pharmacokinetics for the Non-mathematical |
| (v) CVS Subrahmanyam | : Textbook of Physical Pharmaceutics |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-IV
 Course: 405/ Unit-1
 Subject: Pharmaceutical Technology-III
 Full Marks – 100

- 1) Compaction and Compression of Powder: Physics of tablet compression, different stages of tablet compression, effect of compression force on tablet properties, strength of tablet, factors affecting the strength of tablet, mechanism of bonding to tablets, problems associated with large scale manufacturing of tablet.
- 2) Sustained Release Drug Delivery Systems: Definition, advantages and limitations of SR dosage forms, principle of SR dosage forms, classification and types of SR dosage forms, methods of obtaining SR effects of drugs, formulation and manufacturing of SR matrix tablets, release mechanism of drug, sustained action oral liquids, parenteral sustained action dosage form, pellets, dose calculation for SR dosage forms, in vitro and in vivo evaluation of sustained action dosage form.
- 3) Aerosol Science and Technology: Definition and classifications of aerosols, advantages and disadvantages of aerosols, propellants for aerosol manufacturing, components of aerosol formulations, systems of aerosol, container, valves and actuators for aerosols, manufacturing of aerosols, metered dose inhalers and dry powder inhalers, testing and quality assurance of aerosols.
- 4) Design and Operation of Clean Rooms: Source of contamination, classification of clean rooms, air flow systems conventional flow, unidirectional flow, laminar air flow units, air filtration mechanisms, fibrous filters and HEPA filters, temperature and humidity control, building design, construction and use, personnel, protective clothing, cleaning and disinfection, commissioning tests of clean and aseptic rooms, routine monitoring tests, the operation of clean and aseptic rooms, key factors in clean room operations.
- 5) i) Parenteral Products: Definition and classification of parenteral products, formulation considerations, vehicles and additives, containers, manufacturing consideration, environment, manufacturing techniques, raw materials and machines, quality control of parenteral products.
 ii) Ophthalmic Products : Anatomy of eye and adrena, absorption of drugs in the eye, classification of ophthalmic products, formulation, vehicles and additives, manufacturing consideration, environment, manufacturing techniques, ocular drug delivery system, quality control of ophthalmic products.
- 6) Packaging Technology: Purpose of packaging, properties of packaging materials, factors influencing choice of package, advantages and disadvantages of different packaging materials, glass and glass containers, metal and metal containers, plastic and plastic containers, films foils and laminates, rubber based materials, closures, tamper resistant packaging, testing and quality assurance of packaging materials, different packaging machines and accessories, organization of packaging line and labeling.

Recommended Books :

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| (i) E. A. Rawlins | : Bentley's Textbook of Pharmaceutics |
| (ii) L. Lachman, H.A. Liebernan, J.L. Kanig | : The Theory and Practice of Industrial Pharmacy |
| (iii) S. J. Carter | : Cooper and Gunn's Dispensing for Pharmaceutical Students |
| (iv) M. E. Aulton | : Pharmaceutics, the Science of Dosage Form Design |
| (v) H. C. Ansel and N. G. Popovich | : Pharmaceutical Dosage Forms and Drug Delivery Systems |
| (vi) A. R. Gennaro | : Remington, The Science and Practice of Pharmacy |

* Other Books will be indicated by respective teachers

B.Pharm. (Honours) Part-IV
 Course: 406 (Unit-1)
 Course Title: Molecular Biology and Biotechnology
 Full Marks-100

Molecular Biology:

1. Introduction to Cell: Differences between prokaryotic cells and eukaryotic cells, structure and functions of mitochondria, and chloroplasts, cytoskeleton, cell development and differentiation.
2. Nucleic Acid: Structure, classification, isolation and purification of nucleic acid, detection and quantification of DNA, chemical and enzymatic hydrolysis and hybridization.
3. Central Dogma of Molecular Biology:
 - a) Replication: DNA replication, DNA polymerases, types of DNA replication, and inhibitors of replication.
 - b) Transcription: RNA synthesis and mRNA processing (post-transcriptional modification of mRNA, promoters, enhancers and transcriptional factor) in bacteria and yeast, inhibitors of transcription.
 - c) Genetic code: Characteristic feature of genetic code, Wobble hypothesis with experimental evidence, initiation and termination codon.
 - d) Translation: Structure of Ribosome, mechanism of translation, (protein synthesis), post-transcriptional modification, inhibitors of translation.
4. Proteins: Structures of proteins, important domains and their functions, conformational changes of protein, denaturation and renaturation of protein, synthesis of protein and protein sequencing.
5. Mutation: Types of mutation, molecular mechanism of mutation, site specific mutagenesis, mutation hot spot, DNA repair mechanism, inheritant mutational diseases.
6. Techniques in Molecular Biology: Polymerase chain reaction (PCR), DNA sequencing techniques, Southern, Northern and Western blotting, agarose gel electrophoresis, SDS- PAGE, RT-PCR, In vitro kinase assay and microarray analysis.

Biotechnology:

1. General Introduction: Definition and historical perspective, scope, potential and achievements, Pharmacist and biotechnology, GMP compliance and Biopharmaceutical facilities.
2. Fermentation Technology: General consideration: Introduction and historical perspectives; the fermentation process and optimization; Improvement of microbial strain-Mutations, recombination, protoplast fusion; Structure and types of fermenters. Fermentation of industrial products- antibiotics, vitamins and amino acids.
3. Recombinant DNA technology: Basic principle, cutting and rejoining of DNA molecules, restriction endonuclease, ligase and other enzymes used in gene cloning, cloning of particular fragment of gene in different vector, expression in the recombinant DNA molecules, cDNA library construction, pharmaceutical application of recombinant DNA technology.
4. Gene Therapy: Ex vivo versus in vivo therapy, potential target diseases for gene therapy, gene transfer method, non-viral gene transfer.

Recommended Books:

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| (i) | De Robertis | : Cell and Molecular Biology |
| (ii) | Stefen Surzycki | : Human Molecular Biology |
| (iii) | W.H. Elliott and Daphne C. Elliott | : Biochemistry and Molecular Biology |
| (iv) | P.C. Turner and M.R.H. White | : Instant Notes in Molecular Biology |
| (v) | S.P. Vyas and V.K. Dixit | : Pharmaceutical Biotechnology |
| (vi) | K. Sambamurthy and A. Kar | : Pharmaceutical Biotechnology |
| (vii) | W. Crueger and A. Crueger | : Biotechnology, A Textbook of Industrial Microbiology |
| (viii) | Harvey Lodish | : Molecular cell Biology |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-IV
 Course: 407 (Unit-0.5)
 Course Title: Organic Spectroscopy
 Full marks- 50

1. Ultra violet and visible spectroscopy: Definition, Lambert's law, Beer's Law, Instrument, Electronic Transition, Transition probability, Chromophore concept, Auxochrome, Absorption & Intensity shift, Absorption bands, Solvent effects, Absorption maxima calculation using Woodward-Fieser rules, Importance in structure determination and application of ultra-violet and visible spectroscopy.
2. Infra-red spectroscopy: Molecular vibration and their types, Hook's law of vibrational frequency, Fundamental vibration, Number of fundamental vibration, Overtone, Factors influencing vibrational frequency, Instrument, Sampling techniques, Precautions in running IR spectra, Finger point region, Importance of Finger point region and IR spectra in structure determination and application of IR spectroscopy.
3. Nuclear Magnetic Resonance Spectroscopy: ^1H -NMR spectroscopy: introduction & theory, relaxation process, instrumentation, chemical shift, spin-spin coupling, different spin systems, coupling constants, spin-spin decoupling, long range coupling, Fourier transform NMR, ^{13}C NMR: introduction, theory, use of NMR to study drugs in pharmacy.
4. Mass Spectroscopy: Introduction, theory, instrumentation, mass spectrum, determination of molecular formula, ionization technique, recognition of molecular ion, fragmentation process, high resolution MS, applications of MS in pharmacy.

Recommended Books:

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| (i) | D. L. Pavia, G. M. Lampman and G.S. Kriz | : Introduction to Spectroscopy |
| (ii) | Y. R. Sharma | : Elementary Organic Spectroscopy |
| (iii) | Douglas A Skoog | : Principles of Instrumental Analysis |
| (iv) | B.K. Sharma | : Instrumental Methods of Chemical Analysis |
| (v) | Gurdeep R. Chatwal and Sham K. Anand | : Instrumental Methods of Chemical Analysis |
| (vi) | L.G. Chatten | : Pharmaceutical Chemistry Vol. I & II |
| (vii) | Willard, Merritt, Dean and Scattle | : Instrumental Methods of Analysis |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-IV
 Course: 408 (Unit - 0.5)
 Course Title: Clinical Pharmacy and Pharmacy Law & Ethics
 Full Marks – 50

Clinical Pharmacy:

1. Introduction to Clinical Pharmacy Practice: Functions and scope. Status of clinical pharmacy in Bangladesh.
2. Modern Dispensing aspects: Patient compliance, reasons and importance of non-compliance. Role of pharmacists in improving patient compliance and instructions for the use of some common drugs.
3. Drug abuse, drug addiction, drug habituation, drug dependence, drug over-dose and draw back of self-medication
4. a) Diagnosis and routine tests for diagnosis, common sources of laboratory errors and role of pharmacists.
 b) Physiological parameters and interpretation of clinical laboratory tests:
 (i) Blood chemistry, (ii) Hematology (iii) Urinalysis (iv) Stool, Sputum and CSF examination
5. Manifestations and pathophysiology of the following diseases:
 (a) Essential hypertension, (b) Diabetes, (c) Asthma, (d) Osteoporosis, (e) Hepatitis, (f) Anemia, (g) Rheumatoid arthritis (h) Osteoporosis.
6. Drug Interaction: Introduction, mechanism of drug interaction, drug-drug interaction with reference to analgesics, diuretics, cardiovascular drugs, gastrointestinal agents, vitamins and hypoglycemic agents. Drug-food interaction.
7. Adverse Drug Reactions (ADRs): Definition, importance, drug-induced diseases and teratogenicity.
8. Clinical Toxicity: Poisons, toxins of animal origin, role of poison centers, poisoning incidence, analysis of poisoning situation, sources and assessment of poison exposure, general treatment of poisoning. Symptoms and management of poisoning cases with pesticides, fumigants, solvents, vapors, food toxins and heavy metal poison. Snake poisons, venoms.

Pharmacy Law and Ethics:

1. Law, ethics, forensic pharmacy, ordinance, act, etc.
2. A brief description of the following acts:
 a) Drugs act 1940. b) Poison act 1952. c) Pharmacy act and pharmacy ordinance 1976. d) Narcotic act. e) Drug control ordinance 1982. f) Pharmacists code of ethics. g) Drug and Cosmetics Act and Rules
3. National Drug Policy (NDP) 2005

Recommended Books:

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| (i) Pratibha Nand and R.K. Khar | : A Textbook of Hospital and Clinical Pharmacy |
| (ii) Anees Ahmed Siddiqui and M. Ali | : Hospital and Clinical Pharmacy |
| (iii) J. Marshal and K. Bangert | : Clinical Biochemistry |
| (iv) A. R. Gennaro | : Remington, The Science and Practice of Pharmacy |
| (v) Lloyd Y. Young and M.A. Koda | : Applied Therapeutics |
| (vi) S.C. Sahajan and J. B. K. Narang | : Forensic Pharmacy and Ethics |
| (vii) B. M. Mithal | : Textbook of Forensic Pharmacy |

* Other Books will be indicated by respective teachers

B. Pharm. (Honours) Part-IV
 Course: 409 / Unit-0.5
 Subject: Pharmaceutical Marketing and Management
 Full Marks - 50

1. Introduction of Management: Definition, Importance, Level of Management, Function.
2. Personnel Management:
 - a) Definition, scope, importance, behavioral science and personnel management.
 - b) Motivation, moral and job satisfaction.
 - c) Education, training, management development and performance evaluation.
 - d) Means of achieving harmonious industrial relation collective bargaining, joint consultation worker council, arbitration, and industrial democracy.
3. Production Management: Definition, scope, importance and application of management, techniques and principles to production management, production planning and quality control.
4. Materials Management:
 - a) Purchasing: Formulating effective buying policies, determination of needs and desires of patrons, selecting the sources of supply, determination the terms of purchase, receiving, marketing and stocking goods.
 - b) Inventory control: Methods of inventory control, selection of optimum method, effect of inventory control.
5. Risks Management
6. Pharmaceutical Marketing:
 - a) Promotion: Objectives, classification, developing a promotional plan, promotion strategy, budget and executing the program. Steps of implantation of advertising, types (display, direct mail, etc.) and preparation of advertisement. Personal selling and evaluation of promotion (general and specialized method).
 - b) Pricing: General consideration, pricing method, prescription pricing and professional fees.
 - c) Channel of distribution
 - d) Forecasting of sales
7. Management of Community Pharmacy and Governmental Pharmacy.

Recommended Books:

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| (i) | R. M. Mehta | : Pharmaceutical Industrial Management |
| (ii) | Kotler Armstrong | : Principles of Marketing |
| (iii) | V.S. Ramaswamy | : Marketing Management |
| (iv) | F.D. Sturdivant and L.W. Stern | : Managerial Analysis in Marketing |
| (v) | Robert E. Stevens | : Strategic Marketing Plan Master Guide |

* Other Books will be indicated by respective teachers

