

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
*(Established by Govt. of A.P., Act. No. 30 of 2008)*  
**ANANTHAPURAMU – 515 002 (A.P.) INDIA.**

**Course Structure for B.Pharmacy-R15 Regulations**

**B.Pharmacy**

**I B.Pharm. - I Semester**

S.No	Course code	Subject	L	T	P	C
1.	15R00101	Remedial Mathematics	3	1	-	3
	15R00102	Remedial Biology	2	1	-	2
	15R00103	Remedial Biology Lab	-	-	2	1
2.	15R52101	Functional English	3	1	-	3
3.	15R00104	Pharmaceutical Organic Chemistry - I	3	1	-	3
4.	15R00105	Human Anatomy and Physiology - I	3	1	-	3
5.	15R00106	Pharmaceutical Inorganic Chemistry	3	1	-	3
6.	15R00107	Pharmaceutical Organic Chemistry – I Lab	-		4	2
7.	15R00108	Human Anatomy and Physiology – I Lab	-		4	2
8.	15R00109	Pharmaceutical Inorganic Chemistry Lab	-		4	2
Total			17	6	14	21

**I-II Semester**

S.No	Course code	Subject	L	T	P	C
1.	15R00201	Pharmaceutical Organic Chemistry - II	3	1	-	3
2.	15R00202	General & Dispensing Pharmacy	2	1	-	2
3.	15R00203	Pharmaceutical Biochemistry	3	1	-	3
4.	15R00204	Pharmacognosy – I	2	1	-	2
5.	15A52201	English for Professional Communication	3	1	-	3
6.	15R00205	Pharmaceutical Organic Chemistry – II Lab	-		4	2
7.	15R00206	General & Dispensing Pharmacy Lab	-		4	2
8.	15R00207	Pharmaceutical Biochemistry Lab	-		4	2
9.	15R00208	Pharmacognosy – I Lab	-		4	2
Total			13	5	16	21

**II-I Semester**

S.No	Course code	Subject	L	T	P	C
1.	15R00301	Pharmaceutical Engineering	3	1	-	3
2.	15R00302	Physical Pharmacy –I	3	1	-	3
3.	15R00303	Pharmaceutical Organic Chemistry – III	3	1	-	3
4.	15R00304	Pharmaceutical Microbiology	3	1	-	3
5.	15A01101	Environmental Studies	2	1	-	2
6.	15R00305	Pharmaceutical Engineering Laboratory	-		4	2
7.	15R00306	Physical Pharmacy –I Laboratory	-		4	2
8.	15R00307	Pharmaceutical Organic Chemistry – III Laboratory			4	2
9.	15R00308	Pharmaceutical Microbiology Laboratory	-		4	2
Total			14	5	16	22

**II-II Semester**

S.No	Course code	Subject	L	T	P	C
1.	15R00401	Pharmaceutical Analysis – I	3	1	-	3
2.	15R00402	Pharmacognosy – II	3	1	-	3
3.	15R00403	Pharmaceutical Technology – I	3	1	-	3
4.	15R00404	Physical Pharmacy –II	3	1	-	3
5.	15R00405	Pathophysiology	2	1	-	2
6.	15R00406	Pharmaceutical Analysis – I Laboratory	-	-	4	2
7.	15R00407	Pharmacognosy – II Laboratory	-	-	4	2
8.	15R00408	Pharmaceutical Technology – I Laboratory		-	4	2
9.	15R00409	Physical Pharmacy –II Laboratory	-	-	4	2
10.	15R00410	Comprehensive Online Exams-I	-	-	-	1
Total			14	5	16	23

## B.Pharm III-I Semester

S. No.	Course Code	Subject	L	T	P	C
1.	15R00501	Medicinal Chemistry-I	3	1	-	3
2.	15R00502	Pharmacology-I	3	1	-	3
3.	15R00503	Pharmaceutical Technology-II	3	1	-	3
4.	15R00504	Pharmaceutical Biotechnology	3	1	-	3
5.	15R00505	<b>MOOCS - I</b> (Application of spectroscopic methods in molecular structure Determination) / <b>Conventional/ Self study</b>	3	1	-	3
6.	15R00506	Medicinal Chemistry-I Laboratory	-	-	4	2
7.	15R00507	Pharmacology-I Laboratory	-	-	4	2
8.	15R00508	Pharmaceutical Technology-II Laboratory	-	-	4	2
9.	15R00509	Pharmaceutical Biotechnology Laboratory	-	-	4	2
10.	15A99501	Audit course –Social Values & Ethics	2	0	2	
<b>Total</b>			17	5	18	23

Note: MOOC-I- NPTEL (<http://nptel.ac.in>) Chemistry & Biochemistry and Biotechnology

## B.Pharm III-II Semester

S. No.	Course Code	Subject	L	T	P	C
1.	15R00601	Pharmacology-II	3	1	-	3
2.	15R00602	Pharmaceutical Analysis-II	3	1	-	3
3.	15R00603	Biopharmaceutics & Pharmacokinetics	3	1	-	3
4.	15R00604	Pharmaceutical Jurisprudence	3	1	-	3
5.	15R00605 15R00606 15R00607	<b>CBCC-I</b> 1. Pharmacy Administration 2. Clinical Trials 3. Cosmetic Technology	3	1	-	3
6.	15R00608	Pharmacology-II Laboratory	-	-	4	2
7.	15R00609	Pharmaceutical Analysis-II Laboratory	-	-	4	2
8.	15R00610	Biopharmaceutics & Pharmacokinetics Laboratory	-	-	4	2
9.	15A52602	Advanced English Language Communication Skills (AELCS) Laboratory (Audit Course)	-	-	2	-
10.	15R00611	Comprehensive Online Exam - II	-	-	-	1
<b>Total</b>			15	5	16	22

## B.Pharm IV-I Semester

S. No.	Course Code	Subject	L	T	P	C
1.	15R00701	Novel Drug Delivery Systems	3	1	-	3
2.	15R00702	Pharmacology -III	3	1	-	3
3.	15R00703	Clinical and Hospital Pharmacy	3	1	-	3
4.	15R00704	Medicinal Chemistry-II	3	1	-	3
5.	15R00705 15R00706 15R00707	<b>CBCC-II</b> 1.Chemistry of Natural Products 2. Computer Aided Drug Design 3. Pharmacovigilance.	3	1	-	3
6.	15R00708	Novel Drug Delivery Systems Laboratory	-	-	4	2
7.	15R00709	Clinical and Hospital Pharmacy Laboratory	-	-	4	2
8.	15R00710	Medicinal Chemistry-II Laboratory		-	4	2
<b>Total</b>			15	5	12	21

## B.Pharm IV-II Semester

S. No.	Course Code	Subject	L	T	P	C
1.	15R00801	<b>MOOCS -II</b> (Biostatistics and Design of Experiments) / <b>Conventional/ Self study</b>	3	1	-	3
2.	15R00802	<b>MOOCS - III</b> ( Intellectual Property Rights) / / <b>Conventional/ Self study</b>	3	1	-	3
3.	15R00803	Comprehensive viva voice	-	-	4	2
4.	15R00804	Technical Seminar	-	-	4	2
5.	15R00805	Project Work	-	-	24	13
<b>Total</b>			06	02	32	23

<b>Subject</b>	<b>REMEDIAL MATHEMATICS</b>	<b>Course Code</b>	15R00101	<b>Credits</b>
<b>Course year</b>	B. Pharmacy I Year	<b>Semester</b>	I Semester	3
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week	
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks	

**Objectives:** The objective of course is to impart knowledge in basic concepts of Mathematics relevant to pharmacy professionals

### UNIT I: Algebra

Arithmetic Progression-Geometric progression, quadratic equations: Equations reducible to quadratics, Logarithms: Logarithm of a real number to an arbitrary base, theorems on logarithms, application of logarithms in pharmaceutical computations and Partial fractions

### UNIT II: Trigonometry

Trigonometric ratios and the relations between them,  $\sin(A+B)$ ,  $\cos(A+B)$ ,  $\tan(A+B)$  formulae only, Trigonometric ratios of multiple and sub-multiple angles, Sum and Product transformations.

### UNIT III: Co-ordinate Geometry

Distance between points, Area of a triangle, Co-ordinates of a point dividing a given line segment in a given ratio, equation to a straight line in different forms, angle between straight lines-point of intersection.

### UNIT IV: Differential and Integral calculus

Limit of a function, differentiation, derivatives of trigonometric functions, logarithmic and partial differentiation, maxima and minima (elementary), derivatives of second order.

**Integration:** Definition of integration, integration by substitution, integration by parts and definite integrals. (Basic problems)

### UNIT V: Differential Equations and Laplace Transforms

**Differential Equations:** Order and degree, formation of a differential, solution of first order differential equations (variable separable method) application of first order and first degree differential equation. Law of natural growth and decay, Newton's law of cooling. Laplace transforms

- Definition, elementary functions, properties of linearity and shifting.

**Text Books:**

1. Intermediate first and second year mathematics text books printed and published by Telugu academy.
2. A textbook of Remedial mathematics by P.Seshagiri Rao.

**References:**

1. Grewal B. S. Numerical Methods Khanna Publishers.
2. Steve Dobbs & Jane, Miller Advanced Level Mathematics Statistics, Cambridge University Press.
3. Adams Dany Spencer Laboratory Mathematics Carrol & Graphs.
4. Jenny Olive Maths. A Students Survival Guide Cambridge University Press.

**Outcomes:**

- The student is able to identify the type differential equations and uses the right method to solve the differential equations. Also the able to apply the theory of differential equations to the real world problems
- The student is able to transform functions on time domain to frequency domain using Laplace transforms
- The student will able to understand the methods of differential calculus to optimize single and multivariable functions.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>REMEDIAL BIOLOGY</b>	<b>Course Code</b>	15R00102	<b>Credits</b>
<b>Course year</b>	B. Pharmacy I Year	<b>Semester</b>	I Semester	2
<b>Theory</b>	2 hrs/week	<b>Tutorial</b>	1hr/week	
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks	

**Objectives:** This subject is introduced to the pharmacy course in order to make the student aware of the characters of the plants and animals. This subject gives basic foundation to Pharmacognosy

### UNIT I

Plant and animal cell: Detailed structure and their functions. Mitosis, meiosis, different types of plant tissues and their functions.

### UNIT II

Salient features and classification of plants into major groups- algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms. Classification of animal kingdom and salient features of each phyla.

### UNIT III

Morphology and histology of root, stem, bark, wood, leaf, flower, inflorescence, fruit and seed. Modifications of root stem and leaf.

### UNIT IV

Study of Structure and life history of parasites: Amoeba, Entamoeba, Trypanosoma, Plasmodium, Taenia, Ascaris, Schistosoma, Oxyuris and Ancylostoma.

### UNIT V

General structure and life history of insects like Cockroach, Mosquito and Housefly.

**Text Books:**

1. Intermediate First Year and Second Year Botany / Zoology Text Books printed and published by Telugu Academy, Himayatnagar, Hyderabad.
2. A.C. Dutta, Text Book of Botany.
3. Botany for Degree students Vol I & II by B.P. Pandey.

**References:**

1. Concepts of biology, Enger.
2. Text book of Biology by S.B.Gokhale.
3. Outlines of zoology by M.Ekambaranatha Ayyar and T.N.Ananda Krishnan.

**Outcomes:**

- Describe the structure and functions of animal and plant cell
- Describe the various salient features of animal and plant kingdom
- Student able to identify the morphology of various plant parts
- Student able to identify the structure of the various diseases causing parasite



<b>Subject</b>	<b>REMEDIAL BIOLOGY LAB</b>	<b>Course Code</b>	15R00103	<b>Credits</b>  1
<b>Course year</b>	B. Pharmacy	<b>Semester</b>	I Semester	
<b>Practical</b>	2 hrs/week	<b>Tutorial</b>	-	
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks	

### I. EXPERIMENTS:

- a) Care and uses of microscope
- b) Morphology of plant parts indicated in theory.
- c) Preparation, Microscopic Examination of stem, root and leaf of Mono and Dicot leaves.
- d) Structure of human parasites and insects mentioned in the theory with the help of specimen

### II. Demo/Workshop:

Dissection of cockroach mouth parts, observation of different phases of mitotic division in onion root tips.

### III. Seminar/Assignment/Group discussion:

Preparation of herbarium of plant parts indicated in theory and study of salient features for identification.

### Reference:

1. Intermediate Botany/Zoology Text manuals printed and published by Telugu academy, himayatnagar, Hyderabad.

<b>Subject</b>	<b>FUNCTIONAL ENGLISH</b>	<b>Course Code</b>	15R52101
<b>Course year</b>	B. Pharm. I year	<b>Semester</b>	I
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	3		

**Preamble:**

English is an international language as well as a living and vibrant one. People have found that knowledge of English is a passport for better career, better pay, and advanced knowledge and for communication with the entire world. As it is a language of opportunities in this global age, English is bound to expand its domain of use everywhere. The syllabus has been designed to enhance communication skills of the students of engineering and pharmacy. The prescribed book serves the purpose of preparing them for everyday communication and to face the global competitions in future.

The text prescribed for detailed study focuses on LSRW skills and vocabulary development. The teachers should encourage the students to use the target language. The classes should be interactive and learner-centered. They should be encouraged to participate in the classroom activities keenly.

In addition to the exercises from the text done in the class, the teacher can bring variety by using authentic materials such as newspaper articles, advertisements, promotional material etc.

**Objectives:**

- To enable the students to communicate in English for academic and social purpose.
- To enable the students to acquire structure and written expressions required for their profession.
- To develop the listening skills of the students.
- To inculcate the habit of reading and critical thinking skills.
- To enhance the study skills of the students with emphasis on LSRW skills.

**UNIT –I**

**Topics:** Paragraph writing, writing letters, role play, reading graphs, prepositions, designing posters, tenses, making recommendations.

**Text:** ENVIRONMENTAL CONSCIOUSNESS' from *MINDSCAPES*  
Climate Change - Green Cover – Pollution

**UNIT –II**

**Topics:** Compound nouns, imperatives, writing instructions, interpreting charts and pictures, note making, role play, prefixes, subject-verb agreement.

**Text:** EMERGING TECHNOLOGIES from *MINDSCAPES*

Solar Thermal Power - Cloud Computing - Nanotechnology

**UNIT –III**

**Topics:** Making conversations, homonyms and homophones, SMS and use of emotions, past participle for irregular verbs, group discussion, E - mail communication, antonyms, Preparing projects **Text:** GLOBAL ISSUES from *MINDSCAPES*

Child Labour - Food Crisis - Genetic Modification - E-Waste - Assistive Technology

**UNIT –IV**

**Topics:** Group discussion, affixes, double consonants, debates, writing a book / film review, predicting and problem-solving-future tense, adverbs

**Text:** SPACE TREK from *MINDSCAPES*

Hubble Telescope - Chandrayan-2 - Anusat - Living Quarters - Space Tourism

**UNIT –V**

**Topics:** Compare and contrast, effective writing, group discussion, writing reports, writing advertisements, tweeting and blogging, types of interviews, framing questions.

**Text:** MEDIA MATTERS from *MINDSCAPES*

History of Media - Language and Media - Milestone in Media -  
Manipulation by Media - Entertainment Media - Interviews

**Text Books:**

1. MINDSCAPES: English for Technologists and Engineers, Orient Blackswan, 2014.

**References:**

1. A Practical Course in Effective English Speaking Skills by J.K.Gangal, PHI Publishers, New Delhi.2012
2. Technical Communication, Meenakshi Raman, Oxford University Press,2011.
3. Spoken English, R.K. Bansal & JB Harrison, Orient Longman,2013, 4<sup>Th</sup> edition.
4. Murphy's English Grammar with CD, Murphy, Cambridge University Press,3<sup>Rd</sup> edition.
5. An Interactive Grammar of Modern English, Shivendra K. Verma and Hemlatha Nagarajan , Frank Bros & CO,2008.

**Outcomes:**

- Have improved communication in listening, speaking, reading and writing skills in general.
- Have developed their oral communication and fluency in group discussions and interviews.
- Have improved awareness of English in science and technology context.
- Have achieved familiarity with a variety of technical reports.

<b>Subject</b>	<b>PHARMACEUTICAL ORGANIC CHEMISTRY-I</b>	<b>Course Code</b>	15R00104	<b>Credits</b>
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	I	3
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week	
<b>End exam</b>	70 marks	<b>Internal exam</b>	30 marks	

**Objectives:**

- To understand fundamentals of organic chemistry
- To apply the knowledge for the synthesis of various new organic molecules.

**UNIT I**

Structure and activity of Organic Molecules: Concept on shapes of organic molecules, valency (C, H, O, N, S, P, X, Si), hybridization SP<sup>3</sup>, SP<sup>2</sup>, SP, different bonds, bond lengths, bond angles, bond dissociation energies, molecular weight calculations, impact of structure on BP, MP, refractive index, surface tension and solubility.

Electronic effect in organic molecules: Inductive effect, electromeric, mesomeric effect, hyperconjugation, concept of resonance and stability. Types of organic reagents and reactions.

**UNIT II**

Aliphatic/Alicyclic Hydrocarbons: Nomenclature, isomerism (Chain, Conformational and geometrical) relative stabilities (heat of combustion and hydrogenation) ring stabilities of cyclohexane, Chair-boat conformation, Bayer's strain theory and Sachse-Mohr concept. Free radical substitution reactions (halogenation) of alkanes, selectivity and reactivity of halogens.

**UNIT III**

Alkenes: Electrophilic addition reactions of alkenes, Markovnikow's rule, anti-Markovnikow's rule, Hkarasch effect, Bayer's oxidation (Cis-hydroxylation, Polymerization)

**Alkadienes:** Stability of conjugated dienes, 1,2 and 1,4 - addition reactions of conjugated dienes.

## UNIT IV

**Alkynes:** Acidity of 1-alkynes, formation of metal acetylides, stereo specific reduction of alkynes, addition of hydrogen halide, addition of water and keto-enol tautomerism.

**Halogen compounds - Aliphatic:** Nomenclature, general methods of preparation Characteristic nucleophilic substitution reactions, factors that play role in SN 1 and SN2, Walden inversion, elimination reaction and Saytzeff's rule.

## UNIT V

**Carbonyl compounds:** Nomenclature, two important methods of preparation, polarity of carbonyl group, relative reactivities of carbonyl compounds, nucleophilic addition and addition-elimination reactions, Oxidation-reduction reactions, aldol condensation, Cannizzaro reaction, benzoin condensation, Perkins reactions, Reformatsky reaction and Oppenauer oxidation.

### Text Books:

1. Advanced pharmaceutical organic chemistry, Bahl & Bahl, S.Chand.
2. Organic chemistry, T.R.Morrison and R.N.Boyd, Pearson Education India , New Delhi.

### References:

1. Reactions and Mechanism, Jerry March, 4<sup>th</sup> edition Wiley Publication.
2. Organic chemistry, Carey, 8<sup>th</sup> Edition, Mc Graw-Hill.
3. Organic chemistry, Pillai Orient Longman Publisher.

### Outcomes:

- Graduates will demonstrate the knowledge of the inter-link of pharmaceutical sciences with pharmaceutical organic chemistry by learning.
- Graduates will understand IUPAC Common system of nomenclature, types of organic reactions, mechanisms, named reaction with mechanism.
- Graduates will expertise their skills for pharmaceutical organic chemistry concepts, tools and atomic models.

<b>Subject</b>	<b>HUMAN ANATOMY AND PHYSIOLOGY - I</b>	<b>Course Code</b>	15R00105	<b>Credits</b>
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	I Semester	3
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	I	
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks	

**Objectives:** This course is designed to impart a fundamental knowledge on the structure and functions of the human body. It also helps in understanding both homeostasis mechanisms and homeostatic imbalances of various body systems

#### UNIT - I: Cell

Scope of anatomy and physiology, basic terminology used in these subjects. Structure of cell, its components and their functions. Body fluids, homeostasis.

**Tissues** Elementary tissues of the human body: epithelial, connective, muscular and nervous tissues, their sub types and characteristics and functions.

**Urinary system:** Various parts, structure & functions of the kidney and urinary tract. Physiology of urine formation.

#### UNIT- II:

**Haemopoietic system:** Composition and functions of blood, blood groups and their significance and mechanism of coagulation of blood. Types of anemia, disorders related to blood components (Definitions only)

**Respiratory System:** Various parts of respiratory tract and their functions. mechanism and regulation of respiration, respiratory volumes and vital capacity. Disorders related to respiratory system (Definitions only)

#### UNIT-III:

**Reproductive Systems:** Male and Female reproductive systems and their hormones,

**Digestive System:** Gross anatomy of the gastro-intestinal tract, functions of its different parts including those of liver, pancreas and gall bladder. Disorders related to GIT (definitions only)

**UNIT - IV:**

- a) **Cardiovascular system:** Basic anatomy and physiology of heart and blood vessels, circulation (Systemic, pulmonary, coronary). Understanding of cardiac cycle, heart sounds and electrocardiogram. Blood pressure and its regulation. Disorders related to Cardiovascular system (Definitions only)
- b) **Lymph and Lymphatic System:** Composition, formation and circulation of lymph; Disorders related to lymphatic system (Definitions only)
- c) **Study of sense organs:** Structure and detailed functions of eye, ear, nose, tongue, skin

**UNIT - V:**

- a) **Central Nervous System:** Functions of different parts of brain and spinal cord. Structure of blood brain barrier and its importance. Neurochemical transmission in the central nervous system, electroencephalogram, cranial nerves and their functions.
- b) **Autonomic Nervous System:** Physiology and functions of autonomic nervous system. Mechanism of neurohumoral transmission in the A.N.S.
- c) **Musculoskeletal system:** Structure, composition and functions of skeleton, Joints, classification of joints and types of movements of synovial joints.

**Text Books:**

1. Principles of Anatomy and Physiology, Tortora, G.J. and Anagnostokas, N.P. Harper & Row Publishers N.Y.
2. Text Book of Human Anatomy, Ross & Willson, M.J. Mycek S.B. Gerther and MMPER.
3. Human Physiology, C.C. Chatterjee. Rosen Educational Publishing 13<sup>th</sup> Edition.

**References:**

1. Essential of Human Anatomy & Physiology, Elaine N. Marieb 6<sup>th</sup> Edition Benjamin Eumming's.
2. Fundamentals of Anatomy & Physiology, Rizzo, Cengage Learning (2009) 3<sup>rd</sup> Edition.
3. Human Anatomy, Mc. Kinley, Mc. Graw Hill 2009.



**Outcomes:**

- Describe the structure (gross and histology) and functions of various organs of the human body.
- Describe the various homeostatic mechanisms and their imbalances of various systems.
- Identify the various tissues and organs of the different systems of the human body.
- Perform the hematological tests and also record blood pressure, heart rate, pulse rate.
- Appreciate coordinated working pattern of different organs of each system
- Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

<b>Subject</b>	<b>PHARMACEUTICAL INORGANIC CHEMISTRY</b>	<b>Course Code</b>	15R00106	Credits
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	I	3
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week	
<b>End exam</b>	70 marks	<b>Internal exam</b>	30 marks	

**Objectives:**

- To understand the knowledge on inorganic compounds those exist as pharmaceutical preparations and pharmaceutical aids.
- To apply the knowledge of volumetric analysis for identification and purity testing for inorganic pharmaceutical compounds specified in IP & BP.

**UNIT - I: Basic concepts of Pharmaceutical inorganic chemistry**

Introduction to Indian Pharmacopoeia, concept and content of monograph and definition of various specifications under monograph. Classification of Inorganic Pharmaceuticals based on their applications and therapeutic uses as specified in Indian Pharmacopoeia and British Pharmacopoeia. Sources of impurities in Pharmaceuticals, concept of test for purity, assay, identification and limit test. Qualitative tests for anion and cations. Limit tests for arsenic, heavy metals, lead, iron, chloride and sulphate.

**UNIT - II: Introduction to volumetric analysis**

Concept and understanding of titration, titrate, titrant, indicator, primary standard, secondary standard, normality, molarity, molality, concentrated and dilute acids and bases as per IP. Basic reaction and different titrants used in alkalimetry, acidimetry, oxidation-reduction, non-aqueous, complexometry, argentometry, diazotization titrations. Standardization of sodium hydroxide, perchloric acid, potassium permanganate, silver nitrate, EDTA, sodium nitrite.

**Note: Definition, structure, formula, Preparation\*, Properties, uses identification test\*, principle behind Assays\* of the compounds mentioned in Unit III to Unit V (\*ONLY FOR SPECIFIED COMPOUNDS)**

### UNIT- III: Electrolytes, Mineral supplements and Dental products

**Electrolytes:** Sodium chloride\*, compound sodium chloride solution (Ringer's solution), potassium chloride, ORS, calcium gluconate\*, calcium chloride, sodium citrate, haemodialysis fluids. **Mineral Nutrients/Supplements:** Ferrous sulphate\*, ferrous fumarate, ferrous gluconate, ferric ammonium citrate\*, iron and dextrose injection.

**Dental products:** Sodium fluoride\*, sodium monofluorophosphate, stannous fluoride, calcium carbonate, dibasic calcium phosphate\* and strontium chloride.

### UNIT – IV: Topical agents and Pharmaceutical aids

**Topical Agents:** Zinc sulphate, calcium hydroxide\*, bismuth sub carbonate. zinc oxide\*, calamine, zinc stearate, talc, titanium-dioxide, heavy kaolin and light kaolin (only uses), activated dimethicone, hydrogen peroxide solution\*, potassium permanganate, silver nitrate (silver protein), iodine (solutions of iodine, povidoneiodine), boric acid\*, zinc undecylenate and yellow mercury oxide.

**Pharmaceutical aids:** Magnesium stearate\*, talc, bentonite, colloidal silica. titanium dioxide, ferric oxide.

### UNIT – V: Gastro-intestinal agents and other medicinal agents

**Acidifiers & Antacids:** Dilute hydrochloric acid, sodium acid phosphate, sodium bicarbonate\*, aluminium hydroxide gel\*, dried aluminium hydroxide gel, magnesium hydroxide mixture,

magnesium trisilicate.

**Expectorants:** Ammonium chloride\* and potassium iodide.

**Emetics:** Potassium antimony tartarate, copper sulphate\*.

**Antidotes:** sodium thiosulphate\*, sodium nitrite, Activated charcoal.

**Structure and clinical uses for:** Cisplatin, lithium carbonate, barium sulphate, plaster of paris, sodium aurothiomalate, sodium antimony gluconate, potassium perchlorate, sodium tetradecyl sulphate, sodium chloride hypertonic injection.

#### Text Books:

1. Practical pharmaceutical chemistry, Part-I, A.H.Beckett and J.B.Stenlake, The Athtone press, University of London, London.
2. Inorganic Medical and Pharmaceutical Chemistry, J.H Block, E.Roche, T.O Soine and C.O. Wilson, Lea & Febiger Philadelphia PA. 1974.

3. Pharmaceutical Chemistry-Inorganic, G.R. Chatwal, Himalaya Publishing House, Mumbai, India.

**References:**

1. Inorganic chemistry, Gary L. Miessler and Donald A. Tarr, 3/e, Pearson education, New Delhi.
2. Inorganic pharmaceutical chemistry, P. Gundu Rao, Vallabh Prakashan, Delhi.
3. Advanced Inorganic Chemistry, G.D. Tuli, Satya prakash, S.Chand 2006.
4. Modern inorganic chemistry by William L. Jolly Mc Graw-Hill, New York 1984
5. Indian Pharmacopoeia 1996, 2007.

**Outcomes:**

- The graduates will develop the knowledge to find out the purity of pharmaceutical substances.
- They came to know the importance of pharmaceutical inorganic agents in certain diseases.

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

<b>Subject</b>	<b>PHARMACEUTICAL ORGANIC CHEMISTRY-I LAB</b>	<b>Course Code</b>	15R00107	<b>Credits</b>
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	I	2
<b>Practical</b>	4 hrs/week	<b>Tutorial</b>	NIL	
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks	

**I. Experiments:**

- A.** Introduction to Equipment and Glassware, Recrystallization methods, experiments on melting point, boiling point and distillation.
- B.** Preparation of organic compounds (each involving a specific organic reaction covered in theory- any 10 synthesis)
1. N-Acetylation : Preparation of Acetanilide from Aniline
  2. O-Acetylation : Preparation of Aspirin from Salicylic acid
  3. Bromination : Preparation of p-Bromoacetanilide from Acetanilide
  4. Hydrolysis : Preparation of p-Bromoaniline from p-Bromoacetanilide
  5. Nitration : Preparation of m-dinitrobenzene from Nitrobenzene/picric acid from phenol
  6. Reduction : Preparation of m-nitro aniline from m-dinitro benzene.
  7. Oxidation : Preparation of Benzoic acid from benzyl chloride / benzyl alcohol.
  8. Esterification : Preparation of Benzyl benzoate from benzoyl chloride.
  9. Condensation : Benzoin from benzaldehyde.
  10. □-Halogenation : Preparation of Iodoform from Oxidation of Acetone / Ethanol.

**II. Demo / work shop**

Laboratory safety exercises, melting point for different crystals of same compound, atomic models emphasizing hybridization.

### III. Seminar/assignment/group discussion

Exercise on nomenclature of compounds, Knowledge on CAS, IUPAC, ACS, material safety data and different types of explosive, oxidizable substances.

#### References:

1. Text Book of Practical Organic Chemistry, Vogel's, 5<sup>th</sup> Edition Pearson.
2. Laboratory Manual of Organic Chemistry, R.K. Bansal, New Age International 5<sup>th</sup> Edition 2007.
3. Advanced Practical Organic Chemistry, O.P. Agarwal, 3<sup>rd</sup> Edition Goel Publication.
4. Practical Organic Chemistry, F.G.Mann & B.C. Saunders, Pearson 4<sup>th</sup> Edition.

#### List of Minimum Equipment Required:

1. Triple beam balances
2. Physical balances
3. Melting point apparatus
4. Suction pumps
5. Oven
6. Hot plates
7. Water baths
8. Distillation unit
9. Refrigerator
10. Adequate glassware



<b>Subject</b>	<b>HUMAN ANATOMY AND PHYSIOLOGY – I LAB</b>	<b>Course Code</b>	15R00108	<b>Credits</b>
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	I	2
<b>Practical</b>	4 hrs/week	<b>Tutorial</b>	NIL	
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks	

### I. EXPERIMENTS:

1. Study of compound microscope
2. Microscopic study of different tissues(Epithelial, Nervous tissues)
3. Microscopic study of different tissues (Muscular, connective tissues)
4. Determination of blood groups
5. Estimation of Haemoglobin in blood.
6. Determination of bleeding time & clotting time.
7. Recording of Blood pressure.
8. Recording of pulse rate
9. Study of ECG
10. Recording of body temperature.

### II. DEMO

Study of different systems with the help of charts and models.

1. Study of Cardiovascular system.
2. Study of nervous system.
3. Study of Lymphatic system.





<b>Subject</b>	<b>PHARMACEUTICAL INORGANIC CHEMISTRY LAB</b>	<b>Course Code</b>	15R0010
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	I
<b>Practical</b>	4 hrs/week	<b>Tutorial</b>	NIL
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks

### I. Experiments:

1. Limit tests for the following as per the procedure given in Indian Pharmacopoeia
  - a) Chlorides & Modifications in limit test for chlorides in potassium permanganate
  - b) Sulphates & Modifications in limit test for sulphates in potassium permanganate
  - c) Iron
  - d) Arsenic
2. Balances and Weighing: Calibration of Pipette and Burette.
3. Preparation and standardization of Hydrochloric acid solution (0.1N).
4. Preparation and standardization of Potassium permanganate solution (0.1N).
5. Preparation and purification of Boric acid.
6. Preparation and purification of Potash alum.
7. Assay of sodium bicarbonate and assay of Boric acid (Neutralization).
8. Assay of calcium gluconate (or) any calcium compounds (Complexometry).
9. Assay of copper sulphate (Redox titration).
10. Assay of sodium acetate (Non-aqueous titration).
11. Assay of ferrous sulphate (Oxidation-reduction / Redox titration).

### II. Demo/workshop

Labelling, handling, storage of inorganic compounds, safety practices in laboratory, identification of anions and cations.

**III. Assignment/Seminar/Group Discussion**

- a) Radioactive metals in the environment and its importance
- b) Importance of inorganic compounds in cancer
- c) Different catalysts which are used in various organic preparations and their characteristics
- d) Inorganic metals used in biochemical functions and their role.

**References:**

1. Practical pharmaceutical chemistry, Part-I, A.H.Beckett and J.B.Stenlake, The Athtone press, University of London, London.
2. Inorganic chemistry, Gary L.Miessler and Donald A.Tarr, 3/e, Pearson education, New Delhi
3. Inorganic pharmaceutical chemistry, P. Gundu Rao, Vallabh Prakashan, Delhi.
4. Advanced Inorganic Chemistry, G.D.Tuli, Satya prakash, S.Chand 2006.
5. Modern inorganic chemistry by William L. Jolly Mc Graw-Hill, New Yark 1984
6. Indian Pharmacopoeia 1996, 2007.

**List of Minimum Equipment Required:**

1. Analytical balances
2. Physical balances
3. Suction pumps
4. Oven
5. Hot plates
6. Water baths
7. Distillation unit
8. Limit test apparatus for arsenic

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

Subject	PHARMACEUTICAL ORGANIC CHEMISTRY-II	Course Code	15R00201
Course year	B. Pharmacy I year	Semester	II
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

**Objectives:**

1. To understand the reactivity of various functional groups.
2. To understand the recent advances in organic synthesis by knowing safe technologies.

**UNIT - I:**

**Alcohols:** Nomenclature, classification, general methods of preparation, physical properties, hydrogen bonding, characteristic nucleophilic substitution reactions (replacement of -OH by -Cl), elimination reactions, and relative reactivities of 1°, 2° and 3° alcohols, Meerwein Ponderoff Verley reduction.

**Phenols:** Nomenclature, general methods of preparation, physical properties, acidity of phenols, stability of phenoxide ion, reactions of phenols, Kolbe-Schmidt reaction, Fries rearrangement, and Reimer-Tiemann Reaction.

**Ethers:** Nomenclature, Williamson's synthesis, action of hydro iodoc acid on ethers (Ziesel's method).

**UNIT - II:****Aromatic Hydrocarbons:**

Kekule Structure of Benzene, Bond Length, Heat Of Hydrogenation, Stability, Molecular Orbital Picture Of Benzene, Aromaticity, Huckel's rule, Nomenclature of benzene derivatives, Characteristic reactions of Benzene, Theory of reactivity and orientation in Monosubstituted Benzenes.

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**Aromatic Halogen Compounds:**

Nomenclature, Low reactivity of Halobenzenes towards nucleophilic substitution, Arenes, Benzyne ion Concept.

**UNIT-III:****Polynuclear Aromatic Hydrocarbons**

Nomenclature, Structure and Aromatic Character of Naphthalene, Anthracene and Phenanthrene resonance structures, electron density and reactivity, electrophilic substitution, oxidation and reduction reactions.

**UNIT - IV:**

**Carboxylic acids:** Nomenclature, intermolecular association, stability of carboxylate anion, two important methods of preparation, decarboxylation, functional groups reactions and reduction of carboxylic acids.

**Acid derivatives:** (acid chlorides, anhydrides, esters and amides): Nomenclature, reactions like hydrolysis, reduction of esters and amides, Hofmann's degradation of amides. Brief account of preparation and properties of malonic and acetoacetic esters, their importance in organic synthesis.

**UNIT - V:**

**Nitro compounds:** Nomenclature, acidity of nitro compounds containing  $\alpha$ -hydrogens, reductive reactions of aromatic nitro compounds.

**Amines:** Nomenclature, classification, basicity of amines, relative reactivity, Hinsberg method of separation, acylation reactions. Diazotisation and reactions of diazonium salts.

**Nitriles and isonitriles:** Nomenclature, two methods of synthesis, reactivity and functional reactions.

**TEXT BOOKS**

1. *Advanced pharmaceutical organic chemistry*, Bahl & Bahl, S.Chand.
1. *Organic chemistry*, T.R.Morrison and R.N.Boyd, Pearson Education India, New Delhi.

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**REFERENCES**

- 1 *Organic chemistry, Bruice 6<sup>th</sup> Edition, Pearson Publisher, 2010.*
- 2 *Reactions and Mechanism, Jerry March, 4<sup>th</sup> edition Wiley Publication.*
- 3 *Organic chemistry, Carey, 8<sup>th</sup> Edition, Mc Graw-Hill.*
- 4 *Organic chemistry, Pillai Orient Longman Publisher.*
- 5 *The Fundamentals Principles of Organic Chemistry Vol.I & Vol. II, I.L.Finar, ELBS/Longman.*

**Course outcomes:**

1. The graduate can understand nomenclature and chemistry of various functional groups and chemical properties with their mechanisms.  
Student can apply green chemical methods for the synthesis of new chemical entities in the view of environment protection.

<b>Subject</b>	<b>GENERAL AND DISPENSING PHARMACY</b>	<b>Course Code</b>	15R00202
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	II
<b>Theory</b>	2 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

**Scope and objectives:** This course is designed to impart a fundamental knowledge on the art and science of formulating different dosage forms. It prepares the students for most basics of the applied field of pharmacy.

### UNIT I Origin and History

Development of pharmacy, Evolution of Pharmacy education & Pharma industry in India. Origin and development of the Pharmacopoeias, History of Ayurveda, salient features of IP, USP and BP.

### UNIT II Dispensing Pharmacy

Drug - Definition, Essential characteristics. Dosage form – Definition, Classification, Formulation and purpose. Principles of dispensing, parts of prescription, handling of prescription, general dispensing procedures, source of errors in prescription and care required in dispensing procedures including labeling of dispensed products.

### UNIT III Pharmaceutical calculations

Weights and Measures, introduction to Latin terms, Percentage calculations, alligation method, proof spirit calculations, displacement value and calculations of isotonicity adjustment. Posology-factors affecting selection of dose & dosage form and calculations of doses.

### UNIT IV Principles involved and procedures adopted in dispensing of the following

**classes of preparations:**

i) Powders ii) Solutions iii) Mixtures iv) Lotions & liniments v) Suspensions vi) Emulsions and vii) Ointments.

### **UNIT V Incompatibilities**

Introduction, classifications, methods to overcome incompatibility.

#### **TEXT BOOKS**

1 *Dispensing Pharmacy, Cooper & Gunns CBS, Publ. and Distributors New Delhi – (2008).*

2 *Dispensing Pharmacy, R.M Metha, 2006 Vallabh Publication, New Delhi.*

#### **REFERENCES**

1. *Text Book of Pharmaceutics, E.A. Rawlins, Bentley's ELBS publ.*

2. *Essential dosage calculations -Hospital Pharmacy. Lorria & William, William Hassan.*

#### **OUTCOME**

**Upon the completion of the course the student should be able to:**

- a. recognize the formulation aspects of different dosage forms;
- b. do different pharmaceutical calculation involved in formulation;
- c. formulate different types of dosage forms; and
- d. appreciate the importance of good formulation for effectiveness.



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL BIOCHEMISTRY</b>	<b>Course Code</b>	15R00203
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	II
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	3		

**Scope and objectives:** This course is designed to impart a fundamental knowledge on the biochemistry. It prepares the students for most basics of life and chemistry of living.

### **UNIT I: Cell Processes, Bioenergetic and Cellular Reactions**

Bio chemical organization of the cell, molecular constituents of membrane, active & passivetransport process, sodium and potassium pumps, osmoregulation and heamostatis. The concept of freeenergy, determination of change in free energy from equilibrium constant & reduction potential.

Production of ATP and its biological significance.Redox reactions, redox potential, the respiratorychain & its role in energy capture & its control.Oxidative phosphorylation & its energetics & E.T.Cmechanism.

### **UNIT II**

**Introduction to Bio-Molecules:** Structure, classification, cell and biological functions of carbohydrates, proteins, lipids, nucleic acids (DNA & RNA) vitamins & minerals.

**Enzymes & Co-Enzymes:** Classification, Structure, mechanism of action, properties, factors

affecting enzymes action, enzyme kinetics and enzyme inhibitions, repressions with reference to drugaction, Isoenzymes, Coenzymes from Vitamins, Nucleotides and non-nucleotides. clinical importanceof enzymes in treatment and diagnosis.

### **UNIT III : Metabolism of carbohydrates**

Metabolic pathway, regulation and significance of the following pathways and cycles: Metabolism of Carbohydrates: Glycolysis (aerobic and anaerobic), glycogenolysis, gluconeogenesis, Krebs's cycle, HMP & uronic acid pathways, Cori cycle.

#### **UNIT IV : Metabolism of Lipids and Proteins**

Lipids : Alpha, Beta, Gamma & Omega oxidations of fatty acids, bio-synthesis of fatty acids,

cholesterol, ketogenesis, Utilization of ketone bodies, Regulation and energetics of Lipid metabolism, Metabolic disorders of lipid metabolism.

Proteins: Structure, classification of protein. Classification of amino acids, concept of essential and non-essential amino acids and their importance in deamination, Transamination, de-carboxylation, Urea cycle. Metabolism of Valine, cystine, cysteine, tryptophan, tyrosine, methionine. Biosynthesis of purines, pyrimidines, proteins. Metabolic disorders of Carbohydrate and protein.

#### **UNIT V: Clinical Biochemistry**

Introduction to clinical biochemistry, Normal values of various biochemical parameters (Blood / or Urine: Glucose, VLDL, LDL etc. total proteins, urea, Minerals, Hormones... etc.) and their abnormal values in diagnosis. Liver function test and kidney function test, OGTT.

#### **TEXT BOOKS:**

1. A.L. Lehninger, Principles of Biochemistry; CBS Publishers and distributors.
2. Harper, Biochemistry McGraw Hill Medical, 28th Edition.
3. Text Book of Biochemistry by Satyanarayana Oxford University Press.
4. J.L. Jain, Fundamentals of Biochemistry S.Chand

**REFERENCE BOOKS:**

1. Biochemistry, C.B.Powar&G.R.Chatwal, Himalaya publishing house
2. L.Stryer, Text Book of Bio Chemistry. W.H.Freemann& Co. Ltd. 6th Edition.
3. West, Edward Text Book of Biochemistry; Freeman and company, Sanfransisco.
4. E.E.Conn and PK Stumpf, Outlines of Biochemistry; John Wiley and sons, New York.

**OUTCOME**

**Upon the completion of the course the student should be able to:**

- a. Understand the chemistry involved in life.
- b. Understand biochemical reactions in the human body.
- c. Understand the metabolic pathways of various biomolecules.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

Subject	PHARMACOGNOSY-I	Course Code	15R00204
Course year	B. Pharmacy I year	Semester	II
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

**Objectives:** This subject has been introduced for the pharmacy course in order to make the student aware of medicinal uses of various naturally occurring drugs its history, sources, distribution, method of cultivation, active constituents, medicinal uses, identification tests, preservation methods, substitutes and adulterants.

**UNIT I**

- A) Definition, history, development and scope of Pharmacognosy
- B) Brief introduction to natural sources of drugs with examples: plants, animals, minerals, marine and microorganisms

**UNIT II**

- A) Classification of drugs of natural origin: Alphabetical, morphological, taxonomical, chemotaxonomic, pharmacological and chemical classification with suitable examples.
- B) Cultivation, collection, processing, drying, and storage of medicinal plants.
  - Factors influencing cultivation of medicinal plants.
  - Plant hormones and their applications.
  - Improved methods of cultivation techniques: polyploidy, mutation and hybridization with reference to medicinal plants.
  - WHO guidelines on Good Agricultural and Collection Practices (GACP) for medicinal plants

**UNIT III**

- A) Introduction, definition, classification, different chemical tests for the carbohydrates and derived products. Systemic Pharmacognostic study of the following carbohydrates and derived products: Acacia, Tragacanth, Agar, Starch, Guar gum, Pectin, Isabgol and Honey.

**UNIT IV**

- A) Definition, classification and properties of tannins. Study of tannin containing drugs-Gambir, Black catechu, Galls, Myrobalan and Arjuna.
- B) Study of source, preparation and identification of fibres used in pharmacy like cotton, silk, wool, nylon and polyester.

**UNIT V**

Introduction, definition, classification, different physical, chemical properties, extraction methods, chemical tests for the lipids. Systemic Pharmacognostic study of the following lipids: castor oil, cod liver oil, shark liver oil, linseed oil, cocoa butter, kokum butter, bees wax, wool fat, hydnocarpus oil, Rice bran oil and Lard.

**TEXT BOOKS:**

1. *Kokate C.K., Purohit A.P., Gokhale S. B. Pharmacognosy, Nirali Prakashan, New Delhi.*
2. *Text book of Pharmacognosy by Handa and Kapoor.*
3. *Pharmacognosy by Robert, Tyler.*

**REFERENCE BOOKS:**

1. *WHO guidelines on good agricultural and collection practices (GACP)-WHO, Geneva*
2. *Cultivation & utilization of medicinal plants by Atal CR and Kapoor BM.*
3. *Text book of Pharmacognosy by Wallis.*
4. *Pharmacognosy by Trease and Evans, latest edition.*
5. *Swain T; Chemical Plant taxonomy, Academic Press London.*

**Upon completion of the course student shall be able to:**

- a. understand the basic principles and improved techniques of cultivation, collection and storage of crude drugs.
- b. know the scientific name, geographical distribution, chemical nature and uses of crude drugs;
- c. know the significance of carbohydrates, tannins, lipids and fibres in pharmacy.

Subject	English for Professional Communication	Code	15A52201
Course year	B. Pharm. I year	Semester	II
Theory	2 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	2		

## 1. INTRODUCTION:

English is a global language and has international appeal and application. It is widely used in a variety of contexts and for varied purposes. The students would find it useful both for social and professional development. There is every need to help the students acquire skills useful to them in their career as well as workplace. They need to write a variety of documents and letters now extending into professional domain that cuts across business and research also. The syllabus has been designed to enhance communication skills of the students of engineering and pharmacy. The prescribed book serves the purpose of preparing them for everyday communication and to face the global competitions in future.

The text prescribed for detailed study focuses on LSRW skills and vocabulary development. The teachers should encourage the students to use the target language. The classes should be interactive and learner-centered. They should be encouraged to participate in the classroom activities keenly.

In addition to the exercises from the text done in the class, the teacher can bring variety by using authentic materials such as newspaper articles, advertisements, promotional material etc.

## 2. OBJECTIVES:

1. To develop confidence in the students to use English in everyday situations.
2. To enable the students to read different discourses so that they appreciate English for science and technologies.
3. To improve familiarity with a variety of technical writings.
4. To enable the students to acquire structure and written expressions required for their profession.

5. To develop the listening skills of the students.

### **3. SYLLABUS:**

#### **UNIT –I**

**Topics:** Group discussion, cause and effect, events and perspectives, debate, if conditional, essay writing.

**Text:** **LESSONS FROM THE PAST** from *MINDSCAPES*

Importance of History - Differing Perspectives - Modern Corporatism - Lessons From The Past

#### **UNIT-II**

**Topics:** Idioms, essay writing, power point presentation, modals, listening and rewriting, preparing summary, debate, group discussion, role play, writing a book review, conversation

**Text:** **'ENERGY'** from *MINDSCAPES*

Renewable and Non-Renewable Sources - Alternative Sources -Conservation -Nuclear Energy

#### **UNIT-III**

**Topics:** Vocabulary, impromptu speech, creative writing, direct and indirect speech, fixed expressions, developing creative writing skills, accents, presentation skills, making posters, report writing

**Text:** **'ENGINEERING ETHICS'** from *MINDSCAPES*

Challenger Disaster - Biotechnology - Genetic Engineering - Protection From Natural Calamities

#### **UNIT-IV**

**Topics:** Vocabulary, Conversation, Collocation, Group discussion, Note-making, Clauses, Interpreting charts and tables , Report writing.

**Text:** **'TRAVEL AND TOURISM'** from *MINDSCAPES*

Advantages and Disadvantages of Travel - Tourism - Atithi Devo Bhava - Tourism in India

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**UNIT-V**

**Topics:** Vocabulary, phrasal verbs, writing a profile, connectives, discourse markers, problem-solving, telephone skills, application letters, curriculum vitae, interviews (telephone and personal)

**Text:** 'GETTING JOB-READY' from *MINDSCAPES*

SWOT Analysis - Companies And Ways Of Powering Growth - Preparing For Interviews

**Prescribed Text**

**MINDSCAPES:** English for Technologists and Engineers, Orient Blackswan, 2014.

**REFERENCES:**

1. **Effective Tech Communication**, Rizvi, Tata McGraw-Hill Education, 2007.
2. **Technical Communication**, Meenakshi Raman, Oxford University Press.
3. **English Conversations Prcatice**, Grant Taylor, Tata Mc GrawHill publications, 2013.
4. **Practical English Grammar**. Thomson and Martinet, OUP, 2010.

**Expected Outcomes:**

At the end of the course, students would be expected to:

1. Have acquired ability to participate effectively in group discussions.
2. Have developed ability in writing in various contexts.
3. Have acquired a proper level of competence for employability.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

Subject	PHARMACEUTICAL ORGANIC CHEMISTRY-II LAB	Course Code	15R00205
Course year	B. Pharmacy I year	Semester	II
Practical	4 hrs/week	Tutorial	NIL
End exam	70 marks	Internal	30 marks
Credits	2		

**I. Experiments:****A.** Preparation of organic compounds (each involving a specific organic reaction covered in theory- any 10 synthesis)

1. Sulphonation : Preparation of Toluene para sulphonic acid from toluene
2. Bromination : Tribromoaniline from Phenol or Aniline.
3. Addition/Elimination : Preparation of phenyl hydrazone or oxime from Benzaldehyde
4. Addition : Preparation of 2,3-dibromo-3-phenyl propionic acid from benzaldehyde
5. Dehydration : Preparation of acetonedicarboxylic acid from citric acid
6. Condensation : Preparation of dibenzalacetone from benzaldehyde

**B.** Identification of the following organic compounds by systematic qualitative analysis including acidic/basic/neutral character, aromatic/aliphatic, saturated/unsaturated, test for special elements and functional group identification tests.

- a. Phenols
- b. Amides
- c. Amines
- d. Carboxylic acids
- e. Aldehydes and Ketones

- 
- f. Alcohols
  - g. Anilides and nitrocompounds
  - h. Esters
- II. Demo / work shop**

Crystallization by using various solvents, atomic models emphasizing organic molecules & TLC for synthesized compounds.

**III. Seminar/assignment/group discussion**

Exercise on nomenclature of compounds, Knowledge on Protection of groups by green chemical methods, microwave assisted synthesis.

**REFERENCES**

1. Text Book of Practical Organic Chemistry, Vogel's, 5<sup>th</sup> Edition Pearson.
2. Laboratory Manual of Organic Chemistry, R.K. Bansal, New Age International 5<sup>th</sup> Edition 2007.
3. Advanced Practical Organic Chemistry, O.P. Agarwal, 3<sup>rd</sup> Edition Goel Publication.
4. Practical Organic Chemistry, F.G.Mann & B.C. Saunders, Pearson 4<sup>th</sup> Edition.

**LIST OF MINIMUM EQUIPMENT REQUIRED**

1. Triple beam balances
  2. Physical balances
  3. Melting point apparatus
  4. Suction pumps
  5. Oven
  6. Hot plates
  7. Water baths
  8. Distillation unit
  9. Refrigerator
- Adequate glassware

<b>Subject</b>	<b>GENERAL AND DISPENSING PHARMACY LAB</b>	<b>Course Code</b>	15R00206
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	II
<b>Theory</b>	4hrs/week	<b>Tutorial</b>	Nil
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

### **I. EXPERIMENTS**

a) Dispensing of prescriptions falling under the categories: Mixtures, syrups, solutions, emulsions, ointments, powders, lotions, liniments (minimum two prescriptions from each class).

b) Identification of physical, chemical and therapeutic incompatibilities in a prescription, and dispensing of such prescriptions (3 Exercise).

c) Dispensing procedures involving pharmaceutical calculations, and dosage calculations for

paediatric and geriatric patients

### **II. DEMO/WORKSHOP**

Demo on homogenizer and identification test for emulsions.

### **III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION**

a) Current status of Indian pharma industry.

b) Applications of various dosage forms.

### **REFERENCE:**

a) Dispensing Pharmacy, Cooper & Gunns CBS, Publ. and Distributors New Delhi – (2008).

b) Dispensing Pharmacy, R.M Metha, 2006 Vallabh Publication, New Delhi.

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**LIST OF MINIMUM EQUIPMENT REQUIRED**

Adequate number of the following, such that each student gets

1. Mortars and pestles.
2. Analytical balance and weight box.
3. Percolators.
4. Dispensing containers.
5. PH meter.
6. Electronic balance.
7. Adequate quantities of chemicals and glassware.

<b>Subject</b>	<b>PHARMACEUTICAL BIOCHEMISTRY LAB</b>	<b>Course Code</b>	15R00207
<b>Course year</b>	B. Pharm I year	<b>Semester</b>	II
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

### I. EXPERIMENTS:

1. To prepare standard buffers (citrate, phosphate & carbonate) and measure the pH.
2. Separation of amino acids by gel / paper electrophoresis.
3. Identification of carbohydrates
4. Identification of amino acids.
5. Identification of lipids.
6. Estimation of glucose in urine and blood.
7. Estimation of creatinine in urine.
8. Estimation of creatinine in blood.
9. Estimation of cholesterol in blood.
10. Estimation of Urea in Blood
11. Estimation of Serum protein.
12. Estimation of bile pigments in serum.
13. Estimation of alkaline phosphatase, SGOT, SGPT in serum
14. Effect of temperature on the activity of alpha-amylase.

**NOTE:**Collection of blood samples from human should be carried out by trained pathologist and subject as per norms from the human subject.

## **II. WORKSHOP / DEMO**

Different diagnostic methods in diagnostic lab, Blood Glucose estimation by Glucometer

## **III. SEMINAR / ASSIGNMENT/GROUP DISCUSSION**

Various diagnostic tests for different diseases, Gene therapy and gene targeting

### **LIST OF MINIMUM EQUIPMENTS REQUIRED**

1. Colorimeter
2. Table top centrifuge
3. Digital balance
4. Physical/chemical balance
5. pH meter
6. Water bath
7. Folin-Wu tubes
8. Autoanalyser
9. Adequate glass wares

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

Subject	PHARMACOGNOSY-I LAB	Course Code	15R00208
Course year	B. Pharmacy 1 year	Semester	II
practical	4 hrs/week	Tutorial	NIL
End exam	70 marks	Internal	30 marks
Credits	2		

**EXPERIMENTS:**

1. Collection and preparation of herbarium/laminated photos/ specimens of natural drugs.
2. Study of microscope.
3. Study of various morphological characters of the drugs mentioned in theory under carbohydrates.
4. Study of various morphological characters of the drugs mentioned in theory under lipids.
5. Study of various morphological characters of the drugs mentioned in theory under tannins.
6. Study of various morphological characters of the drugs mentioned in theory under fibres.
7. Chemical tests for Acacia, Tragacanth, Guar gum, Agar and Starch.
8. Chemical tests for Castor oil, Linseed oil, Shark liver oil, Cod liver oil.
9. Chemical tests for Gambir, Black catechu.
10. Chemical test for fibres mentioned in theory.
11. Determination of swelling factor of mucilage containing herbal drug.

**Seminar/ Assignment:**

Seminar/ Assignment related to theory:

**Workshop/Demo**

Cultivation of medicinal plants

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**References**

1. Practical Pharmacognosy, C K Kokate, Nirali Prakashan
2. Practical Pharmacognosy, Khandelwal, Nirali Prakashan
3. Practical Pharmacognosy Iyengar, Manipal Press Ltd.
4. Brain KR and Turner TD. The practical Evaluation of Phytopharmaceuticals, Wright-Sciencetchnics, Bristol.
5. Peach K and Tracey MV, Modern methods of Plant analysis, Narose publishing house, New Delhi.

**LIST OF MINIMUM EQUIPMENTS REQUIRED**

1. Microscopes with stage
2. Heating mantle
3. Water baths
4. Adequate glass wares



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL ENGINEERING</b>	<b>Course Code</b>	15R00301
<b>Course year</b>	B. Pharmacy II year	<b>Semester</b>	I
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	3		

**Scope and objectives:**

This course is dealing with the various unit operations i.e. drying, evaporation and working principles of different machinery like hammer mill, cyclone separator.

**Unit I**

**Introductory concepts:** Unit operation / Unit processes, material and energy balance, equilibriumstate, rate process.

**Fluid Flow:** Types of flow, Reynold's number, bernoulli's equation, viscosity, concept of boundarylayer, basic equations of fluid flow, valves, flow meters, manometers and principles of measuring

instruments.

**Material handling systems**

a. Liquid and Gas handling - Study of different types of pumps such as Reciprocating pumps, Turbine pumps and centrifugal pumps, fans, blowers and compressors.

b. Solid handling – Conveyor.

**Corrosion:**

Classification, mechanism of corrosion, factors effecting, prevention and control.

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**Unit II****Dehumidification and Humidity control**

Basic concepts and definition, wet bulb and adiabatic saturation temperature. Psychrometric chart and

measurement of humidity, application of humidity measurement, Equipments for dehumidification

operations.

**Refrigeration and air-conditioning:** Principles and applications.

**Evaporation and drying:** Basic concept of phase equilibria. Definition and theory of evaporation, factors affecting evaporation, evaporators-film evaporators.

Moisture content and theory of drying, rate of drying and time of drying calculations, drying

curves. Concept of loss on drying and its importance. Classification and types of dryers, dryers used

in pharmaceutical industries- tray dryer, Fluid bed dryer, spray dryer, freeze-dryer, tunnel dryer and

vacuum dryer.

**UNIT III****Crystallization:**

Miers supersaturation theory, crystals growth, size, shape, geometry. Material and heat balances around Swenson walker crystallizer. Nucleation mechanisms, steady of various types of crystallizers, tanks, agitated batch, single vacuum, circulating magma and krystal crystallizer.

**Filtration and Centrifugation:** Theory of filtration, Factors affecting filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, Air filtration. Principles of centrifugation, industrial centrifugal filters and centrifugal sedimenters.

#### **UNIT IV**

**Size Reduction:** Definition, theory and objectives of size reduction, factors affecting size reduction,

laws governing energy and power requirements of a mill. A brief study of ball mill, hammer mill, fluid energy mill.

**Size Separation:** Different techniques of size separation, sieves, sieve shakers, sedimentation tank, cyclone separators, bag fillers.

**Mixing:** Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipments-double cone,

twin-shell, silverson mixer, colloid mill, sigma blade mixer, planetary mixer, propeller mixer and

turbine mixer. Homogenizer, triple roller mill.

#### **UNIT V**

**Automated process control systems:**

Process variables, temperature, pressure, flow, level and vacuum and their measurements. Elements of automatic process control and introduction to automatic process control systems, elements of computer aided manufacturing. Reactors and fundamentals of reactors design for chemical reactions.

**TEXT BOOKS:**

1. S.J. Carter, *Cooper and Gunn's Tutorial Pharmacy*, 6th ed., CBS publisher, Delhi.
2. CVS Subramanyam, *Pharmaceutical Engineering*. Vallabh Prakasham New Delhi.
3. K. Samba Murthy, *Pharmaceutical Engineering* new Age International Publishers Ltd. 1998.
4. L. Lachman, H. Lieberman & J.B.Schwartz. *Pharmaceutical dosage forms volume-II*, 2nd ed.,  
marcel dekker Inc.

**REFERENCE BOOKS:**

1. E.A. Rawlin's, Bentley's *Text Book of Pharmaceutics*, 8th ed ELBS.
2. Badzer&Banchoro, *Introduction to Chemical Engineering*. Tata – Mc Graw Hill.

**OUTCOME**

**Upon the completion of the course the student should be able to:**

- a. Graduate understands the basic fundamentals of various unit operations required for drug development.  
Apply the operating skills of pharmaceutical machinery required to work in the pharmaceutical field viz.drug manufacturing & production.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHYSICAL PHARMACY – I</b>	<b>Course Code</b>	15R00302
<b>Course year</b>	B. Pharmacy II year	<b>Semester</b>	I
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	3		

**Scope and objectives:**

This course is designed to provide the basis for understanding the chemical and physical phenomena that govern the *in vivo* and *in vitro* actions of pharmaceutical products.

**UNIT I**

**Intermolecular forces and states of matter:** Binding forces between molecules, the states of matter, change in the state of matter, latent heat and vapour pressure, sublimation critical point, eutectic mixtures, relative humidity, the liquid state, liquid crystalline state, Glossy state and solid state, amorphous and polymorphism.

**Phase rule:** Definition and explanation. One component (water system), two compartment system (phenol - water system & TEA (Tri Ethyl Amine) and Water system).

**UNIT II**

**Thermodynamics:** The zeroth, first, second and third law of thermodynamics, Free energy functions and applications.

**Physical properties of drug molecules:** Dielectric constant induced polarization, dipole moment,

refractive index and molar refraction and optical rotatory dispersion.

**UNIT III**

**Solutions of Non electrolytes:** Concentration expressions, ideal and real solutions, colligative properties ( lowering of vapour pressure, depression in freezing point, elevation of boiling point and

Osmotic pressure), molecular weight determinations.

**Solutions of Electrolytes:** Properties of solutions of electrolytes. The Arrhenius theory of electrolyte

dissociation. The modern theory of strong electrolytes (Activity co-efficient and ionic strength).

**UNIT IV**

**Ionic equilibria:** Modern theories of acids, bases and salts, Sorensen's pH scale, concentration as a function of pH, calculation of pH and acidity constants.

**Buffers and isotonic systems:** The buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, isotonic solutions, methods of adjusting tonicity and pH (relevant numerical problems).

**UNIT V**

**Kinetics and drug stability:** General consideration and concepts, half life period ( $t_{1/2}$ ) determination, influence of temperature and Arrhenius theory, light, solvent, catalytic species and other factors. Accelerated stability studies, expiration dating.

**TEXT BOOKS:**

1. Patrick J. Sinko, *Martin's Physical Pharmacy and Pharmaceutical Sciences Fifth Edition*. Lippin

*Cott Williams and Wilkins.*

2. C.V.S.Subramanyam, *Essentials of Physical Pharmacy*, VallabhPrakashan.

3. Manavalan & Ramaswamy. *Physical pharmaceutics. 2nd ed. Vignesh publisher, 2008.*

**REFERENCE BOOKS:**

1. *Pharmacopoeia, (I.P., B.P., U.S.P. and European)*
2. *Martindale, The Extra Pharmacopoeia; latest edition, the Royal Pharmaceutical Society.*
3. *Lippincott Williams and Wilkins, Remington Pharmaceutical Sciences.*
4. *L. Lachman, H. Lieberman The Theory And Practice Of Industrial Pharmacy J. L Kaniz Lee & Febiger Philadelphia, USA.*

**OUTCOME****Upon the completion of the course the student should be able to:**

- a. Understand the chemical & physical fundamental aspects of intermolecular forces,
- b. Relevant with laws of thermodynamics,
- c. Know the importance of solubilization of electrolytes & non-electrolytes,
- d. Recognize the significance of pH & tonicity that govern the *In vivo* & *In vitro* actions of pharmaceutical products.
- e. Define reaction kinetics, reaction order, and discuss factors affecting the rate of the reaction, degradation and stabilization of medicinal agents as well as accelerated stability testing.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

Subject	PHARMACEUTICAL ORGANIC CHEMISTRY – III	Course Code	15R00303
Course year	B. Pharmacy II year	Semester	II
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

**Objectives:**

1. To fulfil the knowledge on basics of hetero cyclic chemistry and stereo chemistry of organic molecules.
2. To understand the knowledge of organic chemistry in relation to natural compounds such as carbohydrates, proteins and lipids etc..
3. To impart the knowledge on fundamentals of named reactions and rearrangements.

**UNIT I: Heterocyclic chemistry**

Definition, nomenclature, structure, aromaticity, reactivity, synthesis, acidity-basicity and characteristic reactions of the following heterocyclic compounds. Few examples of drugs which contain the cited ring system.

**Five membered ring systems:** Furan, pyrrole, thiophene, Pyrazole, imidazole, oxazole, isoxazole, thiazole. Six membered ring systems: pyridine, pyrazine, pyrimidine and pyridazine. Fused ring systems: Indole, quinoline, iso-quinoline, acridine, Benzimidazole, phenothiazine, purines.

**UNIT II: Stereochemistry of Carbon compounds** - Optical rotation, plane polarized light, optical activity, chirality, notations (assignment of configuration), relative configuration (Fischer DL configuration), absolute configuration (R & S), sequence rules (with examples), enantiomers, meso compounds, racemic mixture and resolution of racemic mixture.



Concept of E & Z, Cis & Trans, Syn & Anti configurations. Elements of symmetry. Stereo selective & stereo specific reactions. Optical activity of biphenyl compounds.

### UNIT III

**Carbohydrates:** Definition, classification, nomenclature, study of glucose structure, mutarotation, ring structure, oxidation-reduction reactions, osazone formation, epimerization, Lobry De Bruyn – Van Ekenstein reaction, structure of the sucrose, starch and cellulose. non-reducing nature; A brief account on pharmaceutical importance of various carbohydrates. **Glycosides:** Definition, classification,  $\alpha$ ,  $\beta$  – glycosidic linkages, enzymatic hydrolysis, structure and physiological importance of Anthraquinone glycosides.

### UNIT IV

**Amino acids and Proteins:** Definition, classification, configuration, methods of preparation of aminoacids, physical, chemical properties, Zwitter ionic nature and isoelectric point. peptide synthesis, CTAA and NTAA concept and determination. Structure and chemistry of Insulin, Oxytocin, Heparin. Pharmaceutical importance of polypeptides and proteins.

**Lipids (oils and fats):** Definition, classification of fatty acids, trans and cis fatty acids, fat analysis including Saponification value, acid value, peroxide value and Iodine value etc.), hydrogenation and rancidity of oils and fats. Comparison of fat, oil, wax based on their properties.

### UNIT V: Reaction mechanisms and applications in Drug synthesis

Beckmann rearrangement, Birch reduction, Mannich reaction, Michael addition reaction, Wittig reaction, MPV reduction, Oppanauer oxidation, Curtius rearrangement, Schmidt reaction. Neighbouring group effects and reduction by transition metal complexes.

**TEXT BOOKS:**

1. *Heterocyclic chemistry by Bansal, 5<sup>th</sup> edition.*
2. *Arun Bahl & S.S Bahl, Advanced Organic Chemistry-S.Chand.*
3. *R Morrison and R. Boyd, organic chemistry, Pub by Printice Hall of India, New Delhi.*
4. *I L Finar, Organic Chemistry, Vol. I. & II, 6<sup>th</sup> Pearson education*
5. *O.P Agarwal, A Textbook of Organic Chemistry*
6. *Eliel, Stereochemistry of Organic compounds.*
7. *Oraganic reactions, Stereo chemistry&mechanizam by PS Kalsi*

**REFERENCE BOOKS:**

1. *Jerry March, Advanced Organic Chemistry 4<sup>th</sup> Edition Wiley Publication. 2 Cram & Hammond.Organic Chemistry Mc Graw-Hill.*
3. *A.I. Vogel's, A textbook of practical organic chemistry Mc Graw Hill. 6<sup>th</sup> Edition.*
4. *Solomons, Organic Chemistry 9<sup>th</sup> Edition Wiley Publication.*

**Course outcomes:**

1. Graduate will Understand and apply the nomenclature, basic chemistry, stereochemistry, rearrangement reaction, mechanisms of heterocyclic & other organic compounds.
2. Graduates will able to synthesise basic heterocyclic molecules, analyze, estimate organic compounds and understand the recent methods of organic synthesis.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL MICROBIOLOGY</b>	<b>Course Code</b>	15R00304
<b>Course year</b>	B. Pharmacy Iyear	<b>Semester</b>	I
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	3		

**OBJECTIVE :**

To know the anatomy, identification, growth factors and sterilization of microorganisms. To know the mode of transmission of diseases and applications of microorganisms in pharmaceutical field.

**UNIT I Introduction to Microbiology:** Origin, scope and discovery of spontaneous generations

theory, contributions of Antonie Van Leeuwenhoek, Pasteur, Koch and Lister. Diversity of

Microorganisms: Prokaryotes versus eukaryotes – eukaryotic and prokaryotic cell structure, threedomains of life (bacteria, archaea and eukaryotes). Pharmaceutical significance of protozoa, algae, fungi, bacteria and viruses. Characterization and identification of microorganisms.

**UNIT II Nutrition and Growth of Microbes:** Nutritional requirements, Types of Nutrient

media and growth conditions and Nutritional types based on energy source. Isolation, cultivation (aerobic & anaerobic) and preservation of microorganisms, physiology of

growth, bacterial growth curve, methods for determining bacterial numbers, mass and cell

constituents. Exponential growth and generation time. Bacterial growth in batch and continuous culture (chemostat and turbidostat) synchronous growth.

**UNIT III Control of Microorganisms:** General Concepts, Inhibition of growth and killing,

sterilization and disinfection, antiseptics and sanitation, mode of action application & limitation of physical agents (moist and dry heat, radiation and filtration), chemical agents. Various types of disinfectants, factors affecting sterilization and disinfection, evaluation of antimicrobial activity. Chemotherapeutic agents, mode of action and applications, drug resistance. Official methods of sterility testing of pharmaceuticals and biosafety measures.

## UNIT IV

**Epidemiology of Diseases:** Study of etiology, diagnosis, source of infection, mode of transmission, immunization methods, prevention and control of the following diseases. Bacillary dysentery, diphtheria, tuberculosis, leprosy, cholera, typhoid, syphilis, gonorrhoea, tetanus, food poisoning and infective hepatitis. Diagnostic tests of Malaria, Typhoid, Cholera, TB, Leprosy.

## UNIT V Application of Microbes in Pharmaceutical Industry

a. **Microbiological Assays:** Principles and Methods involved in Assay of Antibiotics (penicillins, tetracyclines and streptomycins only) Vitamins (cyanocobalamin and riboflavin only), Amino acids (lysine and glutamic acid only) & Bio-Sensors in Analysis.

b. **Microbial Source & applications of various pharmaproducts** like Antibiotics, vitamins, Amino acids, solvents, enzymes & genetic engineered products etc.

### **Text Books:**

1. *Pelczar and Reid, Text Book of Microbiology Lippincott Williams & wilkins, 2nd Edition.*
2. *Anantha Narayan and Jayram Panikar, Text Book of Microbiology, Orient Longman, Delhi, Hyderabad.*
3. *R.C. Dubey, A textbook of Microbiology S.Chand.*

**Reference Books:**

1. *Pharmaceutical microbiology* by Kishore Gujar, Himalaya publishing house.
2. *Nester, Anderson, Roberts, Pearsall, Microbiology*, McGraw-Hill.
3. *Hugo.W B, Pharmaceutical Microbiology*. PA Publishing Pvt. Ltd.
4. *Tortora, Gerard, Text Book of Microbiology*. Benjamin Cummings.
5. *Prescott and Dunn, "IndustrialMicrobiology" 2nd Ed*, Mc Graw hill Book Company Inc.

**OUTCOMES :**

1. Students can understand the importance of microbiology in industry & pharmacy
2. Students can learn the microbiological significance disease and its treatment.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>ENVIRONMENTAL STUDIES</b>	<b>Course Code</b>	15A01101
<b>Course year</b>	B. Pharmacy Ilyear	<b>Semester</b>	I
<b>Theory</b>	2 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

**Objectives:**

To make the students to get awareness on environment, to understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life to save earth from the inventions by the engineers.

**UNIT – I**

**MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:** – Definition, Scope and Importance – Need for Public Awareness.

**NATURAL RESOURCES** : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

**UNIT – II**

**ECOSYSTEMS:** Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

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- a. Forest ecosystem.
  - b. Grassland ecosystem
  - c. Desert ecosystem
  - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**BIODIVERSITY AND ITS CONSERVATION** : Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

### **UNIT – III**

**ENVIRONMENTAL POLLUTION:** Definition, Cause, effects and control measures of :

- a. Air Pollution.
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

**SOLID WASTE MANAGEMENT:** Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

### **UNIT – IV**

**SOCIAL ISSUES AND THE ENVIRONMENT:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of

Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

## **UNIT – V**

**HUMAN POPULATION AND THE ENVIRONMENT:** Population growth, variation among nations. Population explosion – Family Welfare Programmed. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

**FIELD WORK:** Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

### **Text Books:**

1. Text Book of Environmental Studies for Undergraduate Courses, Erach Bharucha, Universities Press Pvt Ltd, Hyderabad. 2<sup>nd</sup> Edition 2013.
2. Environmental Studies by Kaushik, New Age Publishers.

### **References:**

1. Environmental Studies by Rajagopalan, Oxford Publishers.
2. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.
3. Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Printice hall of India Private limited.

### **Outcomes:**

- Students will get the sufficient information that will clarify modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.
- Students will realize the need to change their approach so as to perceive our own environmental issues correctly, using practical approach based on observation and self learning.
- Students become conversant with the fact that there is a need to create a concern for our environment that will trigger pro-environmental action; including simple activities we can do in our daily life to protect it.



- By studying environmental sciences, students is exposed to the environment that enables one to find out solution of various environmental problems encountered on and often.
- At the end of the course, it is expected that students will be able to identify and analyze environmental problems as well as the risks associated with these problems and efforts to be taken to protect the environment from getting polluted. This will enable every human being to live in a more sustainable manner.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL ENGINEERING –LABORATORY</b>	<b>Course Code</b>	15R00305
<b>Course year</b>	B. Pharmacy II year	<b>Semester</b>	I
<b>Theory</b>	4 hrs/week	<b>Tutorial</b>	NIL
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

**I. EXPERIMENTS:**

1. Evaluation of filter media, determination of rate of filtration and study of factors affecting filtration

Including filter aids.

2. Particle size measurement by sieve shaker.

3. Determination of Humidity-using Dry Bulb and Wet Bulb thermometers and Psychometric charts.

4. Determination of overall Heat Transfer Coefficient.

5. Determination of rate of evaporation.

6. Determination of rate of drying, free moisture content and bound moisture content.

7. Experiments to illustrate the influence of various parameters on construction of drying curves.

8. Experiments to illustrate principles of size reduction, Laws governing energy and power

requirements of a size reduction (Ball mill).

9. Experiments to illustrate solid-solid mixing, determination of mixing efficiency using different

types of mixers.

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10. Analysis of pharmaceutical packaging materials-leaching of contents from packaging materials.

## **II. DEMO/ WORKSHOP**

Determination of type of flow (Reynolds experiment)

Double cone blender, homogenizer, tray dryer.

## **III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION**

Advances in packaging technology.

## **LIST OF MINIMUM EQUIPMENTS REQUIRED**

1. Tray dryer
2. Ball mill
3. Seive shaker with set of sieves as per IP
4. Double cone blender
5. Propeller type mechanical agitator
6. Homogeniser
7. Buchner filtration apparatus
8. Vacuum pump
9. Desiccators'
10. Energy meter
11. Autoclave

<b>Subject</b>	<b>PHYSICAL PHARMACY – I LABORATORY</b>	<b>Course Code</b>	15R00306
<b>Course year</b>	B. Pharmacy II year	<b>Semester</b>	I
<b>Theory</b>	4hrs/week	<b>Tutorial</b>	NIL
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

### I. EXPERIMENTS:

1. Percent composition – Capillary Flow method.
2. Percent composition –refractometer.
3. Molecular weight – Rast camphor method.
4. Calibration of pH Meter using standard buffers pH Estimation – pH meter.
5. pKa Estimation by Half Neutralization Method.
6. Refractive index of liquids.
7. Phenol water system – CST.
8. Lower consolute temperature – TEA (Tri Ethyl Amine) and Water.
9. Ternary phase diagram.
10. Preparation of phosphate Buffers and their Buffer Capacity Determination.
11. Effect of temperature on first order kinetics and to find the energy of activation.

### II. Demo/ Workshop

Demo on polarimeter (To prove that the hydrolysis of sucrose follows first order kinetics).

### III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION

Thermodynamics of solutions and polymers, Types of electrodes.

### LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Ostwald's viscometer
2. Stalgnometer

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3. Polarimeter

4. Abbe's refractometer

5. CST apparatus

6. pH meter

7. Colorimeter

8. Digital balances

Subject	PHARMACEUTICAL ORGANIC CHEMISTRY-III LABORATORY	Course Code	15R00307
Course year	B. Pharmacy II year	Semester	II
Theory	4 hrs/week	Tutorial	NIL
End exam	70 marks	Internal	30 marks
Credits	2		

### I. Experiments:

#### A. Quantitative determination of organic compounds via functional groups

1. Phenolic groups by bromination method.
2. Alcoholic group by acetylation method.
3. Carbonyl group by hydroxylamine hydrochloride-pyridine method.
4. Aldehyde group by sodium sulphite-sulphuric acid procedure.
5. Carboxyl group by acid-base method.
6. Amino group by bromination method.
7. Amino acid formal titration method.

#### B. Synthesis/preparation involving more than one step (Any five).

8. Synthesis of acetophenone oxime and its conversion to acetamide.
9. Phenothiazine from diphenyl amine
10. Benzimidazole from o-phenylene diamine
11. Knorr quinoline synthesis (4-methyl 2- quinoline) from aceto acetanilide
12. Synthesis of Imidazole -4,5-dicarboxylic acid from tartaric acid
13. Benzilic acid from benzene.
14. Preparation of 2-phenylindole from Phenylhydrazine by Fischer's method.

#### C. Systematic analysis of organic binary mixtures

#### D. Analysis of oils & fats

- a. Determination of Acid value of fixed oils.
- b. Determination of Saponification value of a fixed oils.

- c. Determination of Iodine value of a fixed oils.
- d. Determination of peroxide value of a fixed oils.

**II. Demo/Workshop:**

Synthesis of some asymmetric organic molecules, identification of synthesized compounds by TLC, Catalyst and solvent effect in synthesis.

**III. Seminar/Assignment/Group discussion:**

Principles of green chemistry, solvent free synthesis, sonication as the green chemical method for organic synthesis.

**References:**

1. *Indian Pharmacopoeia*. – 1996.
2. *A.I. Vogel's – Practical Organic Chemistry – Prentice Hall*.
3. *Text Book of Practical Organic Chemistry, Vogel's, 5<sup>th</sup> Edition Pearson*.
4. *Laboratory Manual of Organic Chemistry, R.K. Bansal, New Age International 5<sup>th</sup> Edition 2007*.
5. *Advanced Practical Organic Chemistry, O.P. Agarwal, 3<sup>rd</sup> Edition Goel Publication*.
6. *Practical Organic Chemistry, F.G.Mann & B.C. Saunders, Pearson 4<sup>th</sup> Edition*.

**LIST OF MINIMUM EQUIPMENTS REQUIRED**

1. *Triple beam balances*
2. *Physical balances and analytical balances*
3. *Melting point apparatus*
  
4. *Suction pumps*
  
5. *Oven*
  
  
6. *Hot plates*
7. *Water baths*
  
8. *Distillation unit*
9. *Refrigerator*
  
10. *Mechanical stirrer*
11. *Reflex flask with condenser*
12. *Magnetic stirrer with thermostat*
13. *Adequate glassware's*



<b>Subject</b>	<b>PHARMACEUTICAL MICROBIOLOGY LABORATORY</b>	<b>Course Code</b>	15R00308
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	I
<b>Theory</b>	4 hrs/week	<b>Tutorial</b>	--
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

### I. EXPERIMENTS:

- 1 Introduction to equipment and glassware used in microbiology laboratory.
- 2 Preparation of various culture media.
- 3 Sterilization techniques and their validations.
- 4 Aseptic transfer of culture into different types of media.
- 5 Characterization of microbes by staining methods (simple gram's, acid fast and negative staining and spore staining) and motility testing by hanging drop method.
- 6 Enumeration of bacteria by pour plate/spread plate technique
- 7 Enumeration of bacteria by direct microscopic count.(Neubauer's chamber)
- 8 Isolation of pure cultures by streak plate, spread plate and pour plate.
- 9 Evaluation of antiseptics and disinfectants by phenol coefficient method(R/w),
- 10 Sterility test for bulk powders and water for injection (IP).
- 11 Observation of colony/culture characters
- 12 Bio chemical reactions:

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- i) Indole test.
  - ii) Methyl red test.
  - iii) Voges proskauer test.
  - iv) Starch hydrolysis test.
  - v) Fermentation of carbohydrates and gelatin liquefaction.

13 Anti-microbial assay by cup and plate method and turbidometric method

**II. Demonstration/Workshop:** Construction of Bacterial growth curve by different methods, Rapid

Diagnostic tests by kits

**III. Assignment/Seminar/Group discussion:**

Recent trends in Identification, Cultivation, Handling of Microorganisms. Polymer Chain Reaction

(PCR).

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL ANALYSIS – I</b>	<b>Course Code</b>	15R00401
<b>Course year</b>	B. Pharmacy II year	<b>Semester</b>	II
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1 hr/week
<b>End exam</b>	70 marks	<b>Internal exam</b>	30 marks
<b>Credits</b>	3		

**COURSEOBJECTIVE**

To acquire adequate scientific knowledge regarding basic principles of pharmaceutical analysis.

**UNIT I**

a) Definition of Analytical chemistry and role of pharmaceutical analysis in pharmaceutical industry.

Significant figures, concept of error, precision, accuracy, rejection of doubtful values with special

reference to volumetric analysis. Calibration of glassware used in volumetric analysis- Burette, pipette and volumetric flask. Methods of expression of concentration(w/w,w/v,v/v).

b) **Theory of Neutralization Titrations:** Acid-base concept, Acidimetry, Alkalimetry, Common ion

effect and solubility product, indicators, Ostwald and quinonoid theories of Indicators

c) **Non-aqueous titration:** Theory, types, solvents used and application in pharmaceutical analysis.

***Application of the above methods in the analysis of drugs and formulations as under IP 2007and***

**2010.**

**UNIT II**

- a) General principles, theory and examples of **oxidation-reduction methods**, permanganometry, ceriometry, iodometry, iodimetry indicators used in these titrations, self indicators.
- b) General principles, theory and examples of **Precipitation methods**: Mohr's method, volhard's method, account of the indicators used in these titrations, Adsorption indicators.
- c) **Complexometric titration**: Theory, types and application in pharmaceutical analysis. Indicators used, Masking and demasking and their applications.

***Application of the above methods in the analysis of drugs, as under IP 2007 and 2010.***

**UNIT III**

- a) Potentiometry: Introduction to EMF, electrochemical cells and half cells, Electrodes, measurement of potential, pH curve, EMF curve, derivative curve in application to end point determination.
- b) Conductometric titrations: Basic concepts, conductivity cell, different types of conductometric titrations.
- c) Polarography: Basic concepts, apparatus and principles, different currents, polarographic maxima, general polarographic analysis, applications in identification and quantification of metals.

d) Amperometric titrations with one polarized electrode, general procedure, titration curves,

applications in pharmaceutical analysis.

#### **UNIT IV**

**Fluorimetry:** Theory, Fluorescence and chemical structure, Stokes and anti-Stokes, quantum efficiency, factors affecting the intensity of fluorescence, Instrumentation (double beam), Applications in Pharmaceutical analysis.

**Flame Emission photometry Vs Atomic absorption spectroscopy:** Emission spectra, Absorption spectra, line spectra, principle of absorption / emission of UV light by elements, instrumentation, applications in pharmaceutical analysis. Focus on interference.

**Nephelo-turbidimetry:** Introduction, principle, instrumentation of Nephelo-turbidimeter, pharmaceutical application as specified in IP, determination of chlorides and sulphates.

#### **UNIT V**

a) Principle and applications of the following instruments and various grades of reagents in a QC laboratory.

i) Refractometry ii) Polarimetry. iii) LR Grade iv) AR grade v) HPLC grade.

b). Role of moisture content determination in QC of pharmaceuticals (including Karl-Fisher method, LOD, IR balance).

#### **TEXT BOOKS:**

1. A.H. Beckett & J.B. Stanlake Vol. I & II., *Practical Pharmaceutical Chemistry*, Athlone Press of the Univ of London

2. B.K. Sharma, *Instrumental Chemical Analysis*, Goel Publishers.

3. Chatwal & Anand, *Instrumental Methods of Analysis*. Himalaya Publishing Home, 2009.

**REFERENCE BOOKS:**

1. *A.I Vogel, Quantitative Chemical Analysis, VI edition, Pearson education Delhi.*
2. *Pharmacopoeia (IP, BP, USP).*
3. *D. A. Skoog, Principles of Instrumental Analysis, V edition, Thomson Brooks Banglore.*
4. *Connors, a Textbook of Pharmaceutical Analysis. Wiley India Pvt. Ltd*

**OUTCOME:**

Graduates will conduct analyze and interpret data of experiments in production, Analytical and clinical aspects

Subject	PHARMACOGNOSY-II	Course Code	15R00402
Course year	B. Pharmacy II year	Semester	II
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

**Objectives:** To make the student aware of Secondary metabolites production in plants and its medicinal significance, cosmeceuticals and nutraceuticals importance.

## UNIT I

### Glycosides

Definition, classification, properties and general tests of glycosides and detailed Pharmacognostic study of the following glycosides containing drugs:

- a. **Saponin glycosides**- Glycyrrhiza, Ginseng, Dioscorea, Senega, Sarsaparilla
- b. **Cardioactive glycosides**-Digitalis, Squill, Strophanthus, Thevetia
- c. **Anthraquinone glycosides**-Aloe, Senna, Rhubarb, Cascara
- d. **Bitter Glycosides**- Psoralea, Gentian, Chirata

## UNIT II

- A) General introduction to cosmeceuticals, role of herbs in cosmetics.
  - Study of the following cosmeceuticals - Amla, Henna, Cyperus, Soap Nut, Aloe Vera, Turmeric, Sandal Wood and Bitter Orange Peel.
- B) Definition and study of Nutraceuticals: Garlic, Spirulina, Soya and Royal jelly.

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**UNIT III****Alkaloids:**

Definition, classification, properties and general tests and detailed pharmacognostic study of the following alkaloid containing drugs:

- a. **Pyridine-Piperidine alkaloids**- Tobacco, Lobelia
- b. **Tropane**- Belladonna, Hyoscyamus, Datura, Coca.
- c. **Indole**-Ergot, Rauwolfia, Vinca, Nux Vomica
- d. **Imidazole**-Pilocarpus
- e. **Steroid**- Kurchi, Veratrum, Aswagandha

**UNIT IV**

- a. **Quinoline-Isoquinoline**-Cinchona, Ipecac, Opium
- b. **Alkaloidal amine**- Ephedra, Colchicum
- c. **Glycoalkaloid**-Solanum
- d. **Purine**-Coffee, Tea, cola
- e. **Quinazoline** -Vasaka



**UNIT V**

A) **Biogenesis:** General techniques of biosynthetic studies and basic metabolic pathways.

- Biogenesis of secondary metabolites of pharmaceutical importance.

B) **Extraction of herbal materials:** Definition of extraction, principle involved in extraction, different types of extraction.

- Factors affecting the process of extraction.

C) **Phytochemical Screening:** Preparation of extracts, identification and screening of alkaloids, saponins, cardiac glycosides, flavonoids, tannins and anthraquinones in plant extracts.

**Text Books:**

1. Kokate CK, Purohit A.P. & Gokhale; *Pharmacognosy Nirali Prakashan, New Delhi.*
2. *Text book of Pharmacognosy by Handa and Kapoor.*
3. Peach K and Tracey MV, *Modern methods of Plant analysis, Narose publishing house, New Delhi.*
4. *Pharmacognosy by Brady & Tyler.*
5. *Tutorial Pharmacy by Cooper and Gunn.*
6. *text book of pharmacognosy and phytochemistry by Vinod D Rangari, Vol I and II.*

**Reference Books:**

1. *Text book of Pharmacognosy by Wallis.*
2. *Herbal drug technology by Pulok Mukharjee*
3. *Pharmacognosy by Trease and Evans*
4. *Biosynthesis of natural products by Manitto P*
5. *Harbone JB, Phytochemical methods, Chapman and Hall*

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**OUTCOME**

- a. know the scientific name, geographical distribution, chemical nature and uses of crude drugs.
- b. know the role of glycosides, alkaloids in treating of various ailments of human beings.
- c. know the significance of nutraceuticals and cosmeceuticals in maintaining the health conditions and appearance.
- d. know various techniques used in biogenesis of secondary metabolites.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL TECHNOLOGY – I</b>	<b>Course Code</b>	15R00403
<b>Course year</b>	B. Pharmacy II year	<b>Semester</b>	II
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	3		

**Scope and objectives:**1. This course is designed to understand the aspects of preformulation and formulation of liquid and semi solids

2. To gain the knowledge on stability associated ICH guidelines.

3. To gain basic knowledge on blood products.

### UNIT I

**Preformulation:** Goals, Physicochemical properties like physical form, particle size, shape, density, wetting, dielectric constant, solubility, dissolution, partition coefficient, organoleptic additives, hydrolysis, oxidation-reduction, racemization, polymerization, etc and their effect on formulation, drug-excipient incompatibility studies,. Introduction to Stability testing of finished products as per

ICH guidelines.

### UNIT II

**Liquid dosage forms:** Introduction, types of additives used in formulations, vehicles, stabilizers,

preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavours and others,

manufacturing packaging and evaluation of clear liquids, suspensions and emulsions official in

pharmacopoeia.

**Dry syrups:** Requirements, formulation, methods of preparation, containers, evaluation.

### **UNIT III**

**Semisolid dosage forms:** Definitions, types, mechanisms of drug penetration, factors influencing

penetration, semisolid bases and their selection. General formulation of semi solids, clear gels

manufacturing procedure, evaluation and packaging.

**Suppositories:** Ideal requirements of bases, Different types of bases, displacement value, manufacturing procedure, packing and evaluation.

### **UNIT IV**

**Pharmaceutical aerosols:** Definition, propellants general formulation, manufacturing and packaging

methods, pharmaceutical applications. Quality control tests for aerosols.

### **UNIT V**

**Blood Products and Plasma Substitutes:** Collection, processing and storage of whole human blood, Concentrated human RBC's, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin, foam plasma substitutes, ideal requirements, PVP, Dextran etc. For control of blood pressure as per IP.

#### ***Text Books:***

1. L. Lachman, H.A. Lieberman and J.L. Kanig, *Theory & Practice of industrial pharmacy*, Lea &

*Febieger, Philadelphia Latest Edn.*

2. L. V. Allen Jr., N. G. Popovich, H. C. Ansel. *Ansel's pharmaceutical dosage forms and drug*

*delivery systems. Lippincott Williams & Wilkins, 2005.*

3. M. E. Aulton *Pharmaceutics. The science of dosage form design. - 2nd ed. Churchill-Livingstone,*

*2002*

4. B.M.Mithal. *a text book of pharmaceutical formulations, 6th ed., vallabh prakashan, 2010.*

**Reference Books:**

1. *Banker and Rhodes, Modern pharmaceuticals, marcel dekker series.*

2. *James Swarbrick, Encyclopedia of pharmaceutical technology, 3 rd ed, informa healthcare.*

**Upon the completion of the course the student should be able to:**

- a. Acquire sufficient knowledge of preformulation and formulation of liquid and semi solids.
- b. Understand the importance of blood products.
- c. Describe what the pharmaceutical suspension and emulsion is and what roles they play in pharmaceutical science.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHYSICAL PHARMACY – II</b>	<b>Course Code</b>	15R00404
<b>Course year</b>	B. Pharmacy II year	<b>Semester</b>	II
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	3		

**Scope and objectives:** This course is designed to understand the physico-chemical fundamental aspects of solubility, distribution, flow of liquids & solids, complexation & interfacial phenomenon, and to gain knowledge on formulation & stability aspects of dispersion systems, drug decomposition & their kinetics.

### UNIT I

**Solubility and distribution phenomena:** Solvent-solute interaction, solubility of gases in liquids,

solubility of liquids in liquids, solubility of solids in liquids, distribution of solutes in immiscible

solvents.

**Introduction to phenomena of diffusion:** Fick's first law and second law.

**Complexation:** Classification of complexes, methods of preparation, analysis and applications.

### UNIT II

**Interfacial Phenomena:** Liquid interfaces, spreading coefficient, measurement of surface and interfacial tensions, adsorption at liquid interfaces. Adsorption isotherms only (Freundlich's isotherms and Langmuir's isotherm's). Surface-active agents and HLB classification, solubilization, detergency. Parachor, Adsorption at solid interfaces. Solid gas and solid liquid interfaces, complex films, electrical properties of interfaces.

**UNIT III**

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

**UNIT IV**

**Rheology:** Newtons law of flow, kinematic viscosity, effect of temperature, Newtonian systems, non-Newtonian systems: pseudoplastic, dilatant, plastic, thixotropy, negative thixotropy Determination of viscosity, capillary, falling ball and rotational viscometers.

**UNIT V**

**Colloids:** Introduction, types of colloidal systems, protective colloids, applications of colloids in pharmacy.

**Coarse Dispersions:**

*Suspensions:* Types and theories of suspensions, effect of Brownian motion, interfacial properties of suspended particles, settling in suspensions. Sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations.

*Emulsions:* Theories of emulsification, physical stability of emulsions.

**TEXT BOOKS:**

1. Patrick J. Sinko, *Martin's Physical Pharmacy and Pharmaceutical Sciences 5th Edition*. Lippincott

*Williams.*

2. CVSubhramanyam, *Physical Pharmaceutics*, Vallabhprakashan.

3. Manavalan&Ramaswamy. *Physical pharmaceutics*. 2nd ed. Vignesh publisher, 2008.

**REFERENCE BOOKS:**

1. *Lippincott Williams and Wilkins, Remington Pharmaceutical Sciences*

2. *L. Lachman, H. Lieberman The Theory And Practice Of Industrial Pharmacy J. L Kaniz Lee &*

*Febiger Philadelphia, USA.*

**OUTCOME**

**Upon the completion of the course the student should be able to:**

- a. Acquire sufficient knowledge of surface and interfacial tension and its measurement.
- b. Appreciate the role of surface active agents in controlling the solubility and stability of the liquids
- c. Understand the different types of flow, thixotropic properties in order to identify and choose the suitable characters for each formulation
- d. Describe what the pharmaceutical suspension and emulsion is and what roles they play in pharmaceutical science.



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

Subject	PATHOPHYSIOLOGY	Course Code	15R00405
Course year	B. Pharmacy II year	Semester	II
Theory	2 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	2		

**Objectives:** This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic Pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge of its application in other subject of pharmacy.

**UNIT I:**

**Basic Principles of Cell Injury, Adaptation:** Causes of cellular injury, pathogenesis and morphology of cell injury-autolysis, necrosis, apoptosis. Cellular adaptations-atrophy, hypertrophy.

**Inflammation:** Basic mechanism involved in inflammation and repair, alteration in vascular permeability and blood flow. Acute and chronic inflammation, mediators of inflammation.

**UNIT II:**

**Cancer:** Types of cancer, causes of cancer, cell cycle of normal & cancer cell. Apoptosis and cell differentiation. Carcinogenesis and molecular mechanism of carcinogenesis. Markers involved in diagnosis of cancer.

**UNIT III:**

**Pathophysiology of common diseases** like hypertension, angina, congestive cardiac failure, atherosclerosis, myocardial infraction, diabetes and thyroid.

**UNIT IV:**

**Pathophysiology of common diseases** like epilepsy, psychosis, depression, mania, parkinson's disease, arthritis, gout, osteoporosis and peptic ulcer.

**UNIT V:**

**Pathophysiology of common diseases** like asthma, tuberculosis, AIDS, acute & chronic renal failure and urinary tract infections, hepatitis and obesity.

**TEXT BOOKS:**

1. Harsh mohan, text book of pathology, latest edition.
2. Joseph Dipiro, Pathophysiology and applied therapeutics.

**REFERENCE BOOKS:**

1. Robbins, SL & Kumar, Basic Pathology. 8th Edition Elsevier.
2. Mary V. Buras, Pathophysiology: A self Instructional programme. Prentice Hall.
3. Mary Lou Mulvihill, Human Diseases: A Systemic approach. Prentice Hall 6th Edition.

**Outcomes:**

Upon completion of the subject student shall be able to

- a. Describe the etiology and pathogenesis of the selected disease states;
- b. Name the signs and symptoms of the diseases; and
- c. Mention the complications of the diseases.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

Subject	PHARMACEUTICAL ANALYSIS – I LABORATORY	Course Code	15R00406
Course year	B. Pharmacy II year	Semester	II
Theory	4 hrs/week	Tutorial	--
End exam	70 marks	Internal exam	30 marks
Credits	2		

**I. Experiments:**

- 1 Calibration of analytical glass ware.
- 2 Assay of Sodium carbonate by acid-base titration.
- 3 Assay of Ferrous sulfate (redox) ceric ammonium sulfate titration.
- 4 Assay of Sodium benzoate by non-aqueous titration.
- 5 Assay of Sodium chloride by precipitation titration.
- 6 Assay of Calcium gluconate by complexometry.
- 7 Potentiometric titration : Determination of strength of unknown solution HCl, HCl – Acetic acid mixture) against std. NaOH Solution.
- 8 Assay of any drug by potentiometry, (eg. Frusemide, metronidazole).
- 9 Conductometric titration – Determination of strength of unknown solution (HCl, HCl– Acetic Acid mixture) against std. NaOH Solution.
- 10 Determination of refractive index of any sample by Abbe's refractometer.
- 11 Determination of sucrose concentration by Polarimetry.
- 12 Determination of moisture content by Karl-Fishcer reagent.

**II. Demo/work shop**

1. Demonstration on gel electrophoresis
2. Demonstration on Polarography

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**III. Seminar/Assignment/Group discussion**

1. List out various drugs that can be assayed by acid-base titration, as per I.P. 2007.
2. What is the need of determination of moisture content, what is the limit of moisture in various natural and synthetic drugs?

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

Subject	PHARMACOGNOSY-II LABORATORY	Course Code	15R00407
Course year	B. Pharmacy II year	Semester	II
Theory	4 hrs/week	Tutorial	NIL
End exam	70 marks	Internal exam	30 marks
Credits	2		

**EXPERIMENTS:**

1. Study of various morphological characters of the drugs mentioned in theory under alkaloids
2. Study of various morphological characters of the drugs mentioned in theory under glycosides.
3. Microscopy (Transverse section & powder) of Datura and Vinca leaf
4. Microscopy (Transverse section & powder) of Cinchona and Ephedra
5. Microscopy (Transverse section & powder) of Nux vomica and Rauwolfia
6. Microscopy (Transverse section & powder) of Digitalis and Senna
7. Microscopy (Transverse section & powder) of Squill and Liquorice
8. Preparation and evaluation of any one herbal cosmeceutical preparation
9. Preliminary phytochemical screening of any one plant
10. Determination of crude fibre content for any one nutraceutical listed under theory.

**Seminar/ Assignment/Group discussion**

Seminar/assignment related to theory.

**Workshop/Demo**

Extraction of plant material using Soxhlet apparatus

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**References**

1. Practical Pharmacognosy, C K Kokate, Nirali Prakashan
2. Practical Pharmacognosy, Khandelwal, Nirali Prakashan
3. Practical Pharmacognosy Iyengar, Manipal Press Ltd.
4. Peach K and Tracey MV, Modern methods of Plant analysis, Narose publishing house, New Delhi.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL TECHNOLOGY – I LABORATORY</b>	<b>Course Code</b>	15R00408
<b>Course year</b>	B. Pharmacy II year	<b>Semester</b>	II
<b>Theory</b>	4 hrs/week	<b>Tutorial</b>	--
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

**I. EXPERIMENTS:**

1. Preparation, evaluation and packaging of
  - a) Solutions: Paracetamol syrup, codeine phosphate linctus
  - b) Ferrous sulphate syrup
  - c) Suspensions: Milk of magnesia
  - d) Emulsions: o/w or w/o type
  - e) Benzyl benzoate lotion
  - f) Ointments: Benzoic acid ointment
  - g) Methyl salicylate ointment
  - h) Suppositories: Boric acid
  - i) Eye drops: Gentamycin.
  - j) Eye ointments: Chloramphenicol.
  - k) Sodiumchloride eye lotion
  - l) Cream: Cetrimide
  - m) Cold cream
  - n) Zincoxide jelly

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o). Preparation of gel

## **II. DEMO/ WORKSHOP**

Drug-excipient incompatibility studies, ointment filling machine.

## **III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION**

- 1) Excipients and their concentrations in various dosage forms.
- 2) Seminar on blood products



<b>Subject</b>	<b>PHYSICAL PHARMACY – II LABORATORY</b>	<b>Course Code</b>	15R00409
<b>Course year</b>	B. Pharmacy II year	<b>Semester</b>	II
<b>Theory</b>	4 hrs/week	<b>Tutorial</b>	NIL
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

**I. EXPERIMENTS:**

1. Determination of bulk density, true density and percentage porosity.
2. Effect of particle size and effect of glidant on angle of repose.
3. Study of particle/globule size distribution by optical microscopy
4. Determination of CMC of a surfactant.
5. Determination of partition coefficient  
Iodine between water and carbon tetrachloride
6. Determination of sedimentation volume and degree of flocculation.
7. Effect of addition of Salt/pH/co-solvent on the solubility
8. Surface tension using Stalagmometer.
9. HLB value estimation of surfactants.
10. Viscosity – by Ostwald Viscometer.

**II. DEMO/ WORKSHOP**

Determination of particle size by AndreasonPippette, Plotting of an adsorption isotherm  
Brook field viscometer.

**III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION**

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Viscoelasticity, solubilisation techniques

**References**

1. *Physical Pharmaceutics, By Mohanta, and Guru Prasad B.S. Publications*

**List Of Minimum Equipments Required**

1. *Ostwald''s viscometer*
2. *Stalgnometer*
3. *Digital pH meter*
4. *Microscopes*
5. *Stage and eyepiece micrometer*
6. *Digital electronic balance*
7. *Thermometer*
8. *Andreasonpipetter*
9. *Adequate glasswares*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>MEDICINAL CHEMISTRY – I</b>	<b>Code</b>	<b>15R00501</b>
<b>Course year</b>	<b>B. Pharm III year</b>	<b>Semester</b>	<b>I</b>
<b>Theory</b>	<b>3 hrs/week</b>	<b>Tutorial</b>	<b>1 hr / week</b>
<b>End Exam</b>	<b>70 Marks</b>	<b>Internal marks</b>	<b>30 Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to learn medicinal chemistry information about the drugs. In this subject student will be able to understand the properties and its biological activity of the drugs.

**Objectives:** Upon completion of the subject student shall be able to

1. Understand various drugs structure, their properties and biological activities.
2. Correlate and apply the knowledge.
3. Influence of chemical structure on biological activities.

**Outcomes:**

1. Acquire skill in the structure of drugs and their biological activities.
2. Acquire the knowledge of synthesis of chemical compounds.
3. Assay of some official compounds.

## UNIT I

### **Physico chemical properties of drug molecules in relation to biological activity –**

Solubility, partition-coefficient, Ionization, hydrogen bonding, Chelation, redox potential and surface activity, Bioisosterism and steric features of drugs, drug distribution and protein binding. Types of receptor and its relation with biological activity.

Enzyme stimulation, Enzyme inhibition. Theories of drug action (Ferguson's, Dale's, perturbation and occupation). Drug metabolism: Introduction to Biotransformation, concept of soft and hard drug, phase I & II (With one drug example). Introduction, basic concepts and clinical importance of Prodrug.

## UNIT II

### **Drugs acting on ANS**

**Adrenergic and antiadrenergic agents: Adrenergic agonist:** Chemistry and metabolism of neurotransmitters, Dopamine, Ephedrine\*, Isoprenaline\*, Oxymetazoline\*, Salbutamol, **Adrenergic antagonist:** Classification, Phenoxybenzamine\*, Prazosin\*, Propranolol, Atenolol, Metaprolol. SAR Sympathomimetics (Catecholamines)

**Cholinergic and anti-cholinergic agents:** Cholinergic receptor and neuro chemistry and concept of neuromuscular blocking agents. Succinylcholine\*, pilocarpine, Physostigmine, Malathion, Pralidoxime, Nicotine, Dicyclomine\*, Biperiden\*. SAR- Cholinergic agonists, Anti-cholinergics, Neuro muscular blockers.

### **UNIT III**

#### **Drugs acting on CNS**

##### **Depressants and Central dopaminergic signalling agents**

**Anxiolytics, Sedatives and Hypnotics:** Benzodiazepines (Diazepam\*, Oxazepam, Midazolam, Alprazolam), Barbiturates (Phenobarbital\*), Glutethimide\*, Meprobamate\*, SAR-Benzodiazepines, Barbiturates.

**Anti-Psychotics:** Phenothiazines (Chlorpromazine\*, Thioridazine), thioxanthines (Thiothixene\*), Butyrophenones (Haloperidol\*, Droperidol), Miscellaneous- Lithium salts, Clozapine and Olanzapine. SAR- Phenothiazines, Butyrophenones.

**Anti-convulsants:** Phenytoin\*, Valproic acid, Carbamazepine\*, Ethosuximide. SAR- Hydantoins, Oxazolindiones, Succinimides.

**Anti-parkinsonism:** Levodopa\*-Carbidopa, Amantidine\*, Selegiline, Apomorphine, Ropinirole, Entacapone, Tolcapone.

### **UNIT IV**

**Analeptics:** Picrotoxin, Doxapram\*, Methyl xanthines (Caffeine, Theophylline, Theobromine) Psychomotorstimulant: Dextro amphetamine\*, Methamphetamine, Phenfluramine, Sibutramine, Methylphenidate.

**Anti-depressants:** Types, Phenelzine, Tranylcypromine\*, Tricyclic anti-depressants: Imipramine\*, Desipramine, Fluoxetine\*, Newer agents: Venlafaxine, Buspirone and Bupropion. SAR- Tricyclic antidepressants, MAOIs.

Miscellaneous: Psilocybin, Dimethyltryptamine, Mescaline, Lysergic acid and Tetrahydrocannabinol.

### **UNIT V**

#### **Anaesthetics:**

**General anaesthetics:** Chemical classification, Inhaled and Injectable, Meyer-Overton theory, Halothane\*, Propofol, Ketamine, Thiopental sodium\*.

**Local anaesthetics:** Cocaine, Lignocaine\*. Adjuvant to local anaesthetics. SAR- Esters and amides.

**NOTE:** Introduction, definition, chemical classification with structure, nomenclature, synthesis (only for \*marked drugs), mechanism of action, SAR including stereo chemical aspects, metabolites (including its ADR) and therapeutic uses of the following classes of drugs from UNIT II to UNIT V.

**Text Books:**

1. William O. Foye, *Textbook of Medicinal Chemistry*, Lea Febiger, Philadelphia.
2. JH Block & JM Beale (Eds), *Wilson & Giswold's Text book of organic Medicinal Chemistry and pharmaceutical chemistry*, 11th Ed, Lipcolt, Raven, Philadelphia, 2004

**Reference Books:**

1. Hansch, *Comprehensive medicinal chemistry*, Vol 1 – 6 Elsevier pergmon press, Oxford
2. D. Abraham (Ed), *Burger Medicinal chemistry ad Drug discovery*, Vol. 1 & 2. John Wiley & Sons, New York 2003, 6th Ed.
3. M. Atherden, *Bentley and Driver's Textbook of Pharmaceutical Chemistry* Ed: I. Oxford University Press, Delhi.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACOLOGY – I</b>	<b>Code</b>	<b>15R00502</b>
<b>Course Year</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>I</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:**

This subject provides an insight to know the class and mode of action of drugs, their unwanted effects and therapeutic actions.

**Objectives:** Upon completion of the subject student shall be able to

1. Understand various pharmacological aspects like pharmacokinetics, side effects, drug interactions, contraindications and indications of drugs falling under below mentioned chapters.
2. Correlate and apply the knowledge.

**Outcomes:**

1. Acquire the knowledge in basic mechanism of action of drugs.
2. Therapeutic uses of drugs of the following chapters.

**UNIT I****General Pharmacology:****a. Introduction**

Definition, historical development and scope of pharmacology. Sources of drugs and routes of administration. Principles of discovery and development of new drugs, phases of clinical trials.

**b. Pharmacodynamics**

Mechanism of action with special emphasis on receptors, drug-receptor interaction theories, factors modifying drug action.

**c. Pharmacokinetics**

Drug absorption, distribution, metabolism and excretion. Factors affecting/modifying Pharmacokinetic parameters.

**UNIT II****Pharmacology of Peripheral Nervous System**

- a. Neurohumoral transmission (autonomic and somatic), cholinergic receptors and adrenergic receptors.
- b. Parasympathomimetics, parasympatholytics, sympathomimetics and sympatholytics.
- c. Ganglionic stimulants and blocking agents.

d. Neuromuscular blocking agents and local anesthetic agents.

### **UNIT III**

#### **Pharmacology of Central Nervous System: I**

- a. Neurohumoral transmission in the C.N.S with special emphasis on dopamine, GABA and 5-HT neurotransmission.
- b. General anesthetics, sleep cycle, sedatives, hypnotics and anti-anxiety agents.
- c. CNS stimulants and centrally acting muscle relaxants.
- d. Alcohols and disulfiram. Drug addiction, abuse, tolerance and dependence.

### **UNIT IV**

#### **Pharmacology of Central Nervous System: II**

- a. Pharmacology of drugs used in affective/mood disorders like depression and mania and behavioral disorders like psychosis.
- b. Pharmacology of drugs used in neurodegenerative disorders like Parkinsonism and Alzheimer's disease.
- c. Pharmacology of drugs used in epilepsy

### **UNIT V**

- a. Analgesics, Antipyretics, and Anti-inflammatory drugs.
- b. Narcotic analgesics and antagonists.

#### **Text Books:**

1. H.P Rang, M. M. Dale & J.M. Ritter, Pharmacology, Churchill Livingstone, 4th Ed.
2. J.G. Hardman and Lee E. Limbird, Good & Gilman, The Pharmacological Basis of Therapeutics, McGraw-Hill, Health Professions Division.

#### **Reference Books**

1. Bertram G. Katzung, Basic and clinical pharmacology, 9th Edn; Prentice Hall International
2. Sathoskar, Pharmacology and pharmacotherapeutics Vol. 1 & 2, Published by Popular Prakashan, Mumbai.
3. Tripathi, Essentials of Medical Pharmacology, Jaypee Brothers, Latest Edition

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL TECHNOLOGY –II</b>	<b>Code</b>	<b>15R00503</b>
<b>Course Year</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>I</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to learn about the formulation, evaluation and manufacturing of various types of tablets, capsules and also provide insights about aseptic area and parenteral.

**Objectives:** Upon completion of the subject student shall be able to

1. Understand various formulation aspects of tablets and capsules and also provide knowledge about selection of excipients in the preparation of same.
2. Provide knowledge on packaging materials used in pharmaceutical products.

**Outcomes:**

1. Acquire skill in preparation of different types of tablets.
2. Demonstrate the handling of equipment for evaluation of various dosage forms.
3. Acquire the knowledge of processing of dosage form on large scale that suit pharma industry.
- 4.

### UNIT I

**Tablets:** Introduction to different types of tablets, Formulation of tablets, direct compression, Granulation technology on large-scale by various techniques and equipments. Tablet processing problems and their remedy. Types of tablet compression machinery and the equipments employed and evaluation of tablets.

**Coating of Tablets:** Types of coating, coating materials and their selection, formulation of coating solution, equipment for coating, coating processes, evaluation of coated tablets. Tablet coating defects and their remedy.

### UNIT II

**Capsules:** Advantages and disadvantages of capsule dosage forms, material for production of hard and soft gelatin capsules, sizes of capsules, capsule filling, soft processing problems in capsule manufacturing, importance of base absorption and minimum/gm factors in soft capsules, quality control, stability testing and storage of capsule dosage forms.



**UNIT III**

**Microencapsulation:** Types of microencapsulation and importance of microencapsulation in

Pharmacy, microencapsulation by coacervation phase separation, multi orifice centrifugal separation. Spray drying, spray congealing, polymerization complex emulsion, air suspension technique, and pancoating techniques, evaluation of microcapsules.

**UNIT IV****Parenteral Products**

a. Preformulation factors, routes of administration, water for injection, treatment of apyrogenicity, non-aqueous vehicles, isotonicity and methods of its adjustment.

b. Formulation details, containers, closures and their selection.

c. Prefilling treatment, washing and sterilization of containers and closures, preparation of solutions and suspensions, filling and closing of ampoules, vials, infusion fluids, lyophilization & preparation of sterile powders, equipment for large-scale manufacture and evaluation of parenteral products.

d. Aseptic techniques, sources of contamination and methods of prevention. Design of aseptic area, laminar flow benches, Environmental control monitoring.

**UNIT V****Packaging of Pharmaceutical products:**

Packaging components, types, specifications and methods of evaluation as per I.P. Factors influencing choice of containers, package testing, legal and other official requirements for containers, package testing. Methods of packing of solid, liquid and semi-solid dosage forms, Factors influencing packaging material, stability aspects of packaging.

**Text Books:**

1. L. Lachman, H.A. Lieberman and J.L. Kanig, Theory & Practice of industrial pharmacy, Lea & Febiger, Philadelphia Latest Edn.
2. L. V. Allen Jr., N. G. Popovich, H. C. Ansel. Ansel's pharmaceutical dosage forms and drug delivery systems. Lippincott Williams & Wilkins, 2005.

**Reference Books:**

1. M. E. Aulton Pharmaceuticals. The science of dosage form design. - 2nd ed. Churchill-Livingstone, 2002
2. Lippincott Williams and Wilkins, Remington Pharmaceutical Sciences.
3. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, Elbspubl

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL BIOTECHNOLOGY</b>	<b>Code</b>	<b>15R00504</b>
<b>Course Year</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>I</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** To study the Fermentation, Recombinant and Enzyme Technology

**Objective:** To know the various technologies types, design, preparation and operation

**Outcome:** The Student has to know the Application of below mentioned technologies and uses of immunological preparations.

### UNIT I

**Fermentation Technology:** Isolation, Selection, Screening of Industrially important microbes, Strain improvement. Types, design & operation of Bioreactor. Types of fermentations, optimization of fermentation process, Principle and Procedure involving in downstream process and effluent treatment. **Specific Fermentations:** Selection of organism, fermentation & purification of antibiotics (penicillin, streptomycin, tetracycline, and erythromycin), vitamins (riboflavin and cyanocobalamine), lactic acid, alcohol and acetone.

### UNIT II

**Recombinant DNA Technology:** Introduction to r-DNA technology and genetic engineering, steps involved in isolation of enzymes, vectors, recombination and cloning of genes. Production of bio technology derived therapeutic proteins like humulin, humatrop, activase, intron a, monoclonal antibodies by hybridoma technique, recombinax HB (hepatitis b). Stem cells and their applications.

### UNIT III

**Immunology & Immunological Preparations:** Principles of Immunity, Humoral immunity, cell mediated immunity, antigen – antibody reactions, hypersensitivity and its applications. Active & passive immunizations vaccine preparation, standardization & storage of BCG, cholera, smallpox, polio, typhus, tetanus toxoid, immuno serum & diagnostic agents.

### UNIT IV

**Enzyme Technology:** Techniques of immobilization of enzymes, factors affecting enzyme kinetics, advantages of immobilization over isolated enzymes. Study of

enzymes such as hyaluronidase, penicillinase, streptokinase, streptodornase, amylase, protease etc. immobilization of bacteria & plant cells.

## **UNIT V**

Introductory study & applications of bioinformatics, proteomics and genomics, Nanobiotechnology, Gene therapy.

### **Text Books:**

1. Wulf Crueger and Anneliese Crueger, Biotechnology, 2 nd Ed, Publ- Panima publication cooperation, New Delhi.
2. P. F. Stanbury & A. Whitaker, Principles of fermentation technology, Pergamon Press. J. D. Watson, Recombinant DNA technology. 2 nd Edition, W.H. Freeman 1992.
3. S.P.Vyas and Dixit, Pharmaceutical Biotechnology, CBS Publishers New Delhi.

### **Reference Books:**

1. Prescott and Dunne, "Industrial Microbiology" MC Graw Hill Book Company.
2. K. Kielslich "Biotechnology" Vol 6, Verlegchemic, Switzerland.
3. PF Standury & A. Whitaker, "Principles of fermentation Technology" Pergamon Press, Oxford. Wiseman, Handbook of enzyme biotechnology. A. 3<sup>rd</sup> Edition Elis Horwood.
4. Alexande M Moo-young, Comprehensive Biotechnology, Pergamon Press, New York.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>(MOOCS-I) APPLICATION OF SPECTROSCOPIC METHODS IN MOLECULAR STRUCTURE DETERMINATION</b>	<b>Code</b>	<b>15R00505</b>
<b>Course Year</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>I</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30 Marks</b>
<b>Credits</b>	<b>3</b>		

**Objectives:**

1. Introduction, Modern approaches in Bioanalysis and Bioassays.
2. Spectroscopic techniques: UV-Visible spectroscopy, Fluorescence spectroscopy, IR spectroscopy, CD spectroscopy, and Mass spectroscopy.

**Out comes:**

1. Chemists are molecule makers; whenever a new molecule is synthesized it is essential to determine its structure using spectroscopic techniques.
2. This course is all about practical applications of spectroscopic methods for the determination of organic molecules.

**UNIT-I**

**UV-Vis spectroscopy** - Electronic transitions in organic molecules, selection rules, application of Beer Lambert law, qualitative and quantitative analysis by UV-Vis spectroscopy.

**UNIT-II****Electrophoresis Techniques**

Electrophoresis; Principle, Design of horizontal and vertical gel electrophoresis apparatus, performing electrophoresis techniques, application of electrophoresis in analyzing macromolecules.

**UNIT-III**

**NMR spectroscopy** – Nuclear magnetic resonance spectroscopy (NMR), spin  $\frac{1}{2}$  nuclei,  $^1\text{H}$  and  $^{13}\text{C}$ -NMR spectroscopy. Chemical shifts, spin-spin coupling, spin-spin splitting pattern recognition for structure elucidation, coupling constants.

**UNIT-IV**

**Mass Spectrometry** – various ionization methods – EI, CI, ESI and MALDI methods, fragmentation patterns of simple organic molecules, Use of HRMS. Infra-red spectroscopy – basic concepts, experimental methods, functional group analysis and identification using IR spectroscopy, structural effects on vibrational frequency.

**UNIT-V****Introduction & Bioanalytical Spectroscopic techniques**

Introduction, Modern approaches in Bioanalysis and Bioassays, Spectroscopic techniques: UV-Visible spectroscopy and IR spectroscopy.

**Sources: NPTEL**

1. <http://nptel.iitm.ac.in> Biotechnology (Bioanalytical Techniques and Bioinformatics)
2. <http://nptel.ac.in> Chemistry and Biochemistry ( Application of Spectroscopic methods in molecular structure determination)

**Text Books**

1. Spectroscopy, D. L. Pavia, G. M. Lampman, G. S. Kriz, J. R. Vyvyan, Cengage Learning (Indian Edition), 2007.
2. Organic Spectroscopy, William Kemp, 3<sup>rd</sup> Edition, 1991, Macmillan (Indian Edition).
3. NMR Spectroscopy, H. Gnther, second edition, John Wiley and sons, 1998

**References:**

1. GA. Manz, N. Pamme and D. Iossifidis, Bioanalytical Chemistry, World Scientific Publishing Company, 2004
2. Baxevanis, B. F. F. Ouellette, Bioinformatics -A practical Guide to the analysis of Genes and Proteins, 2nd Ed, John Wiley and Sons Inc., 2001.
3. T. Lengauer; Bioinformatics - From Genomes to Drugs, Vols 1 & 2, Wiley-VCH, 2002.
4. Live Cell Imaging: A Laboratory Manual R. D. Goldman, J. R. Swedlow and D. L. Spector Cold Spring.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>MEDICINAL CHEMISTRY – I LABORATORY</b>	<b>Code</b>	<b>15R00506</b>
<b>Course year</b>	<b>B. Pharm III year</b>	<b>Semester</b>	<b>I</b>
<b>Practical</b>	<b>4hrs/week</b>	<b>Tutorial</b>	<b>Nil</b>
<b>End Exam</b>	<b>70Marks</b>	<b>Internal marks</b>	<b>30Marks</b>
<b>Credits</b>	<b>2</b>		

**Scope:** This subject will provide an opportunity for the student on synthesis of various compounds.

**Objectives:** Upon completion of the subject student shall be able to

- a. Synthesis various chemical compounds.
- b. Provide knowledge on monograph analysis of some chemical compounds.

**Outcomes:**

1. Acquire skills in synthesis various chemical compounds.
2. Demonstrate of stereo models of some drugs relevant to theory.
3. Acquire skills of extraction of drugs from different dosage forms.

### I. EXPERIMENTS

1. Synthesis of Barbituric acid from Diethyl Malonate
  2. Synthesis of Phenyton from Benzoin or Benzil
  3. Synthesis of Diphenyl quinoxaline from o-phenylene diamine and benzil
  4. Synthesis of phenothiazine from o-phenylene diamine
  5. Synthesis of Benzocaine from Para amino benzoic acid
  6. Synthesis of Dibromo succinic acid from malic acid
  7. Synthesis of Benzoxazine from Anthranilic acid
  8. Monograph analysis of Caffeine
  9. Monograph analysis of Phenytoin
  10. Monograph analysis of Barbituric acid
  11. Monograph analysis of Benzocaine
  12. Monograph analysis of carbamazepine citrate
- (Literature, Journal reported lead compounds synthesis relevant to theory can also be Included)

### II Demo/Workshop

1. Stereo models of some drugs relevant to theory.
2. Extraction of drugs from different dosage forms

**III Seminar/Assignment/Group discussion**

Photochemistry as a green synthetic method, novel methods for the separation of optical isomers, highly selective metalation reactions, QSAR, high throughput screening, combinatorial chemistry, In silico drug design.

**References:**

1. A.I. Vogel, Text Book of Practical Organic Chemistry, 5th Edition. Pearson Prentice Hall.
2. F.G. Mann & B.C. Saunders, Practical Organic Chemistry, 4th Edition. Pearson Publishers.

**LIST OF MINIMUM EQUIPMENTS REQUIRED**

1. Water bath
2. Suction pumps
3. Analytical/physical balance
4. Triple beam balance
5. Reflux flask with condenser
6. Hot plates
7. Refrigerator
8. Mechanical and magnetic stirrer with thermostat
9. Distillation unit
10. Oven
11. Adequate glass wares

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACOLOGY – I LABORATORY</b>	<b>Code</b>	<b>15R00507</b>
<b>Course Year</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>I</b>
<b>Practical</b>	<b>4hrs/week</b>	<b>Tutorial</b>	<b>NIL</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30 Marks</b>
<b>Credits</b>	<b>2</b>		

**Scope:**

- To find out the agents suitable for clinical use.
- Study the toxicity and mechanism of Action and Site of action
- Study the actions of drugs in Preclinical

**Objectives:**

To know and understand pharmacological investigation techniques applied in the research

**Outcomes:**

- Knows to administration of drugs to experiments rats by various routes.
- Have insight fundamental difference between agonists and antagonists
- Enlighted with basic equipments, anesthetics, lab animals that are to be handled in the pharmacology lab

**1.EXPERIMENTAL PART****(To use appropriate softwares for animal experimentation)****1. Introduction to Experimental Pharmacology**

- Preparation of different solutions for experiments.
  - Drug dilutions, use of molar and % w/v solutions in experimental Pharmacology.
  - Common laboratory animals and anaesthetics used in animal studies.
  - Commonly used instruments in experimental pharmacology.
  - Different routes of administration in animals
  - Collection of blood samples from animals
2. Study the effect of autonomic drugs on rabbit's eye
  3. Record the concentration response curve (CRC) of acetylcholine using rectus abdominus muscle preparation of frog.
  4. Record the CRC of 5-HT on rat fundus preparation.



5. Record the CRC of histamine on guinea pig ileum preparation.
6. To study the inotropic and chronotropic effects of drugs on isolated frog heart.
7. To study the effects of various agonists and antagonists and their characterisation using isolated preparations like frog's rectus abdominus muscle and isolated ileum preparation of rat & guinea pig.

## **II. DEMO/ WORK SHOP**

Arterial and venous cannulations, organ isolation and its application in research.

## **III. SEMINAR/ ASSIGNMENT/ GROUP DISCUSSION**

1. Isolation, characterization and nomenclature of receptors.
2. Metabolic disorders and their complications
3. Novel targets for the treatment of various disorders

### ***References:***

1. Practicals in pharmacology By Dr.R.K.Goyal
2. Handbook of experimental pharmacology By S.K.Kulakarni
3. Experimental pharmacology By M.N.Ghosh
4. EXPO – Experimental pharmacology software.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL TECHNOLOGY – II LABORATORY</b>	<b>Code</b>	<b>15R00508</b>
<b>Course Year</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>I</b>
<b>Practical</b>	<b>4hrs/week</b>	<b>Tutorial</b>	<b>NIL</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30 Marks</b>
<b>Credits</b>	<b>2</b>		

**Scope:** This subject will provide an opportunity for the student to learn manufacturing of dosage forms such as tablets, capsules and parenteral.

**Objectives:** Upon completion of the subject student shall be able to

- Manufacture the various types of tablets.
- Evaluate the finished pharmaceutical products.

**Outcomes:**

1. Acquire skills in manufacture the various types of tablets.
2. Learn how to evaluate the tablets.
3. Acquire skills of manufacturing and evaluation of parental dosage forms.

### **I. EXPERIMENTS:**

1. Manufacturing of tablets:

- a. Ordinary compressed tablets by wet granulation.
- b. Tablets prepared by direct compression
- c. Soluble tablets/dispersible granules
- d. Chewable tablets
- e. Effervescent tablets.

2. Evaluation of tablets (Weight variation, hardness, friability, disintegration and dissolution)

3. Formulation and filling of hard gelatin capsules.

4. Parenteral:

- a. Manufacturing of parenterals (Ampoule sealing (Pull sealing and tip sealing)
- b. Evaluation of parenterals (Clarity test, and leaking test).

### **II. DEMO/ WORKSHOP**

Coating of tablets (sugar/film/enteric)

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**III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION**

1. Advances in granulation technology.
2. Multifunctional excipients.
3. Excipients and their commercial names.

***Text Books:***

1. L. Lachman, H.A, Lieberman and J.L. Kanig, Theory & Practice of industrial pharmacy, Lea &Febieger, Philadelphia Latest Edn.
2. L. V. Allen Jr., N. G. Popovich, H. C. Ansel. Ansel's pharmaceutical dosage forms and drugdelivery systems. Lippincott Williams & Wilkins, 2005.

***Reference Books:***

1. M. E. Aulton Pharmaceutics. The science of dosage form design. - 2nd ed. Churchill-Livingstone, 2002
2. Lippincott Williams and Wilkins, Remington Pharmaceutical Sciences.
3. E.A.Rawlkins, Bentley's Text Book of Pharmaceutics, Elbspubl

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL BIOTECHNOLOGY LABORATORY</b>	<b>Code</b>	<b>15R00509</b>
<b>Course Year</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>I</b>
<b>Practical</b>	<b>4hrs/week</b>	<b>Tutorial</b>	<b>Nil</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>2</b>		

**I.EXPERIMENTS:**

1. Isolation of antibiotic producing microorganism from soil.
2. Enzyme immobilization by Ca-alginate method.
3. Determination of minimum inhibitory concentration of the given antibiotic.
4. Standardization of Cultures.
5. Microbiological assay of Antibiotics / Vitamins.
6. Production of alcohol by fermentation techniques.
7. Comparison of efficacy of immobilized cells.
8. Isolation of mutants by gradient plate technique.
9. Preparation of bacterial vaccine.
10. Preparation of blood products / Human normal immunoglobulin injection
11. Extraction of DNA and RNA and their estimations by colorimetry.
12. Separation techniques: Various types of Gel Electro Phoresis, Centrifugation.

**II.DEMO/WORKSHOP:**

Production of Antibiotics by Fermentation, Development of a Simple Biosensor.

**III.ASSIGNMENT/SEMINAR/GROUP DISCUSSION:**

Monoclonal antibodies and Diagnosis, New Drug Targets and Vaccine Development, Stem cells and their applications.

**LIST OF MINIMUM EQUIPMENTS REQUIRED**

1. Micropipettes
2. Eppendorf's tubes
3. Ultra centrifuge
4. Dessicators
5. Gel electrophoresis unit
6. Small scale bioreactor
7. Syringes

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8. laminar flow bench
  9. Autoclave
  10. Hot air oven
  11. BOD incubator
  12. Rotary shaker
  13. Anerobic jar
  14. Colorimeter
  15. Adequate glassware

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Pharmacy III-I Sem.</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>2</b>	<b>0</b>	<b>2</b>	<b>0</b>

**15A99501 SOCIAL VALUES & ETHICS (AUDIT COURSE)**

*(Common to all Branches)*

**UNIT - I**

**Introduction and Basic Concepts of Society: Family and Society:** Concept of family, community, PRIs and other community based organizations and society, growing up in the family – dynamics and impact, Human values, Gender Justice.

**Channels of Youth Moments for National Building: NSS & NCC:** History, philosophy, aims & objectives; Emblems, flags, mottos, songs, badge etc.; Organizational structure, roles and responsibilities of various NSS functionaries. **Nehru Yuva Kendra (NYK):** Activities – Socio Cultural and Sports.

**UNIT – II**

Activities of NSS, NCC, NYK:

**Citizenship:** Basic Features Constitution of India, Fundamental Rights and Fundamental Duties, Human Rights, Consumer awareness and the legal rights of the consumer, RTI.

**Youth and Crime:** Sociological and psychological Factors influencing youth crime, Peer Mentoring in preventing crimes, Awareness about Anti-Ragging, Cyber Crime and its prevention, Juvenile Justice

**Social Harmony and National Integration:** Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building.

**UNIT – III**

**Environment Issues:** Environment conservation, enrichment and Sustainability, Climate change, Waste management, Natural resource management (Rain water harvesting, energy conservation, waste land development, soil conservations and afforestation).

**Health, Hygiene & Sanitation:** Definition, needs and scope of health education, Food and Nutrition, Safe drinking water, Sanitation, Swachh Bharat Abhiyan.

**Disaster Management:** Introduction to Disaster Management, classification of disasters, Role of youth in Disaster Management. Home Nursing, First Aid.

**Civil/ Self Defense:** Civil defense services, aims and objectives of civil defense, Need for self defense training – Teakwondo, Judo, karate etc.,

**UNIT – IV**

**Gender Sensitization:** Understanding Gender – Gender inequality – Role of Family, Society and State; Challenges – Declining Sex Ratio – Sexual Harassment – Domestic

Violence; Gender Equality – Initiatives of Government – Schemes, Law; Initiates of NGOs – Awareness, Movements;

## **UNIT - V**

**Physical Education** : Games & Sports: Health and Recreation – Biological basis of Physical activity – benefits of exercise – Physical, Psychological, Social; Physiology of Muscular Activity, Respiration, Blood Circulation.

**Yoga**: Basics of Yoga – Yoga Protocol, Postures, Asanas, Pranayama: Introduction of Kriyas, Bandhas and Mudras.

### **TEXT BOOKS:**

1. NSS MANUAL
2. SOCIETY AND ENVIRONMENT: A.S.Chauha, Jain Brothers Publications, 6th Edition,
3. 2006
4. INDIAN SOCIAL PROBLEM: G.R.Madan, Asian Publisher House
5. INDIAN SOCIAL PROBLEM: Ram Ahuja, Rawat Publications
6. HUMAN SOCIETY: Kingsley Davis, Macmillan
7. SOCIETY: Mac Iver D Page, Macmillan
8. SOCIOLOGY – THEMES AND PERSPECTIVES: Michael Honalambos, Oxford University Press
9. CONSTITUTION OF INDIA: D.D.Basu, Lexis Nexis Butterworth Publishers
10. National Youth Policy 2014 (available on [www.yas.nic.in](http://www.yas.nic.in))
11. TOWARDS A WORLD OF EQUALS: A.Suneetha, Uma Bhrugudanda, Duggirala Vasantha, Rama Melkote, Vasudha Nagraj, Asma Rasheed, Gogu Shyamala, Deepa Streenivas and Susie Tharu
12. LIGHT ON YOGA : B.K.S.lyengar, Penguin Random House Publishers

[www.un.org](http://www.un.org)

[www.india.gov.in](http://www.india.gov.in)

[www.yas.nic.in](http://www.yas.nic.in)

<http://www.who.int/countries/ind/en/>

<http://www.ndma.gov.in>

<http://ayush.gov.in/event/common-yoga-protocol-2016-0>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACOLOGY – II</b>	<b>Code</b>	<b>15R00601</b>
<b>Course Year</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>II</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to learn pharmacological information about the drugs. In this subject drugs acting on cardiovascular system, drugs acting on hematopoietic system, drugs acting on renal system, drugs acting on respiratory system and drugs acting on autacoids will be taught.

**Objectives:** Upon completion of the subject student shall be able to

- Understand various pharmacological aspects like mechanism of action, pharmacokinetics, side effects, drug interactions, contraindications and indications of drugs falling under below mentioned chapters.
- Correlate and apply the knowledge.
- Handle the animals and carry out the experiments on animals

**Outcomes:**

- Acquire the knowledge in basic mechanism of action of drugs.
- Therapeutic uses of drugs of the following chapters.

### **UNIT I**

#### **Drugs acting on cardiovascular System**

- Pharmacology of drugs used in hypertension and CHF
- Pharmacology of drugs used in coronary artery diseases (Atherosclerosis, Angina and MI)
- Pharmacology of drugs used in arrhythmias
- Shock and treatment of different types of shock

### **UNIT II Drugs acting on hematopoietic system**

- Coagulants, anticoagulants
- Fibrinolytics, antifibrinolytics, antiplatelet drugs
- Hematinics and plasma expanders



**UNIT III****a. Drugs acting on urinary system**

- i) Diuretics and antidiuretics

**b. Drugs acting on respiratory system**

- i) Antiasthmatics
- ii) Antitussives, expectorants and respiratory stimulants

**UNIT IV****Autacoids**

- a. Amine autacoids- Histamine and 5-HT
- b. Lipid derived autacoids-Prostaglandins, thromboxanes and leukotrienes.
- c. Peptide autacoids- Angiotensin, bradykinin

**UNIT V****Hormones and hormone antagonists**

- a. Insulin, Oral hypoglycaemics agents
- b. Thyroid and antithyroid drugs
- c. Adrenocortical steroids and their analogues
- d. Uterine stimulants and relaxants

**Text Books:**

1. H.P Rang, M. M. Dale & J.M. Ritter, Pharmacology, Churchill Livingstone, 4<sup>th</sup> Ed.
2. J.G. Hardman and Lee E. Limbird, Goodman & Gilman, The Pharmacological basis of therapeutics, McGraw-Hill, Health Professions Division.
3. Illustrated Pharmacology by Lippincott

**References:**

1. Tripathi, Essentials of Medical Pharmacology, Jaypee Brothers, Latest Edition
2. Sathoskar, Pharmacology and pharmacotherapeutics Vol. 1 & 2, Published by Popular Prakashan, Mumbai.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL ANALYSIS- II</b>	<b>Code</b>	<b>15R00602</b>
<b>CourseYear</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>II</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to learn about the spectroscopic and chromatographic techniques.

**Objective:**

- The course is designed to explore the knowledge in modern analytical instrumental techniques i.e., both spectroscopy and chromatography.
- The course helps to assess the process for identification, determination, quantification and purification of a substance and separation of the components of a solution or mixture.

**Outcome:**

1. To gain knowledge on basic fundamentals of modern analytical instrumental techniques.
2. Analyze the drug structure, identification, purity determination, and quantification of the drug substance.

**UNIT I**

a) Study of separations, introduction to chromatography, classifications, types, various stationary and mobile phase in the following techniques and their applications in pharmacy (IP 2010 and 2014).

b) **Column chromatography:** Adsorption and partition theory, concept of theoretical plates, HETP, adsorbents used, preparation, procedure and methods of detection.

c) **Paper Chromatography:** Theory, different techniques employed, filter papers used, qualitative and quantitative detection.

e) **Thin layer chromatography:** Principle, 1D and 2D techniques, preparation of plates, R<sub>f</sub>, R<sub>x</sub>, R<sub>m</sub> values and detection techniques. Concept of HPTLC.

f) **Ion Pair Chromatography,** Ion suppression and Ion Exchange Chromatography, Introduction to Theory and Principle, Instrumentation. Advantages and limitations. Pharmaceutical and other Applications.

g) **Size exclusion chromatography:** Introduction, principle, instrument. Column packing, Applications.

**UNIT-II**

**Gas Chromatography:** Principle, adsorption isotherm and its relation to tailing and fronting, Instrumentation - carrier gas, flow regulators, injectors columns, detectors. Various parameters used in GC analysis. Brief note on GC-MS.

**UNIT III**

**a) Basic Principles (exothermic and endothermic reactions), Instrumentation and applications** of the following: Differential Scanning Colorimetry (DSC), DTA, & TGA in analysis of Pharmaceuticals,

**b) Quality Assurance**

Concept of Quality control and Quality Assurance, ISO 9000, TQM, QC, Vs QA, Concepts of ICH, GMP and GLP, Calibration of UV and IR, Validation of analytical methods as per ICH guidelines.

**UNIT IV**

**HPLC:** Principle, Instrumentation- mobile phase, degassing, pumps, injectors, columns, detectors. Normal Phase Vs Reverse Phase HPLC, Isocratic and gradient elution in RP-HPLC. Various parameters in chromatogram of HPLC.

**UNIT V**

**Optical Rotatory dispersion:** Principle of optical activity, optical purity, concept of Optical Rotatory dispersion (ORD).

**XRD:** Production X-ray, types of X-rays, Braggs law, Octant rule, Cotton effect, XRD pattern in identification and comparison of polymorphs with examples.

**Radio Immuno Assay & Enzyme Linked Immuno Sorbate Assay:** Principle and procedure of RIA, Principle, Types, Procedures of ELISA and application of RIA and ELISA in various diagnosis.

**Text books:**

1. Willard HH, Merritt LL, Dean JA and Settle FA. (2001). *Instrumental Methods of Analysis*, 7th ed., CBS Publishers and Distributors, Delhi, ISBN: 9788123909431.
2. Douglas A. Skoog, F. James Holler and Stanley R. Crouch. (2006). *Principles of Instrumental Analysis*, Cengage Learning; 6th edition, ISBN-10: 0495012017

**References:**

1. Settle, *Handbook of Instrumental Techniques for Analytical Chemistry*. Prentice Hall.
2. Robert M Silverstein. *Spectrometric Identification of Organic compounds*. Sixth edition, John Wiley & Sons, 2004.
3. B.K. Sharma, *Instrumental Chemical Analysis*, Goel Publishers.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>BIOPHARMACEUTICS AND PHARMACOKINETICS</b>	<b>Code</b>	<b>15R00603</b>
<b>Course Year</b>	<b>B. Pharmacy III year</b>	<b>Sem</b>	<b>II</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to learn about the Biopharmaceutics and pharmacokinetic.

**Objective:**

- The course is designed to explore the knowledge in ADME.
- The course helps to learn significance of plasma drug concentration measurement.

**Outcomes:**

1. Graduate will acquire knowledge on the factors influencing absorption, distribution, protein binding and also on pharmacokinetic models.
2. Able to calculate the pharmacokinetic parameters based on plasma level-time data & urine data.
3. Understand the importance of clinical pharmacokinetics and the bioavailability and bio equivalence studies.

**UNIT – I**

Biopharmaceutics, Pharmacokinetics and Pharmacodynamics. Structure of GI membrane. Routes of drug administration and absorption from different routes.

**Drug Absorption.** Mechanisms of GI absorption, physico-chemical, biological and dosage form factors influencing absorption.

**Drug distribution.** Factors affecting drug distribution, physiological barriers of drug diffusion, apparent volume of distribution, drug binding to blood, tissues, protein binding – factors affecting, significance and kinetics of protein binding.

**UNIT – II**

**Drug Metabolism:** Pathways of drug metabolism. Phase-I (oxidative, reductive and hydrolytic reactions). Phase II reactions (conjugation) Enzyme induction and inhibition, hepatic clearance, pharmacological activity of metabolites, first pass effect.

**Drug excretion.** Glomerular filtration, tubular secretion and reabsorption, effect of pH and other drugs. Clearance concept, excretion through bile, feces, lungs and skin in brief.

#### **UNIT – III**

**Bioavailability and bioequivalence:** concept of equivalents, Definitions of various types of equivalents, types of Bioavailability studies, measurement of Bioavailability, plasma level and urinary excretion studies. Bioequivalence study design, IVIVC.

#### **UNIT – IV**

**Pharmacokinetics.** Basic considerations, compartment modeling, one compartment open model - i.v. bolus and extra vascular administration, urinary excretion studies. Apparent volume of distribution, elimination rate constant, biological half life, area under the curve and clearance. Calculation of pharmacokinetic parameters. Method of residuals, Wagner and Nelson method , excretion rate method, sigma minus method. Solving of simple problems

#### **UNIT – V**

**Nonlinear kinetics.** Non compartmental models, reasons for non linearity, concepts of linearity and non linearity , Michaelis- Menten equation and its significance.

#### **Text Books:**

1. L. Shargel and ABC Yu, textbook of applied biopharmaceutics & Pharmacokinetics, 4th edn, Appleton – century – crofts, Connecticut, 2004.
2. Milo Gibaldi, Biopharmaceutics and clinical pharmacokinetics 4/Edn. Pharma Book
3. Syndicate.Hyderabad.
4. DM Brahmankar and SB Jaiswal, biophamaceutics and pharmacokinetics- a treatise, vallabh prakasham, Delhi.

#### **Reference Books:**

1. Ronald & trouser. Clinical pharmacokinetics concepts & applications. 3rd ed, wolterskluwer Pvt Ltd., 2007.
2. Robert E notary, Biopharmaceutics and pharmacokinetics – an introduction, marcel dekker inc., NY
3. Basic pharmacokinetics by Hedaya, CRC press.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL JURISPRUDENCE</b>	<b>Code</b>	<b>15R00604</b>
<b>Course Year</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>II</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to review Pharmaceutical Legislations, Pharmaceutical ethics & policy.

**Objectives:**

- The course is designed to explore the knowledge Pharmaceutical Education.
- The course helps to learn various laws and acts in pharmacy.

**Outcomes:**

1. Graduate will acquire knowledge on Pharmaceutical Education.
2. Able to understand drugs & pharmaceutical industry.
3. Understand the importance of Pharmacy Acts.

**UNIT I****Introduction**

- a. Pharmaceutical Legislations - A brief review
- b. Drugs & Pharmaceutical Industry - A brief review
- c. Pharmaceutical Education - A brief review.
- d. Pharmaceutical ethics & policy
- e. Pharmacy Act 1948

**UNIT II**

Drugs and Cosmetics Act 1940 and Rules 1945

**UNIT III**

Narcotic Drugs & Psychotropic Substances Act 1985

**UNIT IV**

Drugs (Prices Control) Order 1995.

Medicinal & Toilet Preparations (Excise Duties) Act 1955

Drugs and Magic Remedies (Objectionable Advertisements) Act 1954 and Rules 1955.

**UNIT V**

Study of the salient features of the following.

- a.Prevention of Cruelty to animals Act 1960.
- b.Medical termination of pregnancy act 1970 and rules 1975
- c.Factories Act 1948.
- d.WTO, GATT and The Indian Patents Act 1970

**Text Books:**

1. B.M.Mithal, Text book of Forensic Pharmacy, publ by Vallabh Prakashan
2. Suresh.B, Text book of Forensic Pharmacy
3. C.K.Kokate&S.B.Gokhale, Textbook of Forensic Pharmacy, Pharmabook, Syndicate.
4. N.k.jain. Textbook of Forensic Pharmacy. 7<sup>th</sup>ed, Vallabh prakashan, 2007.

**Reference Books:**

1. Bare Acts and Rules Publ by Govt of India/state Govt from time to time.
2. Pharmaceutical policy of India
3. Notification from NPPA
4. Vijay Malik, Drugs & Cosmetics act 1940 and Rules, Eastern Law House Co. Delhi, Kolkata.
5. K.Sampath, Pharmaceutical Jurisprudence (Forensic Pharmacy) Jai Publishers.



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACY ADMINISTRATION (CBCC-I)</b>	<b>Code</b>	<b>15R00605</b>
<b>Course Year</b>	<b>B.Pharmacy III year</b>	<b>Sem</b>	<b>II</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to learn about the Organization of Distribution and Marketing, Principles of drug store and community pharmacy administration.

**Objectives:**

- To learn Manufacturing Management, work study insurance in pharma industry.
- To gain knowledge on drug store planning and layout.

**Outcome:**

1. To gain knowledge on basic fundamentals of management and administration in pharma industry.
2. To acquire knowledge on organization of distribution and marketing. (organization =correct spelling)

**UNIT – I*****Features of Business Organizations & New Economic Environment:***

Characteristic features of Business, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types, Changing Business Environment in Post-Liberalisation scenario.

**Manufacturing Management:** Goals of Production Management and Organization– Production, Planning and Control – Plant location - Principles and Types of Plant Layout-Methods of production (Job, batch and Mass Production).

**UNIT – II**

**Work Study** -Basic procedure involved in Method Study and Work Measurement- Statistical Quality Control:  $\bar{X}$  chart, R chart,  $c$  chart,  $p$  chart, (simple Problems), Acceptance Sampling, Deming's contribution to quality.

**Organization of Distribution and Marketing:** Functions of Marketing, Marketing Strategies based on Product Life Cycle., Channels of distribution – Factors influencing channels of distribution, sales organization and sales promotion.

### **UNIT - III**

**Pharma Industry:** Growth of Pharma Industry in India – current status and its role in building national economy and national health – Structure of Pharma Industry in India – PSUs in Pharma Industry –Progress in the manufacture of basic drugs, synthetic and drugs of vegetable origin. Export and import of drugs and pharmaceuticals – Export and import Trade.

### **UNIT – IV**

**Insurance and Pharma:** Various types of insurance including marine and health insurance.

### **UNIT – V**

**Principles of drug store and community pharmacy administration:**

Drug store planning and layout, sales promotion and salesmanship in drug store. Accounting records in drug stores.

### **Text Books**

1. Aryasri and Subbarao, Pharmaceutical Administration, TMH.
2. Smarta, Strategic Pharma Marketing
3. G.Vidya Sagar, Pharmaceutical Industrial Management. PBS/BS Publication 2005.

### **References**

1. Subbarao Chaganti, Pharmaceutal Marketing in India – Concepts and Strategy Cases, Pharma Book Syndicate.
2. O.P.Khanna, Industrial Management, Dhanpatrai, New Delhi.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>CLINICAL TRIALS (CBCC-I)</b>	<b>Code</b>	<b>15R00606</b>
<b>Course year</b>	<b>B. Pharmacy III year</b>	<b>Semester</b>	<b>II</b>
<b>Theory</b>	<b>3 hrs/week</b>	<b>Tutorial</b>	<b>1 hr / week</b>
<b>End Exam</b>	<b>70 Marks</b>	<b>Internal marks</b>	<b>30 Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to learn about the Introduction to clinical trials.

**Objective:**

- To learn Phase I, II and III levels of clinical trials.
- To gain knowledge on statistical approaches for various endpoints.

**Outcome:**

1. To gain knowledge on clinical trials.
2. To acquire knowledge on Phase I, II, III toxicity studies and dosage calculations.
3. To learn the selection of volunteers for clinical trials.

**UNIT –I****Overview of clinical trials**

Introduction to clinical trials, Issues in modern clinical trials, Study population.

**UNIT –II****Phase I trials:**

Up-and-down design, Single patient per cohort design, Titration design.

**Phase II trials:**

Randomized dose ranging design, Randomized titration design, Two-stage phase II designs, Multistage design, Bayesian design, Randomized phase II design, Multiple outcomes design.

**UNIT –III****Phase III trials:**

Randomized controlled clinical trials, Uncontrolled trials, Historical controls, Crossover designs, Withdrawal studies, Factorial designs, Group allocation designs, Studies of equivalency.

**Randomization methods:** Simple randomization, Replacement randomization, Random permuted blocks, Blinded studies.

**UNIT –IV**

Baseline assessment, subgroup analysis, recruitment, multicenter trials: Use of baseline data, Analysis of baseline comparability, Balance and imbalance, Difficulties of subgroup analysis, Recruitment of study subjects, Multicenter trials

**UNIT –V**

Statistical approaches for various endpoints: t-test, chisquare test, Fisher's exact test, analysis of variance, regression analysis, longitudinal analysis, nonparametric statistics

**Text Books**

1. Chow SC, Liu JP. Design and Analysis of Clinical Trials: Concepts and Methodologies. New York, NY: Wiley; 1998.
2. Geller N, Chow SC. Advances in Clinical Trial Biostatistics. New York, NY: Marcel Dekker; 2004.

**Reference Books**

1. *Interdisciplinary Statistics*. New York, NY: Chapman & Hall; 1997.
2. Jennison C, Turnbull BW. *Group Sequential Methods with Applications to Clinical Trials*. New York, NY: Chapman & Hall; 2000.
3. Machin D, Day S, Green S, Everitt B, George S. *Textbook of Clinical Trials*. New York, NY: Wiley; 2004.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>COSMETIC TECHNOLOGY (CBCC-I)</b>	<b>Code</b>	<b>15R00607</b>
<b>Course year</b>	<b>B. Pharmacy III year</b>	<b>Semester</b>	<b>II</b>
<b>Theory</b>	<b>3 hrs/week</b>	<b>Tutorial</b>	<b>1 hr / week</b>
<b>End Exam</b>	<b>70 Marks</b>	<b>Internal marks</b>	<b>30 Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to learn about Cosmetics, scientific background technology and its future.

**Objectives:** Upon completion of the subject student shall be able to

- a. Understand various formulation aspects of cosmetic preparations.
- b. Provide knowledge on excipients & its applications in cosmetics.

**Outcomes:**

1. Acquire skill in preparation of different types of cosmetics.
2. Demonstrate the handling of equipment for evaluation of various cosmetics.
3. Acquire the knowledge of processing of cosmetic, selection of materials for containers.

**UNIT – I**

**Introduction of Cosmetics:** Purposes of Cosmetics meaning of Cosmetics and cosmeceuticals. Classification of Cosmetics Quality characteristics and Quality Assurance Development Process of Cosmetics. Scientific background technology and its future.

**UNIT – II**

**Excipients & its applications in cosmetics.**

**a. Oily Materials:** Introduction, Oils and Fats, Wax, Hydrocarbons, Higher Fatty Acids, Higher Alcohols, Esters, Silicones.

**b. Surface Active Agents:** Introduction Anionic Surfactant, Cationic, Surfactants, Amphoteric Surfactant, Non-ionic, Surfactant. Other Surfactants.

**c. Humectants:** Introduction, Choice of Humectants Unusual Humectants, Special Uses of Humectants.

**d. Antioxidants:** Introduction, General Oxidative theory, Measurement of Oxidation and Assessment of Oxidant efficiency, Choice of Antioxidant.

### **UNIT – III**

**Safety of Cosmetics:** Basic Concept of Cosmetic Safety, Safety test items & Evaluation method: Skin irritation, sensitization, Testing on Human (Patch test, Usage test)

### **UNIT – IV**

**Cosmetics Containers:** Introduction, Characteristics required by Cosmetic Containers-Quality Maintenance functional Design, Optimum Packaging.

Types of Cosmetic Containers:- Narrow Mouth bottles, Wide Mouth Bottles (Containers), Tubes, tubular Containers, Powders Containers, Compact containers, Stick containers, pencil containers Applicator containers.

### **UNIT – V**

**Material of construction for containers:** Types of Material Forming and processing methods. Container design procedure. Material test methods & Specifications. Trends in Container materials

### **Text Books**

- 1) New Cosmetic Science by Takeo Mitsui
- 2) Harry's Cosmetology.

### **Reference Books**

- 1) Cosmetic Science & Technology by Sagarin C.B.
- 2) Hand book of Cosmetic science & Technology by Marc paye, Andre O. Barel.
- 3) Cooper & Gunn Dispensing for Pharmaceutical Students.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACOLOGY – II LABORATORY</b>	<b>Code</b>	<b>15R00608</b>
<b>CourseYear</b>	<b>B. Pharmacy III year</b>	<b>Sem</b>	<b>II</b>
<b>Lab</b>	<b>4hrs/week</b>	<b>Tutorial</b>	<b>Nil</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>2</b>		

**Scope:**

- To find out the drugs that is beneficial in clinics.
- Study the mechanism of Action and Site of action and their toxicities.
- Study the actions of drugs existing in Preclinicals

**Objectives:**

To know and understand pharmacological investigation techniques applied in the research

**Outcomes:**

- Acquires ability to apply experimental approaches in characterization of drugs.
- Able to use the knowledge to screen novel drugs in different animal models.

**A. EXPERIMENTAL PART**

- Experiments on Isolated Preparations:
  - Calculate the  $PA_2$  value of atropine using acetylcholine as an agonist on rat ileum preparation.
  - Calculate the  $PA_2$  value of chlorpheniramine using histamine as an agonist on guinea pig ileum preparation.
  - Find out the strength of the given sample (e.g. Acetylcholine, Histamine, 5-HT, Oxytocin etc.) using a suitable isolated muscle preparation by
    - Interpolation bioassay
    - Matching or bracketing bioassay
    - Three point bioassay
    - Four point bioassay

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2. Experiments on intact animals like
    - a. Study of drug induced catatonia in rats
    - b. Study of muscle relaxant activity (rotarod apparatus)
    - c. Study of antipsychotic activity (pole climb response apparatus)
    - d. Study of antianxiety activity (elevated plus maze)
    - e. Study of analgesic activity (analgesiometer)
    - f. Study of anti-inflammatory activity (plethysmometer)
    - g. Study of antidepressant activity (swim test & tail suspension test)
    - h. Study of anticonvulsant activity (electroconvulso meter)
  
  - i. Study of spontaneous motor activity and locomotor activity (actophotometer)

**B. DEMO/WORK SHOP**

- a. Screening of antiulcer activity
- b. Invitro antioxidant activity
- c. Screening of antihistaminic activity (histamine chamber)

**C. SEMINAR/ ASSIGNMENT/ GROUP DISCUSSION**

- a. BABE studies
- b. Invitro-invivo correlation studies
- c. Pharmacovigilance
- d. Biostatistics and its application

**REFERENCES**

1. Practicals in pharmacology By Dr.R.K.Goyal
2. Handbook of experimental pharmacology By S.K.Kulakarni
3. Experimental pharmacology By M.N.Ghosh
4. Experimental Pharmacology and Toxicology By Dr.B.M.VrushabendraSwamy and Prof.K.N.Jayaveera, S.Chand & Co.,



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACEUTICAL ANALYSIS-II LABORATORY</b>	<b>Course Code</b>	<b>15R00609</b>
<b>Course Year</b>	<b>B. Pharmacy III Year</b>	<b>Semester</b>	<b>II</b>
<b>Lab</b>	<b>4 Hrs/ Week</b>	<b>Tutorial</b>	<b>NIL</b>
<b>End Exam</b>	<b>70 Marks</b>	<b>Internal Exam</b>	<b>30 marks</b>
<b>Credits</b>	<b>2</b>		

**Scope:**

This subject will provide an opportunity for the student on handling of modern analytical instruments or equipment.

**Objective:**

- The course is designed to explore the knowledge in handling of modern analytical instruments or equipment.
- The course helps to understand the instrumental or equipment operational procedures

**Outcomes:**

- Analyze the drug compound independently by using the instrument.
- Design and deepen their practical skills so as to be capable of performing the analysis in a good manner.
- Compare the results in determination of percent purity of drug performed by self with monographs.

**I. Experiments**

1. Determination of  $\lambda$ - max of  $\text{KMnO}_4$
2. Determination of  $\lambda$ - max of any one drug
3. Determination of isobestic point of any 2 drugs.
4. Estimate the unknown concentration of Paracetamol by UV Spectrophotometric method.
5. Estimate the unknown concentration of ciprofloxacin in the ciprofloxacin injection by colorimetric method.
6. Estimate the unknown concentration of Riboflavin by fluorimetric method.
7. Assay of Ibuprofen (any one drug) by UV-spectrophotometric method using calibrative curve method.
8. Assay of Paracetamol (any one drug) by UV-spectrophotometry-A (1%, 1

- 
- cm) method.
9. Assay of Pheniramine Maleate by UV-spectrophotometry-A (1%, 1 cm) method.
  10. Study of quenching effect of quinine by Fluorimetry.
  11. Determination of Na/K ions by Flame photometry.
  12. Interpretation of UV Spectra.
  13. Interpretation of IR Spectra
  14. Interpretation of Mass Spectra
  15. Interpretation of NMR Spectra

## **II. Demo/ Work Shop**

1. Demonstration of UV instrumentation of single and double beam spectrophotometer.
2. Demonstration of IR instrumentation including KBr pressed pellet technique, ATR, liquid film technique.

## **III. Seminar/Assignment/Group Discussion**

1. Determination of two drugs simultaneously by using UV spectrophotometer.
2. Reagent mechanisms: Ninhydrin, FC, MBTH, PDAC, PDAB (at least two)

## **LIST OF MINIMUM INSTRUMENTS/EQUIPMENTS REQUIRED**

1. Fluorimeter
2. UV-Spectrophotometer
3. Digital balance
4. IR Spectrometer
5. Digital Colorimeter
6. Flame photometry
7. Hot air oven
8. Adequate glassware

## **REFERENCES:**

1. Monographs: Indian Pharmacopoeia, British Pharmacopoeia, United States of Pharmacopoeia, European Pharmacopoeia, Japanese Pharmacopoeia.
2. AH Beckett & Stenlake, Text book of Practical Pharmaceutical chemistry, Vol. II Continuum International Publishing Group, Althone.
3. Martindale: The Complete Drug Reference. 34<sup>th</sup> and 35<sup>th</sup> editions.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>BIOPHARMACEUTICS AND PHARMACOKINETICS LABORATORY</b>	<b>Code</b>	<b>15R00610</b>
<b>Course Year</b>	<b>B. Pharmacy III year</b>	<b>Sem</b>	<b>II</b>
<b>Lab</b>	<b>4hrs/week</b>	<b>Tutorial</b>	<b>Nil</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>2</b>		

**Scope:** This subject will provide an opportunity for the student to learn about the Biopharmaceutics and pharmacokinetic.

**Objective:**

- The course is designed to analysis of biological samples for drug content.
- The course helps to estimation of the pharmacokinetic parameters.

**Outcomes:**

1. Graduate will acquire knowledge on analysis of biological samples for drug content.
2. Able to calculate the pharmacokinetic parameters based on plasma level-time data & urine data.
3. Understand the statistical treatment of pharmaceutical data.

**I. EXPERIMENTS**

1. Analysis of biological samples for drug content and estimation of the pharmacokinetic parameters.
2. *In vitro* evaluation of tablet/capsule for drug release
3. Drug-protein binding studies.
4. Statistical treatment of pharmaceutical data.
5. Problems related to pharmacokinetics – determination of PK Parameters
6. Problems related to bioavailability and bioequivalence.

**II. DEMO/ WORKSHOP**

1. Absorption studies – *in vitro*.
2. Experiments designed for the estimation of various pharmacokinetic parameters.

**III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION**

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Chronopharmacokinetics.

***Text Books:***

1. L. Shargel and ABC Yu, textbook of applied biopharmaceutics & Pharmacokinetics, 4th edn, Appleton – century – crofts, Connecticut, 2004.
2. Milo Gibaldi, Biopharmaceutics and clinical pharmacokinetics 4/Edn. Pharma BookSyndicate.Hyderabad.
3. DM Brahmanekar and SB Jaiswal, biopharmaceutics and pharmacokinetics- a treatise, vallabh prakasham, Delhi.

***Reference Books:***

1. Ronald & trouser. Clinical pharmacokinetics concepts & applications. 3rd ed, wolterskluwer Pvt Ltd., 2007.
2. Robert E notary, Biopharmaceutics and pharmacokinetics – an introduction, marcel dekker inc., NY
3. Basic pharmacokinetics by Hedaya, CRC press.

**B. Pharmacy III-II Sem.**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>

**15A52602      ADVANCED ENGLISH LANGUAGE COMMUNICATION SKILLS  
(AELCS) LAB (Audit Course)**

## **1. INTRODUCTION**

With increased globalization and rapidly changing industry expectations, employers are looking for the wide cluster of skills to cater to the changing demand. The introduction of the Advanced Communication Skills Lab is considered essential at 3<sup>rd</sup> year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information and to organise ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Taking part in social and professional communication.

## **2. OBJECTIVES:**

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

**3. SYLLABUS:**

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

**UNIT-I: COMMUNICATION SKILLS**

1. Reading Comprehension
2. Listening comprehension
3. Vocabulary Development
4. Common Errors

**UNIT-II: WRITING SKILLS**

1. Report writing
2. Resume Preparation
3. E-mail Writing

**UNIT-III: PRESENTATION SKILLS**

1. Oral presentation
2. Power point presentation
3. Poster presentation

**UNIT-IV: GETTING READY FOR JOB**

1. Debates
2. Group discussions
3. Job Interviews

**UNIT-V: INTERPERSONAL SKILLS**

1. Time Management
2. Problem Solving & Decision Making
3. Etiquettes

**4. LEARNING OUTCOMES:**

- Accomplishment of sound vocabulary and its proper use contextually
- Flair in Writing and felicity in written expression.
- Enhanced job prospects.
- Effective Speaking Abilities
- 

**5. MINIMUM REQUIREMENT:**

The Advanced English Communication Skills (AECS) Laboratory shall have the following infra-structural facilities to accommodate at least 60 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system

- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

#### **6. SUGGESTED SOFTWARE:**

The software consisting of the prescribed topics elaborated above should be procured and G

1. **Walden Infotech: Advanced English Communication Skills Lab**
2. **K-VAN SOLUTIONS-Advanced English Language Communication Skills lab**
3. **DELTA's key to the Next Generation TOEFL Test: Advanced Skills Practice.**
4. **TOEFL & GRE( KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)**
5. **Train2success.com**

#### **7. BOOKS RECOMMENDED:**

1. **Objective English for Competitive Exams**, Hari Mohana Prasad, 4<sup>th</sup> edition, Tata Mc Graw Hill.
2. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, O U Press 3<sup>rd</sup> Edn. 2015.
3. **Essay Writing for Exams, Audrone Raskauskiene, Irena Ragaisience & Ramute Zemaitience,OUP, 2016**
4. **Soft Skills for Everyone**, Butterfield Jeff, Cengage Publications, 2011.
5. **Management Shapers Series** by Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. **Campus to Corporate**, Gangadhar Joshi, Sage Publications, 2015
7. **Communicative English**,E Suresh Kumar & P.Sreehari, Orient Blackswan, 2009.
8. **English for Success in Competitive Exams**, Philip Sunil Solomon OUP, 2015

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>NOVEL DRUG DELIVERY SYSTEMS</b>	<b>Code</b>	<b>15R00701</b>
<b>Course year</b>	<b>B. Pharm IV year</b>	<b>Semester</b>	<b>I</b>
<b>Theory</b>	<b>3 hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 marks</b>	<b>Internal exam</b>	<b>30 marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:**The novel drug delivery systems course provide the knowledge about various novel and targeted systems- formulation, evaluation and applications

**Objectives:**To learn the novel technologies in drug delivery systems

**Outcomes:**Student must able to formulate the drug delivery systems for drugs.

#### UNIT I

Concepts of controlled release, sustained release, extended release, timed release and delayed release. Rationale behind the design of above delivery systems. Factors influencing the design and performance of sustained and controlled release dosage forms.

#### UNIT II

**Oral Control Drug Delivery Systems:** Fundamentals, Dissolution Controlled, Diffusion Controlled, Ion Exchange Resins, Osmotic based systems, pH Independent Systems, altered density systems and use of polymers in controlled drug delivery.

#### UNIT III

**Targeted Drug Delivery Systems:** Fundamentals and applications, formulation and evaluation of nano particles, resealed erythrocytes and liposomes and niosomes.

#### UNIT IV

**Transdermal Drug Delivery Systems:** Fundamentals, permeation of drugs across the skin, types of TDDS, Materials employed and Evaluation of TDDS.

#### UNIT V

**Mucoadhesive Delivery Systems:** Mechanism of bioadhesion, mucoadhesive materials, formulation and evaluation of Buccal and Nasal drug delivery systems.



***Text Books:***

1. Robinson JR and Vincent HL. Controlled drug delivery fundamentals and applications, 2ed, marcel dekker 2005.
2. YiewChien, Novel drug delivery systems, 2<sup>nd</sup>ed, marcel dekker 2003.

***Reference Books:***

1. N.K. Jain, Advances in Control & Novel drug delivery, CBS Publishers.
2. Lippincott Williams and Wilkins, Remington Pharmaceutical Sciences
3. E.A Rawlins, Bentley's Text Book of Pharmaceutics, Elbspubl

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACOLOGY – III</b>	<b>Code</b>	<b>15R00702</b>
<b>Course Year</b>	<b>B.Pharmacy IVyear</b>	<b>Sem</b>	<b>I</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to learn pharmacological information about the drugs. In this subject drugs acting on gastrointestinal system, chemotherapeutic agents, principles of toxicology and bioassays will be taught.

**Objectives:** Upon completion of the subject student shall be able to Understand various pharmacological aspects like mechanism of action, pharmacokinetics, sideeffects, druginteractions, contraindications and indications of drugs falling under below mentioned chapters.

**Outcomes:**

- a. Correlate and apply the knowledge.
- b. Handle the animals and carry out the experiments on animals
- d. Understand the chemotherapy of various diseases

**UNIT I. Drugs acting on the gastrointestinal tract**

- a. Anti-ulcers Drugs
- b. Laxatives and anti-diarrhoeal drugs
- c. Emetics and anti-emetics
- d. Appetite Stimulants and Suppressants

**UNIT II. Chemotherapeutic agents and their applications**

- a. General principles of chemotherapy.
- b. Sulphonamides, co-trimoxazole and  $\beta$ -lactam antibiotics
- c. Tetracyclines, aminoglycosides, chloramphenicol, macrolides, quinolones, fluoroquinolones and polypeptide antibiotics

**UNIT III.**

- a. Chemotherapy of tuberculosis & leprosy
- b. Chemotherapy of malignancy and immunosuppressive agents.

**UNIT IV.**

- a. Chemotherapy of fungal and viral diseases
- b. Chemotherapy of protozoal diseases and helminthic infections

**UNITV. Principles of toxicology &Principles of bioassays.**

- a. Definition of poison, general principles of treatment of poisoning
- b. Treatment of barbiturate, opioid, organophosphorous and atropine poisoning.  
Heavy metals and heavy metal antagonists. LD<sub>50</sub>,ED<sub>50</sub> and therapeutic index
- c. Principles of bioassays and errors in bioassays.
- d. Study of bioassay methods for the following drugs
  - i. Digitalis ii. d-tubocurarine, iii. Oxytocin iv. Insulin v. HCV

**Text Books:**

1. H.P Rang, M. M. dale & J.M. Ritter, Pharmacology, Churchill living stone, 4<sup>th</sup> Ed.
2. J.G. Hardman and Lee E. Limbard, Good Mann &Gilman, The Pharmacological basis of therapeutics, Mc Grawhill, Health Professions Dvn.
3. Illiterated Pharmacology by Lippincotts

**REFERENCES**

1. Tripathi, Essentials of Medical Pharmacology, Jaypee Brother's, Latest Edition
2. Sathoskar, Pharmacology and pharmaco therapeutics Vol. 1 & 2, Publ by Popular Prakashan, Mumbai.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>CLINICAL AND HOSPITAL PHARMACY</b>	<b>Code</b>	<b>15R00703</b>
<b>CourseYear</b>	<b>B.Pharmacy IV year</b>	<b>Sem</b>	<b>I</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:**To acquire the Knowledge about Clinical Procedures and study of case reports.

**Objectives:**Patient counseling and Dispensing of Drugs and identification of drug interactions in Prescriptions.

**Outcomes:** To council the patients about usage of drugs and drug interactions

### UNIT I

#### Introduction to clinical pharmacy:

- Prospects and perspectives of clinical pharmacy in national and international scenario, scope of clinical pharmacy
- Therapeutic Drug Monitoring.
- Clinical Pharmacokinetics and individualization of Drug Therapy.
- Concept of Essential Drugs and Rational Drug use.

### UNIT II

#### Introduction to daily activities of Clinical pharmacist

- Drug therapy monitoring (Medication chart review)
- Adverse Drug Reactions & Drug Interactions
- Patient counseling
- Drug and poison information.
- Ward round participation.

### UNIT III

#### Clinical laboratory tests and interpretation of test results.

- Hematological (complete blood picture)
- Pulmonary function tests
- Tests associated with cardiac disorders
- Liver, Renal function tests

### UNIT IV

#### Hospital Management

Organization of a hospital and hospital pharmacy (drug store), responsibilities of a hospital pharmacist, pharmacy and therapeutic committee. Hospital formulary,

purchase and inventory control, role of Pharmacist in community health care and education.

## **UNIT V**

### **Drug distribution and records**

Procedural manual, drug distribution, dispensing to out-patients, in-patients and ambulatory patient dispensing of ancillary and controlled substances. Prescription filling, drug profile.

#### **Text Books:**

- a. A Textbook of clinical pharmacy practice: Essential concepts and skills. Dr G Parthasarathi et al. Orient Longman Pvt Ltd. ISBN: 8125026
- b. Leon Shargel, Comprehensive pharmacy review, Latest Edition
- c. Health Education and Community Pharmacy, Gupta AK, CBS, Publ. and Distributors New Delhi – (2010).

#### **Reference Books:**

1. J.G. Hardman and Lee E. Limbard, Good Mann & Gilman, The Pharmacological basis of therapeutics, Mc Grawhill, Health Professions Divn.
2. Health Education and Community Pharmacy, NK Jain, CBS, Publ. and Distributors New Delhi.
3. *Hospital pharmacy by Hassan.*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>MEDICINAL CHEMISTRY-II</b>	<b>Code</b>	<b>15R00704</b>
<b>CourseYear</b>	<b>B.Pharmacy IV year</b>	<b>Sem</b>	<b>I</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** This subject will provide an opportunity for the student to learn medicinal chemistry information about the drugs. In this subject student will be able to understand the properties and its biological activity of the drugs.

**Objectives:** Upon completion of the subject student shall be able to

1. Understand various drugs structure, their properties and biological activities.
2. Correlate and apply the knowledge.
3. Influence of chemical structure on biological activities.

**Outcomes:**

1. Acquire skill in the structure of drugs and their biological activities.
2. Acquire the knowledge of synthesis of chemical compounds.
3. Assay of some official compounds.

### UNIT I

**Drugs acting on renal system Renin-Angiotensin system inhibitors:** Captopril\*, Enalapril\*, Losartan\*.

**Diuretics:** Acetazolamide, Hydrochlorothiazide\*, Furosemide\*, Ethacrynic acid\*, Spironolactone, Amiloride, Triamterene and Mannitol. SAR- Carbonic anhydrase inhibitors, Thiazides, Loop diuretics.

### UNIT II

**Drugs acting on CVS**

**Anti anginal agents & vasodilators:** Nitroglycerin\*, Isosorbide dinitrate\*. Ion channel blockers- Verapamil, Diltiazem, Nifedipine, Amlodipine\*.

**Antithrombotic agents-** Aspirin, Dipyridamole, Clopidogrel\*

**Antiarrhythmic drugs:** Quinidine, Procainamide\*, Lidocaine, Mexiletine\*, Amiodarone, Sotalol.

**Antihypertensive agents:** classification, Reserpine, Prazosin, Clonidine, Hydralazine, Sildenafil citrate, Minoxidil, Amrinone,. SAR- beta-blockers.

**Antihyperlipidemic agents:** Fenofibrate\*, Dextrothyroxine, Colestipol, Nicotinic acid,  $\beta$ -Sitosterol, Probuco, Ezetimibe, Simvastatin, Atorvastatin, Rosuvastatin. SAR-HMG CO-A inhibitors

### UNIT III

**Drugs acting on Blood, hypoglycemic agents and thyroid.**

**Anticoagulants:** Factors, Warfarin sodium\*, Dicumarol

**Synthetic hypoglycemic agents:** Tolbutamide\*, Tolazamide, Glipizide, Glimperide, Gliclazide, Pioglitazone, Metformin\*, Miglitol.

**Thyroid and antithyroid drugs:** Levothyroxine, Liothyronine, Propylthiouracil.

### UNIT IV

**Analgesic, antipyretic and anti-inflammatory agents**

**Opioids:** Morphine, Levorphanol, Pentazocine, Meperidine\*, Methadone, Tramadol\*, Buprenorphine. Opioid antagonist: Naltrexone, Naloxane, Methylnaltrexone.

**NSAIDs:** A note on prostaglandins and leukotrienes. Aspirin, Indomethacin, Sulindac\*, Ketorolac, Ibuprofen, Naproxen, Mefenamic acid, Diclofenac\*, Piroxicam, Celecoxib, Paracetamol\*.

**Management of Gout and Hyperuricemia:** Allopurinol\*, Sulfinpyrazole.

**Antimigraine drugs:** Sumatriptan, SAR – Salicylates, Aryl propionic acids.

### UNIT V

**Antibiotics  $\beta$ - Lactams:** Penicillin G, Ampicillin\*, Amoxicillin.  $\beta$ - Lactamase inhibitors: Clavulanate potassium, Sulbactam.

**Cephalosporins:** Cephalexin\*, Cefixime. SAR-Penicillins and Cephalosporin

**Aminoglycosides and Tetracyclines:** Streptomycin, Gentamicin, Tobramycin, Tetracycline, Doxycycline. SAR- Aminoglycosides and tetracyclines

**Macrolides and Lincomycins:** Erythromycin, Azithromycin, Clindamycin.

**Miscellaneous:** Chloramphenicol,

**NOTE:** Introduction, definition, chemical classification with structure, nomenclature, synthesis (only for \* marked drugs), mechanism of action, SAR including stereo chemical aspects, metabolites (including its ADR) and therapeutic uses of the following classes of drugs from UNIT I to UNIT V.

### Text Books

1. William O. Foye, Textbook of Medicinal Chemistry, Lea Febiger, Philadelphia.
2. An Introduction to Medicinal Chemistry by Graham. L. Patrick, Oxford University publishers.

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3. JH Block & JM Beale (Eds), Wilson & Giswold's Text book of organic Medicinal Chemistry and pharmaceutical chemistry, 11th Ed, Lipcolt, Raven, Philadelphia, 2004
  4. Rama Rao Nadendla, Medicinal Chemistry; Mc Millan Publishers.

**Reference Books:**

1. Hansch, Comprehensive medicinal chemistry, Vol 1 – 6 Elsevier pergmon press, Oxford
2. Abraham (Ed), Burger Medicinal chemistry and Drug discovery, Vol. 1 & 2. John Wiley & Sons, New York 2003, 6th Ed.
3. M. Atherden, Bentley and Driver's Textbook of Pharmaceutical Chemistry Ed: I.Oxford University Press, Delhi.
4. Daniel lednicer, Strategies for Organic Drug Synthesis and Design, John Wiley, N. Y. 1998. 5. D. Lednicer, Organic drug synthesis, Vol, 1 – 6, J.Wiley N.Y.



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>CHEMISTRY OF NATURAL PRODUCTS (CBCC-II)</b>	<b>Code</b>	<b>15R00705</b>
<b>Courseyear</b>	<b>B. PharmIV year</b>	<b>Semester</b>	<b>I</b>
<b>Theory</b>	<b>3 hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 marks</b>	<b>Internal exam</b>	<b>30 marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:**To Study the Phytochemical evaluation and Synthesis of natural Products

**Objectives:** To identify the structure and screening of the natural products

**Outcomes:**Acquire the skills in determination of structure, mechanism of action and uses of Natural products.

### UNIT I

**Phytochemical Screening:** Preparation of extracts, screening of alkaloids, saponins, cardiac

glycosides, flavonoids, tannins and anthraquinones in plant extracts. Identification and estimation of various phytoconstituents.

**Plant tissue culture:** History, types, media requirements, methodology for establishment of cell cultures; growth measurements, viability measurements and applications. Micropropagation, immobilization, hairy root culture.

**Cosmeceuticals:**

General introduction to cosmeceuticals, role of herbs in cosmetics. Study of the following cosmeceuticals- Amla, Henna, Cyperus, Soap Nut, Aloe Vera, Turmeric, Sandal Wood and Bitter Orange Peel.

**Neutraceuticals:** Definition, introduction and study of Garlic, Spirulina, Soya and Royal Jelly.

Introduction and importance of trade in herbal medicine, herbal cosmetics and Indian herbal drug industry.

### UNIT II

**General structural elucidation of natural products**

Chemical methods for determination of active hydrogen, methoxy, hydroxyl, N-methyl and degradation (Hoffmann, Edmann etc) techniques for the determination of ring size. Structural elucidation of Ephedrine, Atropine, Morphine, Papaverine.

**UNIT III****Alkaloids**

Definition of alkaloids, pseudoalkaloids and protoalkaloids. General methods of extraction, isolation, Properties and tests for alkaloids.

**Opium alkaloids:** Structural features of Morphine molecule – Peripheral groups. Modification of structure and effect on analgesic activity – SAR of morphine and morphine-like analgesics.

**Narcotic antagonists:** Nalorphine, Levallorphan. Anti-tussive agents: Noscapine, Dextromethorphan.

Smooth muscle relaxants: Papaverine and related compounds like ethaverine, Dioxylone. Structures and uses of these compounds.

**Tropane alkaloids:** Structures of Atropine/hyoscyamine, Hyoscyne, Hydrolytic products of these – Tropine and Scopolin. Relationship between tropine and pseudotropine. Biological actions and uses of tropane alkaloids. Homatropine.

**Rauwolfia alkaloids:** Structures and uses of Reserpine, Rescinnamine, Deserpidine, ajmaline, syringapine. Hydrolysis of reserpine and rescinnamine. Mechanism of action of reserpine.

**Ergot alkaloids:** Classification, structures, hydrolytic products, pharmacological actions, therapeutic uses and toxicity. Synthetic derivatives: Methyl ergonovine (Methyl ergometrine), LSD, Ethersergide.

**UNIT IV****Terpenes & Terpenoids:**

Introduction to Volatile oils, terpene vs terpenoids, Classification, isoprene, special isoprene and gem-dialkyl rules. Sources and structures, general extraction procedure for Citral, citral-a (Geraniol), citral-b (Neral). Alpha-terpenol, Carvone, Menthol, Menthone, 1,8-Cineole, Camphor. Chemical transformation and interconversion of citral to citronellal, citronellol, geraniol, nerol, geranic acid, p-cymene, alpha-terpeneol and ionones. Conversion and interconversion of camphor into camphoric acid, camphoric acids, p-cymene, Borneol, isoborneol.

**UNIT V**

**Steroids:** Introduction, nomenclature and classification of steroids. Stereochemistry of Cholesterol. Uses of Bile acids, steroidal hormones. Different Sources of steroidal drugs like diosgenin, cholesterol, stigmaterol and ergosterol.

**Synthetic oestrogens** like diethylstilbesterol, hexosterol, 17-alpha ethinyloestradiol, Interconversions of Estrone, Estriol, Estradiol. Chemistry of keto and non-keto adrenocorticoids. Anabolic steroids (Structures and uses).

**Cardiac glycosides:** Structures of glycosides from Digitalis, Strophanthus, Squill and Bufa. Enzymatic and acid hydrolytic reactions of the glycosides. Mechanism of action, SAR, therapeutic uses and toxicity.

**TextBooks:**

1. I.L. Finar, Organic chemistry, Vol. 1 & 2, the English language books society, London, New Delhi.
2. O.P. Agarwal, Natural products. Vol. 1 & 2, Goel publications— Meerut.
3. Kokate CK, Purohit A.P. & Gokhale; Pharmacognosy Nirali Prakashan, New Delhi.

**ReferenceBooks:**

1. R.T. Morrison and R.N. Boyd, Organic chemistry, Allyn and Bacon, inc., Boston
2. Me-Wolf, ed., Burger's medicinal chemistry, J. Wiley & sons, NY.
3. F.G. Mann & B. Saunders, Practical Organic chemistry Longmans Green & Co. Ltd., UK.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>COMPUTER AIDED DRUG DESIGN (CBCC- II)</b>	<b>Code</b>	<b>15R00706</b>
<b>CourseYear</b>	<b>B.Pharmacy IV year</b>	<b>Sem</b>	<b>I</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Objectives:**

1. CADD course covers the key areas of computational chemistry methods as applied to the modelling of biological processes and to rational drug design, building on students' knowledge of theoretical chemistry.
2. This course also deals with cheminformatics, relations between thermodynamic properties and protein-ligand binding by structure.

**Outcomes:**

1. Describe the use of lead candidates and database representations
2. Explain the drug development pipeline and understand where computational chemistry fits in chemistry
3. Apply how to use software in structure prediction, ligand design methods, docking programs etc.,

**UNITI**

**Introduction to computer aided drug design:** Introduction, types of enzyme inhibition, how drugs are discovered, and the basics of mechanistic drug design, important techniques **UNITII**

**Uses of computer graphics in computer aided drug design:** Computer graphics displays, Computed molecular models, Molecular modeling systems for drug design, uses of computer-assisted drug design, extending molecular modeling.

**UNITIII**

**Molecular mechanics and molecular dynamics:** Potential energy function, Non-bonded energy terms, electrostatic energy, hydrogen bonds, energy minimization, applications of theoretical techniques to drug design.

**UNITIV****Computer-Aided Drug Design**

**EARLY METHODS:** Statistical Prediction of Pharmacological Activity, Molecular descriptors based on lipophilicity (Partition coefficient 'logP', substituent hydrophobicity

constant ' $\pi$ '), polarizability (Molar refractivity, Molar volume), steric (Taft's Steric Factor 'Es', Charton's steric parameter  $r_v$ , Verloopparameters), electrostatics (Hammett substitution constant ' $\sigma$ ', ionization 'pKa') and quantum mechanical (Partial atomic charges, dipolemoment, HOMO/LUMO)

NEWER METHODS: Forces Involved with Drug–Receptor Interactions, Optical Isomerism and Biological Activity, conformational analysis, Comparative/Homology modeling, Molecular Docking, Pharmacophore modeling, Quantitative Structure–Activity Relationships, Structural alerts, Database Searching and Mining, Isosterism.

## UNIT V

**Inhibitors of Dihydrofolate Reductase:** The enzyme, enzyme – inhibitor interactions, inhibitor design. **Approaches to antiviral drug design:** Rhinovirus as a drug receptor, Designing Antiviral drugs. **Conformational Biological activity relationships for Receptor-selective, conformationally constrained Opioid peptides:** Design of conformationally constrained Delta and  $\mu$  Opioid Receptor-selective peptides, Problems and prospects for rational design of Receptor-selective peptides.

### Text Books:

1. **Computer aided drug design** Methods and Applications by Thomas J. Perun, C.L. Propst; Marcel Dekker, 2010.
2. **Wilson and Gisvold's Text book of Organic Medical and Pharmaceutical Chemistry** by John M. Beale, John H. Block; Lippincott Williams & Wilkins, 12<sup>th</sup> Edition, 2011.
3. **Molecular Modelling: Principles and Applications** by Andrew R. Leach, Published by Pearson Education EMA, January 2001.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>PHARMACOVIGILANCE (CBCC- II)</b>	<b>Code</b>	<b>15R00707</b>
<b>CourseYear</b>	<b>B.Pharmacy IV year</b>	<b>Sem</b>	<b>I</b>
<b>Theory</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30Marks</b>
<b>Credits</b>	<b>3</b>		

**Scope:** To study Adverse effects and monitoring of adverse Drug Reactions

**Objectives:** To Identify the Adverse drug reactions and surveillance of Reports.

**Outcomes:** Should have the Knowledge about the terminology of adverse medication related events, roles and responsibilities in Pharmacovigilance.

### UNIT –I

#### Introduction to Pharmacovigilance

- History and development of Pharmacovigilance
- Importance of safety monitoring / Why Pharmacovigilance

#### National and international scenario

- Pharmacovigilance in India
- Pharmacovigilance global perspective
- WHO international drug monitoring programme

### UNIT –II

#### Basic terminologies used in Pharmacovigilance

- Terminologies of adverse medication related events
- Information resources in Pharmacovigilance

#### Establishing Pharmacovigilance programme

- Establishing in a hospital
- Establishment & operation of drug safety department in industry
- Establishing a national programme
- SOPs – Types, designing, maintenance and training
- Roles and responsibilities in Pharmacovigilance
- Licence Partners, Contract Research Organisations (CROs) and Market Authorisation Holders (MAH)

**UNIT –III**

- Pharmacovigilance methods
- Passive surveillance – Spontaneous reports and case series
- Stimulated reporting
- Active surveillance – Sentinel sites, drug event monitoring and registries
- Comparative observational studies – Cross sectional study, case control study and cohort study

**UNIT –IV**

- Adverse drug reaction reporting
- Introduction to reporting systems
- Spontaneous reporting system
- Reporting to regulatory authorities
- Guidelines for reporting ADRs in biomedical literature

**UNIT –V**

- Communication in Pharmacovigilance
- Effective communication in Pharmacovigilance
- Communication in Drug Safety Crisis management
- Communicating with Regulatory Agencies, Business Partners, Healthcare facilities &Media, Doctor Letters to Healthcare Professionals

**TEXTBOOKS**

1. Textbook of Pharmacovigilance by S.K. Gupta, Jaypee brothers.
2. Pharmacovigilance by Ronald D. Mann, Elizabeth B.Andrews, 2<sup>nd</sup> edition.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>NOVEL DRUG DELIVERY SYSTEMS LABORATORY</b>	<b>Code</b>	<b>15R00708</b>
<b>Course year</b>	<b>B. Pharm IV year</b>	<b>Semester</b>	<b>I</b>
<b>Lab</b>	<b>4 hrs/week</b>	<b>Tutorial</b>	<b>NIL</b>
<b>End exam</b>	<b>70 marks</b>	<b>Internal exam</b>	<b>30 marks</b>
<b>Credits</b>	<b>2</b>		

**Scope:** This subject will provide an opportunity for the student to learn about preparation and evaluation of Novel Drug Delivery Systems.

**Objectives:** Upon completion of the subject student shall be able to

- Understand various Novel Drug delivery systems and their preparations.
- Provide knowledge on filing of various regulatory agencies.

**Outcomes:**

- Acquire skill in preparation and evaluation of various Novel formulations.
- Acquire the knowledge of Product development and filing to various regulatory agencies.

### **I. EXPERIMENTS:**

- Preparation and evaluation of Matrix Tablets
- Preparation and evaluation of Transdermal Drug Delivery Systems.
- Formulation and evaluation of Mucoadhesive Delivery Systems.
- Evaluation of Market Sustained Release Formulations.
- Preparation and evaluation of microspheres.
- Assignment on Product development and filing to various regulatory agencies, FDA, TGA.Etc (Ref.: [www.fda.gov](http://www.fda.gov))

### **II. Demo/ Workshop**

Floating drug delivery system.

### **III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION**

Advances in novel drug delivery.



**Text Books:**

1. N.K. Jain, Advances in Control & Novel drug delivery, CBS Publishers.
2. NK Jain, Pharmaceutical product development, CBS publishers.
3. L. Lachman, H.A, Lieberman and J.L. Kanig, Theory & Practice of industrial pharmacy by, Lea &Febieger, Philadelphia Latest Edn.

**Reference Books:**

1. Gilbert S. Banker and Christopher T Rhodes, Modern Pharmaceutics, IVthed, marcel dekker,usa, 2005.
2. Controlled drug delivery systems by Robinson.
3. YiewChien, novel drug delivery systems, 2<sup>nd</sup>ed, marcel dekker 2003.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>CLINICAL AND HOSPITAL PHARMACY LABORATORY</b>	<b>Code</b>	<b>15R00709</b>
<b>Course year</b>	<b>B. Pharm IV year</b>	<b>Semester</b>	<b>I</b>
<b>Lab</b>	<b>4 hrs/week</b>	<b>Tutorial</b>	<b>NIL</b>
<b>End exam</b>	<b>70 marks</b>	<b>Internal exam</b>	<b>30 marks</b>
<b>Credits</b>	<b>2</b>		

**Scope:** This subject will provide an opportunity for the student to learn about various parental preparations.

**Objectives:** Upon completion of the subject student shall be able to Underst and various Sterilization techniques and parenteral preparations. Provide knowledge on Role of Pharmacist in patient counseling.

**Outcomes:**

1. Acquire skill in preparation parenteral Preparations.
2. Acquire the knowledge on First Aid treatment and improving patient Compliance.

**I. EXPERIMENTS:**

1. Preparation of water for injection IP
2. Test for pyrogens on water for injection IP
3. Determination of suitability of NaCl for preparation of transfusion fluid by flame photometer
4. Hydrolytic resistance test on glass used for transfusion fluids
5. Preparation of 5% W/V dextrose IV infusion IP
6. Preparation of 0.9% W/V NaCl IV infusion IP
7. Preparation of Compound NaCl injection (Ringers solution) IP
8. Preparation of NaCl& dextrose injection IP
9. Preparation of sodium bicarbonate intravenous infusion BP
10. Determination of sinking time and water holding capacity of absorbent cotton wool IP
11. Demonstration: Sterilization of surgical instruments, syringes, needles, rubber gloves, hospital fabrics and surgical dressings

**II. ASSIGNMENT**

1. Assignment 1: Study of role of pharmacist in first aid treatment
2. Assignment 2: Study of role of pharmacist in improving patient compliance

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>MEDICINAL CHEMISTRY-II LABORATORY</b>	<b>Code</b>	<b>15R00710</b>
<b>Course Year</b>	<b>B.Pharmacy IV year</b>	<b>Sem</b>	<b>I</b>
<b>Lab</b>	<b>4hrs/week</b>	<b>Tutorial</b>	<b>NIL</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30 Marks</b>
<b>Credits</b>	<b>2</b>		

**Scope:** This subject will provide an opportunity for the student on synthesis of various compounds.

**Objectives:** Upon completion of the subject student shall be able to

- c. Synthesis various chemical compounds.
- d. Provide knowledge on monograph analysis of some chemical compounds.

**Outcomes:**

1. Acquire skills in synthesis various chemical compounds.
2. Demonstrate of stereo models of some drugs relevant to theory.
3. Acquire skills of extraction of drugs from different dosage forms.

**EXPERIMENTS:**

1. Synthesis of Paracetamol from p-amino phenol
2. Synthesis of Cinnamic acid from benzaldehyde
3. Synthesis of Benzotriazole from o-phenylene diamine
4. Synthesis of 1-phenyl-3-methyl-5-pyrazolone from hydrazine hydrate
5. Synthesis of 7-Hydroxy-4-methyl coumarin from resorcinol and ethyl acetoacetate
6. Synthesis of Salicylaldehyde from phenol
7. Identification and test for purity for Aspirin tablet as per IP
8. Identification and test for purity for Acetazolamide tablet as per IP
9. Identification and test for purity for propranolol tablet as per IP
10. Identification and test for purity for Diclofenac sodium tablet as per IP
11. Identification and test for purity for Paracetamol tablet as per IP

**II. DEMO/WORKSHOP:** Microwave assisted organic synthesis, Purification of synthesized compounds (Column chromatography), Demo on Thin layer chromatography.

**III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION** Antibiotic discovery in the twenty-first century: Current trends and future perspectives, Current Trends in  $\beta$ -Lactam based  $\beta$ -Lactamase inhibitors and CVS agents.

**References:**

1. A.I. Vogel, Text Book of Practical Organic Chemistry, 5th Edition. Pearson, Prentice Hall.
2. F.G. Mann & B.C. Saunders, Practical Organic Chemistry, 4th Edition, Pearson Publishers.

**LIST OF MINIMUM EQUIPMENTS REQUIRED**

1. Water bath
2. Suction pumps
3. Analytical/physical balance
4. Triple beam balance
5. Reflux flask with condenser
6. Hot plates
7. Refrigerator
8. Mechanical and magnetic stirrer with thermostat
9. Distillation unit
10. Oven
11. Adequate glass wares

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>MOOCS -II (Biostatistics and Design of Experiments) / Conventional/ Self study</b>	<b>Code</b>	<b>15R00801</b>
<b>Course Year</b>	<b>B.Pharmacy IV year</b>	<b>Sem</b>	<b>II</b>
<b>Lab</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30 Marks</b>
<b>Credits</b>	<b>3</b>		

**SCOPE:** Biostatistics is the application of statistics to different topics in biology including medicine, pharmacy, public health science, agriculture and fishery. It involves the analysis of data from experiments; its interpretation and drawing conclusion from the results. It involves the application of statistical theory to real-world problems, the practice of designing and conducting biomedical experiments and clinical trials. Design of experiments is planning experimental strategy, screening a large number of parameters and selecting the important ones, determining the minimum number of experiments and deciding on the mode and manner in which experiment have to be conducted. The course encompasses topics such as distribution of data, sample size, tests of significance, data reduction, regression analysis, comparison of performance of drugs in clinical trials, design of experiments, screening and second order designs.

**UNIT I**

Introduction to Statistics

Various Distributions: Normal Distribution, sample and Population, Z distribution.

**UNIT II**

Test of Significance, t- test, F test, ANOVA.

**UNIT III**

2 test/odds ratio, Non-Parametric test, other tests.

**UNIT IV**

Design of Experiments: Introduction to design of experiments, screening designs – Data Analysis.

**UNIT V**

Higher order Designs - Data analysis

**REFERENCES:**

1. 'Biostatistics', KS Negi, AITB Publishers, Delhi.
2. 'Fundamentals of Biostatistics', Irfan Ali Khan, Ukaaz Publications
3. 'Biostatistics for Pharmacy', Khan and Khanum, Ukaaz Publications
4. 'Basic statistics and Pharmaceutical applications', J.E, Demuth, MerceL & Dekker.
5. 'Applied statistics' by S.C.Gupta & V.K.Kapoor
6. 'Fundamentals of mathematical statistics' by S.C.Gupta & V.K.Kapoor

**NPTEL:** <http://nptel.ac.in/courses/102106051/>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>Subject</b>	<b>MOOCS – III (Intellectual Property Rights) //Conventional/ Self study</b>	<b>Code</b>	<b>15R00802</b>
<b>Course Year</b>	<b>B.Pharmacy IV year</b>	<b>Sem</b>	<b>II</b>
<b>Lab</b>	<b>3hrs/week</b>	<b>Tutorial</b>	<b>1 hr/week</b>
<b>End exam</b>	<b>70 Marks</b>	<b>Internal exam</b>	<b>30 Marks</b>
<b>Credits</b>	<b>3</b>		

**SCOPE:** The course is designed to introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries. The course introduces all aspects of the IPR Acts. It also includes case studies to demonstrate the application of the legal concepts in Science, Engineering, Technology and Creative Design.

**UNIT I****OVERVIEW OF INTELLECTUAL PROPERTY**

Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, IPR in abroad, Some important examples of IPR

**UNIT II****PATENTS AND UTILITY MODELS**

**PATENTS:** Patent document, searching a patent, Drafting of a patent, Filing of a patent Macro-economic impact of the patent system, Patent and kind of inventions protected by a patent, Granting of patent, Rights of a patent Protecting your inventions – extension in patent protection The different layers of the international patent system (national, regional and international options)

**UTILITY MODELS:** Differences between a utility model and a patent, Trade secrets and know-how agreements.

**UNIT III****COPYRIGHTS, TRADEMARKS AND GEOGRAPHICAL INDICATIONS**

**COPYRIGHTS:** Copyright, things covered by copyright, period of copyright, Rights covered by copyrights and protection of copyrights.

**RELATED RIGHTS:** Related rights, Distinction between related rights and copyright  
**TRADEMARKS:** Trademark –Rights, kind of signs, types and function of trademarks Registration, period, extension and protection of trademark.Well-known marks and their protection, Domain name and its relation to trademarks.

**GEOGRAPHICAL INDICATIONS**

Geographical indication - its protection, reasons for protection

**UNIT IV****INDUSTRIAL DESIGNS AND NEW PLANT VARIETIES**

**INDUSTRIAL DESIGNS:** Protection, kinds of protection, needs for protection

**NEW PLANT VARIETIES:** New varieties of plants – protection and extension

Breeder – Rights and protection

**UNIT V****UNFAIR COMPETITION AND ENFORCEMENT OF INTELLECTUAL PROPERTY**

**RIGHTS UNFAIR COMPETITION:** Unfair competition, Relationship between unfair competition and intellectual property laws.

**ENFORCEMENT OF INTELLECTUAL PROPERTY RIGHTS:** Infringement of intellectual property rights, Enforcement Measures and Emerging Issues in Science and technologies.

Overview of Biotechnology and Intellectual Property Rights in Biotechnology Research. Management - Licensing and Enforcing Intellectual Property, Commercializing Biotechnology Invention and Case studies of Biotechnology. Case studies of patents in other areas – Pharmaceutical Research

**TEXT BOOKS**

1. T. M Murray and M.J. Mehlman, Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons 2000

**REFERENCES**

1. P.N. Cheremisinoff, R.P. Ouellette and R.M. Bartholomew, Biotechnology Applications and Research, Technomic Publishing Co., Inc. USA, 1985
2. D. Balasubramaniam, C.F.A. Bryce, K. Dharmalingam, J. Green and K. Jayaraman, Concepts in Biotechnology, University Press (Orient Longman Ltd.), 2002
3. Bourgagaize, Jewell and Buiser, Biotechnology: Demystifying the Concepts, Wesley Longman, USA, 2000.
4. AjitParulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India Ltd , 2006.
5. B.L.Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000
6. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi , 2010

**NPTEL:** <http://nptel.ac.in/syllabus/syllabus.php?subjectId=110999906>







**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
(Established by Govt. of A.P., Act. No. 30 of 2008)  
ANANTHAPURAMU-515 002 (A.P) INDIA



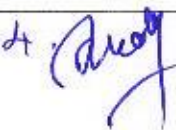
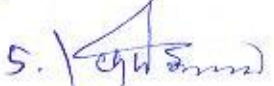

**Academic Regulations (R19) for  
B.Pharm (Regular-Full time)**  
(Effective for the students admitted into 1 year from the Academic Year 2019-2020 onwards)

**Pharmacy Council of India**  
New Delhi

**Rules & Syllabus for the Bachelor  
of Pharmacy (B. Pharm) Course**

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[Framed under Regulation 6, 7 & 8 of the Bachelor of  
Pharmacy (B. Pharm) course regulations 2014]

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## CHAPTER- I: REGULATIONS

### 1. Short Title and Commencement

These regulations shall be called as "The Revised Regulations for the B. Pharm. Degree Program (CBCS) of the Pharmacy Council of India, New Delhi". They shall come into effect from the Academic Year 2016-17. The regulations framed are subject to modifications from time to time by Pharmacy Council of India.

### 2. Minimum qualification for admission

#### First year B. Pharm:

Candidate shall have passed 10+2 examination conducted by the respective state/central government authorities recognized as equivalent to 10+2 examination by the Association of Indian Universities (AIU) with English as one of the subjects and Physics, Chemistry, Mathematics (P.C.M) and or Biology (P.C.B / P.C.M.B.) as optional subjects individually. Any other qualification approved by the Pharmacy Council of India as equivalent to any of the above examinations.

#### 2.2. B. Pharm lateral entry (to third semester):

A pass in D. Pharm. course from an institution approved by the Pharmacy Council of India under section 12 of the Pharmacy Act.

### 3. Duration of the program

The course of study for B.Pharm shall extend over a period of eight semesters (four academic years) and six semesters (three academic years) for lateral entry students. The curricula and syllabi for the program shall be prescribed from time to time by Pharmacy Council of India, New Delhi.

### 4. Medium of instruction and examinations

Medium of instruction and examination shall be in English.

### 5. Working days in each semester

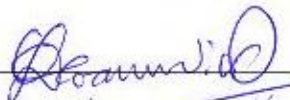

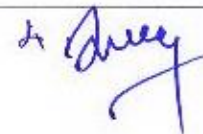
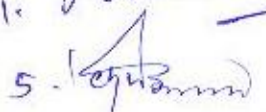
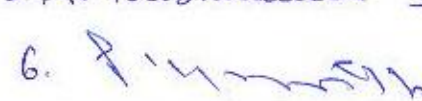
Each semester shall consist of not less than 100 working days. The odd semesters shall be conducted from the month of June/July to November/December and the even semesters shall be conducted from December/January to May/June in every calendar year.

### 6. Attendance and progress

A candidate is required to put in at least 80% attendance in aggregate of all courses considering theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

### 7. Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic

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

## 7.1 Credit assignment

### 7.1.1 Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and /or tutorial (T) hours, and Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and tutorial hours, and a multiplier of half (1/2) for practical (laboratory) hours. Thus, for example, a theory course having three lectures and one tutorial per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout semester carries a credit of 2.

## 7.2 Minimum credit requirements

The minimum credit points required for award of a B. Pharm. degree is 208. These credits are divided into Theory courses, Tutorials, Practical, Practice School and Project over the duration of eight semesters. The credits are distributed semester-wise as shown in Table IX. Courses generally progress in sequences, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

The lateral entry students shall get 52 credit points transferred from their D. Pharm program. Such students shall take up additional remedial courses of 'Communication Skills' (Theory and Practical) and 'Computer Applications in Pharmacy' (Theory and Practical) equivalent to 3 and 4 credit points respectively, a total of 7 credit points to attain 59 credit points, the maximum of I and II semesters.


## 8. Academic work

A regular record of attendance both in Theory and Practical shall be maintained by the teaching staff of respective courses.

### 8.1 Induction Program (zero semester)

Induction program for students to be offered at zero semester to bring the conducive atmosphere among the students community right at the start of the first year for duration of three weeks.

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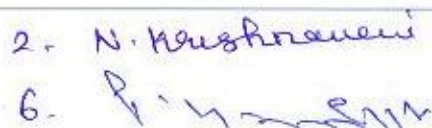
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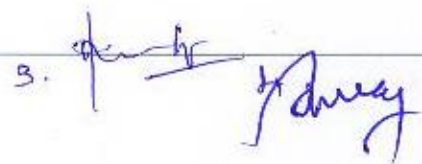
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- a) Physical activity – Sports, Yoga, Heartfulness relaxation and meditation
- b) Creative Arts
- c) Universal Human Values
- d) Literary
- e) Proficiency Modules
- f) Lectures by Eminent People
- g) Visits to local Areas
- h) Familiarization to Dept. & Innovations

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### 9. Course of study

The course of study for B. Pharm shall include Semester Wise Theory & Practical as given in Table – I to VIII. The number of hours to be devoted to each theory, tutorial and practical course in any semester shall not be less than that shown in Table – I to VIII.

**Table-I: Course of study for semester I**

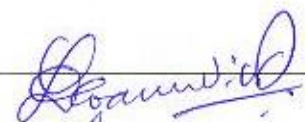

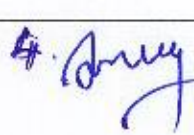


Course code	Name of the course	No. of Hours	Tutorial	Credit points
BP101T	Human Anatomy and Physiology I– Theory	3	1	4
BP102T	Pharmaceutical Analysis I – Theory	3	1	4
BP103T	Pharmaceutics I – Theory	3	1	4
BP104T	Pharmaceutical Inorganic Chemistry – Theory	3	1	4
BP105T	Communication skills – Theory *	2	-	2
BP106RBT BP106RMT	Remedial Biology/ Remedial Mathematics – Theory*	2	-	2
BP107P	Human Anatomy and Physiology – Practical	4	-	2
BP108P	Pharmaceutical Analysis I – Practical	4	-	2
BP109P	Pharmaceutics I – Practical	4	-	2
BP110P	Pharmaceutical Inorganic Chemistry – Practical	4	-	2
BP111P	Communication skills – Practical*	2	-	1
BP112RBP	Remedial Biology – Practical*	2	-	1
BP113CV	Comprehensive Viva-Voce <sup>†</sup> – I	-	-	-
<b>Total</b>		<b>32/34<sup>§</sup>/36<sup>  </sup></b>	<b>4</b>	<b>27/29<sup>§</sup>/30<sup>  </sup></b>

\*Applicable ONLY for the students who have studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB)course.

§Applicable ONLY for the students who have studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM)course.

\* Non University Examination (NUE)

† Non University Examination (NUE) with grading

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**Table-II: Course of study for semester II**

Course Code	Name of the course	No. of hours	Tutorial	Credit points
BP201T	Human Anatomy and Physiology II – Theory	3	1	4
BP202T	Pharmaceutical Organic Chemistry I – Theory	3	1	4
BP203T	Biochemistry – Theory	3	1	4
BP204T	Pathophysiology – Theory	3	1	4
BP205T	Computer Applications in Pharmacy – Theory *	3	-	3
BP206T	Environmental sciences – Theory *	3	-	3
BP207P	Human Anatomy and Physiology II – Practical	4	-	2
BP208P	Pharmaceutical Organic Chemistry I – Practical	4	-	2
BP209P	Biochemistry – Practical	4	-	2
BP210P	Computer Applications in Pharmacy – Practical*	2	-	1
BP211CV	Comprehensive Viva-Voce <sup>†</sup> – II	-	-	-
<b>Total</b>		<b>32</b>	<b>4</b>	<b>29</b>

\* Non University Examination (NUE)

<sup>†</sup> Non University Examination (NUE) with grading

**Table-III: Course of study for semester III**

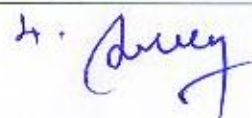
Course code	Name of the course	No. of hours	Tutorial	Credit points
BP301T	Pharmaceutical Organic Chemistry II – Theory	3	1	4
BP302T	Physical Pharmaceutics I – Theory	3	1	4
BP303T	Pharmaceutical Microbiology – Theory	3	1	4
BP304T	Pharmaceutical Engineering – Theory	3	1	4
BP305P	Pharmaceutical Organic Chemistry II – Practical	4	-	2
BP306P	Physical Pharmaceutics I – Practical	4	-	2
BP307P	Pharmaceutical Microbiology – Practical	4	-	2
BP 308P	Pharmaceutical Engineering – Practical	4	-	2
BP309CV	Comprehensive Viva-Voce <sup>†</sup> – III	-	-	-
<b>Total</b>		<b>28</b>	<b>4</b>	<b>24</b>

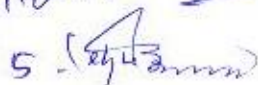
<sup>†</sup> Non University Examination (NUE) with grading

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Table-IV: Course of study for semester IV

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP401T	Pharmaceutical Organic Chemistry III- Theory	3	1	4
BP402T	Medicinal Chemistry I - Theory	3	1	4
BP403T	Physical Pharmaceutics II - Theory	3	1	4
BP404T	Pharmacology I - Theory	3	1	4
BP405T	Pharmacognosy and Phytochemistry I- Theory	3	1	4
BP406P	Medicinal Chemistry I - Practical	4	-	2
BP407P	Physical Pharmaceutics II - Practical	4	-	2
BP408P	Pharmacology I - Practical	4	-	2
BP409P	Pharmacognosy and Phytochemistry I - Practical	4	-	2
BP410CV	Comprehensive Viva-Voce <sup>e</sup> - IV	-	-	-
Total		31	5	28

<sup>e</sup> Non University Examination (NUE) with grading

Table-V: Course of study for semester V

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP501T	Medicinal Chemistry II - Theory	3	1	4
BP502T	Industrial PharmacyI- Theory	3	1	4
BP503T	Pharmacology II - Theory	3	1	4
BP504T	Pharmacognosy and Phytochemistry II- Theory	3	1	4
BP505T	Pharmaceutical Jurisprudence - Theory	3	1	4
BP506P	Industrial PharmacyI - Practical	4	-	2
BP507P	Pharmacology II - Practical	4	-	2
BP508P	Pharmacognosy and Phytochemistry II - Practical	4	-	2
BP509CV	Comprehensive Viva-Voce <sup>e</sup> - V	-	-	-
Total		27	5	26

<sup>e</sup> Non University Examination (NUE) with grading

*Signature*

*Signature*



Table-VI: Course of study for semester VI

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP601T	Medicinal Chemistry III – Theory	3	1	4
BP602T	Pharmacology III – Theory	3	1	4
BP603T	Herbal Drug Technology – Theory	3	1	4
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	3	1	4
BP605T	Pharmaceutical Biotechnology – Theory	3	1	4
BP606T	Quality Assurance – Theory	3	1	4
BP607P	Medicinal chemistry III – Practical	4	-	2
BP608P	Pharmacology III – Practical	4	-	2
BP609P	Herbal Drug Technology – Practical	4	-	2
BP610CV	Comprehensive Viva-Voce <sup>e</sup> – VI	-	-	-
<b>Total</b>		<b>30</b>	<b>6</b>	<b>30</b>

<sup>e</sup> Non University Examination (NUE) with grading

Table-VII: Course of study for semester VII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP701T	Instrumental Methods of Analysis – Theory	3	1	4
BP702T	Industrial Pharmacy II – Theory	3	1	4
BP703T	Pharmacy Practice – Theory	3	1	4
BP704T	Novel Drug Delivery System – Theory	3	1	4
BP705P	Instrumental Methods of Analysis – Practical	4	-	2
BP706PS	Practice School*	12	-	6
BP707MC	Constitution of India <sup>e</sup>	-	-	-
BP708CV	Comprehensive Viva-Voce <sup>e</sup> – VII	-	-	-
<b>Total</b>		<b>28</b>	<b>5</b>	<b>24</b>

\* Non University Examination (NUE)

<sup>e</sup> Non University Examination (NUE) with grading

*Sanjiv*

*S. S. S. S.*

Table-VIII: Course of study for semester VIII

Course code	Name of the course	No. of Hours	Tutorial	Credit points
BP801T	Biostatistics and Research Methodology	3	1	4
BP802T	Social and Preventive Pharmacy	3	1	4
BP803ET	Pharma Marketing Management	3 + 3 = 6	1 + 1 = 2	4 + 4 = 8
BP804ET	Pharmaceutical Regulatory Science			
BP805ET	Pharmacovigilance			
BP806ET	Quality Control and Standardization of Herbals			
BP807ET	Computer Aided Drug Design			
BP808ET	Cell and Molecular Biology			
BP809ET	Cosmetic Science			
BP810ET	Experimental Pharmacology			
BP811ET	Advanced Instrumentation Techniques			
BP812ET	Dietary Supplements and Nutraceuticals			
BP813PW	Project Work	12	-	6
BP814MC	Essence of India Traditional Knowledge <sup>f</sup>	-	-	-
BP815CV	Comprehensive Viva-Voce <sup>g</sup> – VIII	-	-	-
<b>Total</b>		<b>24</b>	<b>4</b>	<b>22</b>

<sup>f</sup> Non University Examination (NUE) with grading

Table-IX: Semester wise credits distribution

Semester	Credit Points
I	27/29 <sup>b</sup> /30 <sup>a</sup>
II	29
III	26
IV	28
V	26
VI	26
VII	24
VIII	22
Extracurricular/ Co curricular activities	01 <sup>*</sup>
<b>Total credit points for the program</b>	<b>209/211<sup>b</sup>/212<sup>a</sup></b>

\* The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.

<sup>b</sup>Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics course.

<sup>a</sup>Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology course.

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### 9.1 Mandatory Courses (Non credit courses)

Mandatory courses shall be conducted at

Semester VII – Constitution of India

Semester VIII – Essence of India Traditional Knowledge

Comprehensive viva-voce should be introduced with internal evaluation.

Comprehensive viva-voce shall be conducted at the end of every semester

### 10. Program Committee

1. The B. Pharm. program shall have a Program Committee constituted by the Head of the institution in consultation with all the Heads of the departments.

2. The composition of the Program Committee shall be as follows:

A senior teacher shall be the Chairperson; One Teacher from each department handling B.Pharm courses; and four student representatives of the program (one from each academic year), nominated by the Head of the institution.

3. Duties of the Program Committee:

- i. Periodically reviewing the progress of the classes.
- ii. Discussing the problems concerning curriculum, syllabus and the conduct of classes.
- iii. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.
- iv. Communicating its recommendation to the Head of the institution on academic matters.
- v. The Program Committee shall meet at least thrice in a semester preferably at the end of each Sessional exam (Internal Assessment) and before the end semester exam.

### 11. Examinations/Assessments

The scheme for internal assessment and end semester examinations is given in Table – X.

#### 11.1 End semester examinations

The End Semester Examinations for each theory and practical course through semesters I to VIII shall be conducted by the university except for the subjects with asterix symbol (\*) in table I and II for which examinations shall be conducted by the subject experts at college level and the marks/grades shall be submitted to the university.





Tables-X: Schemes for internal assessments and end semester examinations semester wise

Course code	Name of the course	Continuous Mode	Internal Assessment			End Semester Exams			Total Marks
			Sessional Marks	Duration	Total	Marks	Duration		
								Marks	
BP101T	Human Anatomy and Physiology I – Theory	10	15	1 Hr	25	75	3 Hrs	100	
BP102T	Pharmaceutical Analysis I – Theory	10	15	1 Hr	25	75	3 Hrs	100	
BP103T	Pharmaceutics I – Theory	10	15	1 Hr	25	75	3 Hrs	100	
BP104T	Pharmaceutical Inorganic Chemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100	
BP105T	Communication skills – Theory *	5	10	1 Hr	15	35	1.5 Hrs	50	
BP106RBT BP106RMT	Remedial Biology/ Mathematics – Theory*	5	10	1 Hr	15	35	1.5 Hrs	50	
BP107P	Human Anatomy and Physiology – Practical	5	10	4 Hrs	15	35	4 Hrs	50	
BP108P	Pharmaceutical Analysis I – Practical	5	10	4 Hrs	15	35	4 Hrs	50	
BP109P	Pharmaceutics I – Practical	5	10	4 Hrs	15	35	4 Hrs	50	
BP110P	Pharmaceutical Inorganic Chemistry – Practical	5	10	4 Hrs	15	35	4 Hrs	50	
BP111P	Communication skills – Practical*	5	5	2 Hrs	10	15	2 Hrs	25	
BP112RBP	Remedial Biology – Practical*	5	5	2 Hrs	10	15	2 Hrs	25	
BP113CV	Comprehensive Viva-voce <sup>4</sup> – I	-	-	-	-	-	-	-	
Total		70/75 <sup>5</sup> /80 <sup>6</sup>	115/125 <sup>5</sup> /130 <sup>6</sup>	23/24 <sup>5</sup> /26 <sup>6</sup> Hrs	185/200 <sup>5</sup> /210 <sup>6</sup>	490/525 <sup>5</sup> / 540 <sup>6</sup>	31.5/33 <sup>5</sup> / 35 <sup>6</sup> Hrs	675/725 <sup>5</sup> / 750 <sup>6</sup>	

<sup>4</sup> Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB) course.

<sup>5</sup> Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM) course.

\* Non University Examination (NUE)

<sup>6</sup> Non University Examination (NUE) and shall be graded as satisfactory (50% and above) / unsatisfactory (less than 50%)

1. 2. N. Krishna Rao 3. 4. 5.



Semester II

Course code	Name of the course	Internal Assessment			End Semester Exams		Total Marks	
		Continuous Mode	Sessional Marks	Duration	Marks	Duration		
BP201T	Human Anatomy and Physiology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP202T	Pharmaceutical Organic Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP203T	Biochemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP204T	Pathophysiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP205T	Computer Applications in Pharmacy – Theory*	10	15	1 Hr	25	50	2 Hrs	75
BP206T	Environmental sciences – Theory*	10	15	1 Hr	25	50	2 Hrs	75
BP207P	Human Anatomy and Physiology II – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP208P	Pharmaceutical Organic Chemistry I – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP209P	Biochemistry – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP210P	Computer Applications in Pharmacy – Practical*	5	5	2 Hrs	10	15	2 Hrs	25
BP211CV	Comprehensive Viva-Voce <sup>†</sup> - II	-	-	-	-	-	-	-
<b>Total</b>		<b>80</b>	<b>125</b>	<b>20 Hrs</b>	<b>205</b>	<b>520</b>	<b>30 Hrs</b>	<b>725</b>



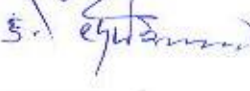
\* The subject experts at college level shall conduct examinations  
<sup>†</sup> Non University Examination (NUE) and shall be graded as satisfactory (50% and above) / unsatisfactory (less than 50%)

1. 2. N. Krishnaveeni 3. 4. 5.

Semester III

Course code	Name of the course	Internal Assessment			End Semester Exams		Total Marks
		Continuous Mode	Sessional Marks	Duration	Marks	Duration	
BP301T	Pharmaceutical Organic Chemistry II – Theory	10	15	1 Hr	75	3 Hrs	100
BP302T	PhysicalPharmaceutics I –Theory	10	15	1 Hr	75	3 Hrs	100
BP303T	Pharmaceutical Microbiology – Theory	10	15	1 Hr	75	3 Hrs	100
BP304T	Pharmaceutical Engineering – Theory	10	15	1 Hr	75	3 Hrs	100
BP305P	Pharmaceutical Organic Chemistry II – Practical	5	10	4 Hr	35	4 Hrs	50
BP306P	Physical Pharmaceutics I – Practical	5	10	4 Hr	35	4 Hrs	50
BP307P	Pharmaceutical Microbiology – Practical	5	10	4 Hr	35	4 Hrs	50
BP308P	Pharmaceutical Engineering – Practical	5	10	4 Hr	35	4 Hrs	50
BP309CV	Comprehensive Viva-Voce <sup>6</sup> - III	-	-	-	-	-	-
<b>Total</b>		<b>60</b>	<b>100</b>	<b>20</b>	<b>160</b>	<b>28Hrs</b>	<b>600</b>

<sup>6</sup> Non University Examination (NUE) and shall be graded as satisfactory (50% and above) / unsatisfactory (less than 50%)

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## Semester IV

Course code	Name of the course	Internal Assessment			End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams Marks	Duration	Marks	Duration	
BP401T	Pharmaceutical Organic Chemistry III - Theory	10	15	1 Hr	75	3 Hrs	100
BP402T	Medicinal Chemistry I - Theory	10	15	1 Hr	75	3 Hrs	100
BP403T	Physical Pharmaceutics II - Theory	10	15	1 Hr	75	3 Hrs	100
BP404T	Pharmacology I - Theory	10	15	1 Hr	75	3 Hrs	100
BP405T	Pharmacognosy I - Theory	10	15	1 Hr	75	3 Hrs	100
BP406P	Medicinal Chemistry I - Practical	5	10	4 Hr	35	4 Hrs	50
BP407P	Physical Pharmaceutics II - Practical	5	10	4 Hrs	35	4 Hrs	50
BP408P	Pharmacology I - Practical	5	10	4 Hrs	35	4 Hrs	50
BP409P	Pharmacognosy I - Practical	5	10	4 Hrs	35	4 Hrs	50
BP410CV	Comprehensive Viva-voce <sup>5</sup> - IV	-	-	-	-	-	-
Total		70	115	21 Hrs	185	31 Hrs	700

<sup>5</sup> Non University Examination (NUDE) and shall be graded as satisfactory (50% and above) / unsatisfactory (less than 50%)


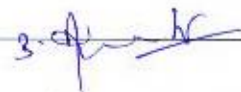
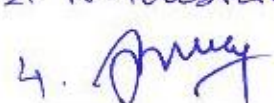
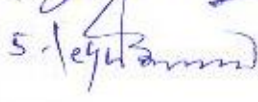

*Prasanna D*

*P. N. Sarin*

Semester V

Course code	Name of the course	Internal Assessment			End Semester Exams		Total Marks	
		Continuous Mode	Sessional Marks	Duration	Marks	Duration		
BP501T	Medicinal Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP502T	Industrial Pharmacy I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP503T	Pharmacology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP504T	Pharmacognosy II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP505T	Pharmaceutical Jurisprudence – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP506P	Industrial Pharmacy I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP507P	Pharmacology II – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP508P	Pharmacognosy II – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP509CV	Comprehensive Viva-voce <sup>e</sup> - V	-	-	-	-	-	-	-
<b>Total</b>		<b>65</b>	<b>105</b>	<b>17 Hr</b>	<b>170</b>	<b>480</b>	<b>27 Hrs</b>	<b>650</b>

<sup>e</sup> Non University Examination (NUE) and shall be graded as satisfactory (50% and above) / unsatisfactory (less than 50%)

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## Semester VI

Course code	Name of the course	Continuous Mode	Internal Assessment			Total	End Semester Exams		Total Marks
			Sessional Marks	Duration	Marks		Marks	Duration	
BP601T	Medicinal Chemistry III – Theory	10	15	1 Hr	25	75	3 Hrs	100	
BP602T	Pharmacology III – Theory	10	15	1 Hr	25	75	3 Hrs	100	
BP603T	Herbal Drug Technology – Theory	10	15	1 Hr	25	75	3 Hrs	100	
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	10	15	1 Hr	25	75	3 Hrs	100	
BP605T	Pharmaceutical Biotechnology – Theory	10	15	1 Hr	25	75	3 Hrs	100	
BP606T	Quality Assurance – Theory	10	15	1 Hr	25	75	3 Hrs	100	
BP607P	Medicinal chemistry III – Practical	5	10	4 Hrs	15	35	4 Hrs	50	
BP608P	Pharmacology III – Practical	5	10	4 Hrs	15	35	4 Hrs	50	
BP609P	Herbal Drug Technology – Practical	5	10	4 Hrs	15	35	4 Hrs	50	
BP610CV	Comprehensive Viva-voce <sup>6</sup> - VI	-	-	-	-	-	-	-	
Total		75	120	18 Hrs	195	555	30 Hrs	750	

<sup>6</sup>Non University Examination(NUE) and shall be graded as satisfactory (50% and above) / unsatisfactory (less than 50%)

*Prasanna D.*

*P. Vasanthan*

## Semester VIII

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Marks	Duration	Total	Marks	Duration	
BP701T	Instrumental Methods of Analysis – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP702T	Industrial Pharmacy – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP703T	Pharmacy Practice – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP704T	Novel Drug Delivery System – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP705 P	Instrumental Methods of Analysis – Practical	5	10	4 Hrs	15	35	4 Hrs	50
BP706 PS	Practice School*	25	-	-	25	125	5 Hrs	150
BP707MC	Constitution of India <sup>†</sup>	-	-	-	-	-	-	-
BP708CV	Comprehensive Viva-voce <sup>‡</sup> - VIII	-	-	-	-	-	-	-
	<b>Total</b>	<b>70</b>	<b>70</b>	<b>8Hrs</b>	<b>140</b>	<b>460</b>	<b>21 Hrs</b>	<b>600</b>

\* The subject experts at college level shall conduct examinations

<sup>†</sup> Non University Examination (NUE) and shall be graded as satisfactory (50% and above) / unsatisfactory (less than 50%)








**Internal assessment: Continuous mode**

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below.

**Table-XI: Scheme for awarding internal assessment: Continuous mode**

Theory		
Criteria	Maximum Marks	
Attendance (Refer Table – XII)	4	2
Academic activities (Average of any 3 activities e.g. quiz, assignment, open book test, field work, group discussion and seminar)	3	1.5
Student – Teacher interaction	3	1.5
<b>Total</b>	<b>10</b>	<b>5</b>
Practical		
Attendance (Refer Table – XII)	2	
Based on Practical Records, Regular viva voce, etc.	3	
<b>Total</b>	<b>5</b>	

**Table- XII: Guidelines for the allotment of marks for attendance**

Percentage of Attendance	Theory	Practical
95 – 100	4	2
90 – 94	3	1.5
85 – 89	2	1
80 – 84	1	0.5
Less than 80	0	0

**11.2.1 Sessional Exams**

Two Sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college(s). The scheme of question paper for theory and practical Sessional examinations is given below. The average marks of two Sessional exams shall be computed for internal assessment as per the requirements given in tables – X.

Sessional exam shall be conducted for 30 marks for theory and shall be computed for 15 marks. Similarly Sessional exam for practical shall be conducted for 40 marks and shall be computed for 10 marks.

**Question paper pattern for theory Sessional examinations****For subjects having University examination**

I. Multiple Choice Questions (MCQs) = 10 x 1 = 10

OR



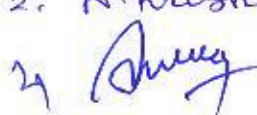

OR

Objective Type Questions (5 x 2) = 05 x 2 = 10  
(Answer all the questions)

I. Long Answers (Answer 1 out of 2) = 1 x 10 = 10

II. Short Answers (Answer 2 out of 3) = 2 x 5 = 10

Total = 30 marks

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**For subjects having Non University Examination**

- I. Long Answers (Answer 1 out of 2) = 1 x 10 = 10
- II. Short Answers (Answer 4 out of 6) = 4 x 5 = 20

Total = 30 marks

**Question paper pattern for practical sessional examinations**

- I. Synopsis = 10
- II. Experiments = 25
- III. Viva voce = 05

Total = 40 marks

**12. Promotion and award of grades**

A student shall be declared PASS and eligible for getting grade in a course of B.Pharm. program if he/she secures at least 50% marks in that particular course including internal assessment. For example, to be declared as PASS and to get grade, the student has to secure a minimum of 50 marks for the total of 100 including continuous mode of assessment and end semester theory examination and has to secure a minimum of 25 marks for the total 50 including internal assessment and end semester practical examination.

**13. Carry forward of marks**

In case a student fails to secure the minimum 50% in any Theory or Practical course as specified in 12, then he/she shall reappear for the end semester examination of that course. However his/her marks of the Internal Assessment shall be carried over and he/she shall be entitled for grade obtained by him/her on passing.

**14. Improvement of internal assessment**

A student shall have the opportunity to improve his/her performance only once in the Sessional exam component of the internal assessment. The re-conduct of the Sessional exam shall be completed before the commencement of next end semester theory examinations.

**Clarification for Improvement of internal assessment**

Whomever is opting for Improvement of internal assessment he/she must appear for end semester examination. In case of improvement of internal assessment the better marks should be considered. The re-conduct of the Sessional exam shall be completed before the commencement of next end semester theory examinations.

**15. Re-examination of end semester examinations**

Reexamination of end semester examinations shall be conducted as per the schedule given in table XIII. The exact dates of examinations shall be notified from time to time.

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3. *[Signature]*

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**Table-XIII: Tentative schedule of end semester examinations**

Semester	For Regular Candidates	For Failed Candidates
I, III, V and VII	November / December	May / June
II, IV, VI and VIII	May / June	November / December

**Question paper pattern for end semester theory examinations**

**For 75 marks paper**

I. Multiple Choice Questions(MCQs) OR = 20 x 1 = 20  
Objective Type Questions (10 x 2) = OR

= 10 x 2 = 20

(Answer all the questions)

II. Long Answers (Answer 2 out of 3) = 2 x 10 = 20

**Note: Not more than one question from any one unit**

**(II. For Long Answers)**

III. Short Answers (Answer 7 out of 9) = 7 x 5 = 35

Total = 75 marks

**Note: One question from each unit and not more than two questions from any one unit (III. For Short Answers)**

**For 50 marks paper**

I. Long Answers (Answer 2 out of 3) = 2 x 10 = 20

II. Short Answers (Answer 6 out of 8) = 6 x 5 = 30

Total = 50 marks

**For 35 marks paper**

I. Long Answers (Answer 1 out of 2) = 1 x 10 = 10

II. Short Answers (Answer 5 out of 7) = 5 x 5 = 25

Total = 35 marks

**Question paper pattern for end semester practical examinations**

I. Synopsis = 5

II. Experiments = 25

III. Viva voce = 5

Total = 35 marks

*B. H. Srinivasan*

**16. Academic Progression:**

No student shall be admitted to any examination unless he/she fulfills the norms given in 6. Academic progression rules are applicable as follows:

A student shall be eligible to carry forward all the courses of I, II and III semesters till the IV semester examinations. However, he/she shall not be eligible to attend the courses of V semester until all the courses of I and II semesters are successfully completed.

A student shall be eligible to carry forward all the courses of III, IV and V semesters till the VI semester examinations. However, he/she shall not be eligible to attend the courses of VII semester until all the courses of I, II, III and IV semesters are successfully completed.

A student shall be eligible to carry forward all the courses of V, VI and VII semesters till the VIII semester examinations. However, he/she shall not be eligible to get the course completion certificate until all the courses of I, II, III, IV, V and VI semesters are successfully completed.

A student shall be eligible to get his/her CGPA upon successful completion of the courses of I to VIII semesters within the stipulated time period as per the norms specified in 26.

A lateral entry student shall be eligible to carry forward all the courses of III, IV and V semesters till the VI semester examinations. However, he/she shall not be eligible to attend the courses of VII semester until all the courses of III and IV semesters are successfully completed.

A lateral entry student shall be eligible to carry forward all the courses of V, VI and VII semesters till the VIII semester examinations. However, he/she shall not be eligible to get the course completion certificate until all the courses of III, IV, V and VI semesters are successfully completed.

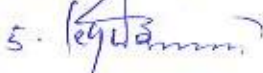
A lateral entry student shall be eligible to get his/her CGPA upon successful completion of the courses of III to VIII semesters within the stipulated time period as per the norms specified in 26.

Any student who has given more than 4 chances for successful completion of I / III semester courses and more than 3 chances for successful completion of II / IV semester courses shall be permitted to attend V / VII semester classes ONLY during the subsequent academic year as the case may be. In simpler terms there shall NOT be any ODD BATCH for any semester.


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Note: Grade AB should be considered as failed and treated as one head for deciding academic progression. Such rules are also applicable for those students who fail to register for examination(s) of any course in any semester.

### 17. Grading of performances

#### Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course. The letter grades and their corresponding grade points are given in Table – XII.

**Table – XII: Letter grades and grade points equivalent to Percentage of marks and performances**

Percentage of Marks Obtained	Letter Grade	Grade Point	Performance
90.00 – 100	O	10	Outstanding
80.00 – 89.99	A	9	Excellent
70.00 – 79.99	B	8	Good
60.00 – 69.99	C	7	Fair
50.00 – 59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

A learner who remains absent for any end semester examination shall be assigned a letter grade of AB and a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course.

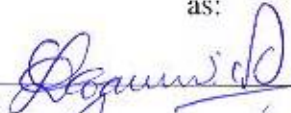
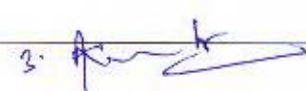

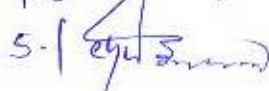

For mandatory courses, “Satisfactory” or “Unsatisfactory” shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA

### 18. The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called ‘Semester Grade Point Average’ (SGPA). The SGPA is the weighted average of the grade points obtained in all the courses by the student during the semester. For example, if a student takes five courses (Theory/Practical) in a semester with credits C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub> and C<sub>5</sub> and the student’s grade points in these courses are G<sub>1</sub>, G<sub>2</sub>, G<sub>3</sub>, G<sub>4</sub> and G<sub>5</sub>, respectively, and then students’ SGPA is equal to:

$$\text{SGPA} = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4 + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ABS grade awarded in that semester. For example if a learner has a F or ABS grade in course 4, the SGPA shall then be computed as:

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$$\text{SGPA} = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4 \text{ ZERO} + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

### 19. Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the VIII semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all VIII semesters and their courses. The CGPA shall reflect the failed status in case of F grade(s), till the course(s) is/are passed. When the course(s) is/are passed by obtaining a pass grade on subsequent examination(s) the CGPA shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$\text{CGPA} = \frac{C_1S_1 + C_2S_2 + C_3S_3 + C_4S_4 + C_5S_5 + C_6S_6 + C_7S_7 + C_8S_8}{C_1 + C_2 + C_3 + C_4 + C_5 + C_6 + C_7 + C_8}$$

where  $C_1, C_2, C_3, \dots$  is the total number of credits for semester I, II, III, ..., and  $S_1, S_2, S_3, \dots$  is the SGPA of semester I, II, III, .....

### 20. Declaration of class

The class shall be awarded on the basis of CGPA as follows:

First Class with Distinction	= CGPA of 7.50 and above
First Class	= CGPA of 6.00 to 7.49
Second Class	= CGPA of 5.00 to 5.99

### 21. Project work

All the students shall undertake a project under the supervision of a teacher and submit a report. The area of the project shall directly relate any one of the elective subject opted by the student in semester VIII. The project shall be carried out in group not exceeding 5 in number. The project report shall be submitted in triplicate (typed & bound copy not less than 25 pages).

The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). Students shall be evaluated in groups for four hours (i.e., about half an hour for a group of five students). The projects shall be evaluated as per the criteria given below.

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school as declared by the program committee from time to time.

The program committee shall discuss with various departments in the college and shall provide the Practice School module which the students can opt to enhance their specific skill as desired by them and perform in the college premises only.

For example:

Quality control & Quality assurance of Pharmaceuticals, Manufacturing of dosage forms and their evaluation, Extraction of phytoconstituents etc.,

#### **24. Award of Ranks**

Ranks and Medals shall be awarded on the basis of final CGPA. However, candidates who fail in one or more courses during the B.Pharm program shall not be eligible for award of ranks. Moreover, the candidates should have completed the B. Pharm program in minimum prescribed number of years, (four years) for the award of Ranks.

#### **25. Award of degree**

Candidates who fulfill the requirements mentioned above shall be eligible for award of degree during the ensuing convocation.

#### **26. Duration for completion of the program of study**

The duration for the completion of the program shall be fixed as double the actual duration of the program and the students have to pass within the said period, otherwise they have to get fresh Registration.

#### **27. Re-admission after break of study**

Candidate who seeks re-admission to the program after break of study has to get the approval from the university by paying a condonation fee.

No condonation is allowed for the candidate who has more than 2 years of break up period and he/she has to rejoin the program by paying the required fees.

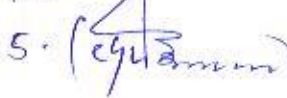
#### **28. A Socially/ Community Health relevant Projects/ Extracurricular/Co curricular activities**

The student has to spend 15 Hrs./semester on any socially/ community health relevant projects (Health awareness – communicable, non-communicable disorders and diseases, nutritional deficiency disorders, Health as per WHO guidelines, prevention of disorder and diseases, Immunization significance and life style modification) and submit a report for evaluation. This shall be evaluated by a committee consisting of Principal, Head of the department, Project mentor and one senior faculty member of the department.

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**ACADEMIC REGULATIONS FOR B.PHARM (R19)  
(LATERAL ENTRY SCHEME)**

*(Effective for the students getting admitted into II year through Lateral Entry Scheme from the Academic Year 2019-2020 and onwards)*

**1. Award of B.Pharm Degree**

A student admitted in Lateral Entry Scheme (LES) will be declared eligible for the award of the B. Pharm degree if the student fulfills the following academic regulations:

- a) Pursues a course of study for not less than three academic years and not more than six academic years.
- b) A student shall register and put up minimum 157/159<sup>§</sup>/160<sup>#</sup> credits and the minimum credit points required for award of a B. Pharm. degree is 156.

\* The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.

§Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics course.






#Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology course.

- c) Students who fail to earn 208 credits as indicated in the course structure within eight academic years from the year of their admission shall forfeit their seat in B.Pharm course and their admission shall stand cancelled

Students, who fail to fulfill the requirement for the award of the degree within six consecutive academic years from the year of admission, shall forfeit their seat.

**2. The regulations are to be adopted as that of B. Pharm (Regular).**

All other regulations as applicable for B. Pharmacy Four-year degree course (Regular) will hold good for B. Pharm (Lateral Entry Scheme).

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## **CHAPTER - II: SYLLABUS**

## **Semester I**

## **BP101T. HUMAN ANATOMY AND PHYSIOLOGY-I (Theory)**

**45 Hours**

**Scope:** This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

**Objectives:** Upon completion of this course the student should be able to

1. Explain the gross morphology, structure and functions of various organs of the human body.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. Perform the various experiments related to special senses and nervous system.
5. Appreciate coordinated working pattern of different organs of each system

### **Course Content:**

#### **Unit I**

**10 hours**

- **Introduction to human body**

Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.

- **Cellular level of organization**

Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine

- **Tissue level of organization**

Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.

#### **Unit II**

**10 hours**

- **Integumentary system**

Structure and functions of skin

- **Skeletal system**

Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system

Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction

- **Joints**  
Structural and functional classification, types of joints movements and its articulation

### **Unit III**

**10 hours**

- **Body fluids and blood**
- Body fluids, composition and functions of blood, hemopoiesis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system.
- **Lymphatic system**  
Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system

### **Unit IV**

**08 hours**

#### **Peripheral nervous system:**

Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system.

Origin and functions of spinal and cranial nerves.

- **Special senses**  
Structure and functions of eye, ear, nose and tongue and their disorders.

### **Unit V**

**07 hours**

- **Cardiovascular system**  
Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.



## **BP107P. HUMAN ANATOMY AND PHYSIOLOGY (Practical)**

**4 Hours/week**

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.

1. Study of compound microscope.
2. Microscopic study of epithelial and connective tissue
3. Microscopic study of muscular and nervous tissue
4. Identification of axial bones
5. Identification of appendicular bones
  
6. Introduction to hemocytometry.
7. Enumeration of white blood cell (WBC) count
8. Enumeration of total red blood corpuscles (RBC) count
9. Determination of bleeding time
10. Determination of clotting time
11. Estimation of hemoglobin content
12. Determination of blood group.
13. Determination of erythrocyte sedimentation rate (ESR).
14. Determination of heart rate and pulse rate.
15. Recording of blood pressure.

### **Recommended Books (Latest Editions)**

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA
4. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.

6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

**Reference Books (Latest Editions)**

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata

## BP102T. PHARMACEUTICAL ANALYSIS (Theory)

45 Hours

**Scope:** This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

**Objectives:** Upon completion of the course student shall be able to

- understand the principles of volumetric and electro chemical analysis
- carryout various volumetric and electrochemical titrations
- develop analytical skills

### Course Content:

#### UNIT-I

10 Hours

(a) **Pharmaceutical analysis-** Definition and scope

- i) Different techniques of analysis
- ii) Methods of expressing concentration
- iii) Primary and secondary standards.
- iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate

(b)**Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures

(c)Pharmacopoeia, Sources of impurities in medicinal agents,limit tests.

#### UNIT-II

10 Hours

- **Acid base titration:** Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves
- **Non aqueous titration:** Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl

#### UNIT-III

10 Hours

- **Precipitation titrations:** Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.
- **Complexometric titration:** Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.
- **Gravimetry:** Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.
- Basic Principles,methods and application of diazotisation titration.

## **UNIT-IV**

**08 Hours**

### **Redox titrations**

(a) Concepts of oxidation and reduction

(b) Types of redox titrations (Principles and applications)

Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate

## **UNIT-V**

**07 Hours**

- **Electrochemical methods of analysis**
  - **Conductometry**- Introduction, Conductivity cell, Conductometric titrations, applications.
  - **Potentiometry** - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications.
  - **Polarography** - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications

## BP108P. PHARMACEUTICAL ANALYSIS (Practical)

4 Hours / Week

### I Limit Test of the following

- (1) Chloride
- (2) Sulphate
- (3) Iron
- (4) Arsenic

### II Preparation and standardization of

- (1) Sodium hydroxide
- (2) Sulphuric acid
- (3) Sodium thiosulfate
- (4) Potassium permanganate
- (5) Ceric ammonium sulphate

### III Assay of the following compounds along with Standardization of Titrant

- (1) Ammonium chloride by acid base titration
- (2) Ferrous sulphate by Cerimetry
- (3) Copper sulphate by Iodometry
- (4) Calcium gluconate by complexometry
- (5) Hydrogen peroxide by Permanganometry
- (6) Sodium benzoate by non-aqueous titration
- (7) Sodium Chloride by precipitation titration

### IV Determination of Normality by electro-analytical methods

- (1) Conductometric titration of strong acid against strong base
- (2) Conductometric titration of strong acid and weak acid against strong base
- (3) Potentiometric titration of strong acid against strong base

### Recommended Books: (Latest Editions)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry
5. John H. Kennedy, Analytical chemistry principles
6. Indian Pharmacopoeia.

## BP103T. PHARMACEUTICS- I (Theory)

45 Hours

**Scope:** This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

**Objectives:** Upon completion of this course the student should be able to:

- Know the history of profession of pharmacy
- Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
- Understand the professional way of handling the prescription
- Preparation of various conventional dosage forms

### Course Content:

#### UNIT – I

10 Hours

- **Historical background and development of profession of pharmacy:** History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.
- **Dosage forms:** Introduction to dosage forms, classification and definitions
- **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription.
- **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.

#### UNIT – II

10 Hours

- **Pharmaceutical calculations:** Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.
- **Powders:** Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.
- **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques

**UNIT – III****08 Hours**

- **Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.
- **Biphasic liquids:**
- **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.
- **Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.

**UNIT – IV****08 Hours**

- **Suppositories:** Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.
- **Pharmaceutical incompatibilities:** Definition, classification, physical, chemical and therapeutic incompatibilities with examples.

**UNIT – V****07 Hours**

- **Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosage forms

## BP109P. PHARMACEUTICALS (Practical)

3 Hours / week

### 1. Syrups

- a) Syrup IP'66
- b) Compound syrup of Ferrous Phosphate BPC'68

### 2. Elixirs

- a) Piperazine citrate elixir
- b) Paracetamol pediatric elixir

### 3. Linctus

- a) Terpin Hydrate Linctus IP'66
- b) Iodine Throat Paint (Mandles Paint)

### 4. Solutions

- a) Strong solution of ammonium acetate
- b) Cresol with soap solution
- c) Lugol's solution

### 5. Suspensions

- a) Calamine lotion
- b) Magnesium Hydroxide mixture
- c) Aluminium Hydroxide gel

### 6. Emulsions

- a) Turpentine Liniment
- b) Liquid paraffin emulsion

### 7. Powders and Granules

- a) ORS powder (WHO)
- b) Effervescent granules
- c) Dusting powder
- d) Divided powders

### 8. Suppositories

- a) Glycero gelatin suppository
- b) Cocoa butter suppository
- c) Zinc Oxide suppository

### 8. Semisolids

- a) Sulphur ointment
- b) Non staining-iodine ointment with methyl salicylate
- c) Carbopal gel

### 9. Gargles and Mouthwashes

- a) Iodine gargle
- b) Chlorhexidine mouthwash

**Recommended Books: (Latest Editions)**



1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.
3. M.E. Aulton, Pharmaceutics, The Science & Dosage Form Design, Churchill Livingstone, Edinburgh.
4. Indian pharmacopoeia.
5. British pharmacopoeia.
6. Lachmann. Theory and Practice of Industrial Pharmacy, Lea & Febiger Publisher, The University of Michigan.
7. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi.
8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.
10. Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York.
11. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York.
12. Françoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

## BP104T. PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)

45 Hours

**Scope:** This subject deals with the monographs of inorganic drugs and pharmaceuticals.

**Objectives:** Upon completion of course student shall be able to

- know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
- understand the medicinal and pharmaceutical importance of inorganic compounds

### Course Content:

#### UNIT I

10 Hours

- **Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate

**General methods of preparation,** assay for the compounds superscripted with **asterisk (\*)**, properties and medicinal uses of inorganic compounds belonging to the following classes

#### UNIT II

10 Hours

- **Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.
- **Major extra and intracellular electrolytes:** Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride\*, Potassium chloride, Calcium gluconate\* and Oral Rehydration Salt (ORS), Physiological acid base balance.
- **Dental products:** Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.

#### UNIT III

10 Hours

- **Gastrointestinal agents**

**Acidifiers:** Ammonium chloride\* and Dil. HCl

**Antacid:** Ideal properties of antacids, combinations of antacids, Sodium

Bicarbonate\*, Aluminum hydroxide gel, Magnesium hydroxide mixture

**Cathartics:** Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite

**Antimicrobials:** Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide\*, Chlorinated lime\*, Iodine and its preparations

#### UNIT IV

**08 Hours**

- **Miscellaneous compounds**

**Expectorants:** Potassium iodide, Ammonium chloride\*.

**Emetics:** Copper sulphate\*, Sodium potassium tartarate

**Haematinics:** Ferrous sulphate\*, Ferrous gluconate

**Poison and Antidote:** Sodium thiosulphate\*, Activated charcoal, Sodium nitrite<sup>333</sup>

**Astringents:** Zinc Sulphate, Potash Alum

#### UNIT V

**07 Hours**

- **Radiopharmaceuticals:** Radio activity, Measurement of radioactivity, Properties of  $\alpha$ ,  $\beta$ , radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide  $I^{131}$ , Storage conditions, precautions & pharmaceutical application of radioactive substances.

## **BP110P. PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)**

**4 Hours / Week**

- I Limit tests for following ions**
  - Limit test for Chlorides and Sulphates
  - Modified limit test for Chlorides and Sulphates
  - Limit test for Iron
  - Limit test for Heavy metals
  - Limit test for Lead
  - Limit test for Arsenic
- II Identification test**
  - Magnesium hydroxide
  - Ferrous sulphate
  - Sodium bicarbonate
  - Calcium gluconate
  - Copper sulphate
- III Test for purity**
  - Swelling power of Bentonite
  - Neutralizing capacity of aluminum hydroxide gel
  - Determination of potassium iodate and iodine in potassium Iodide
- IV Preparation of inorganic pharmaceuticals**
  - Boric acid
  - Potash alum
  - Ferrous sulphate

### **Recommended Books (Latest Editions)**

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4<sup>th</sup> edition.
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3<sup>rd</sup> Edition
4. M.L Schroff, Inorganic Pharmaceutical Chemistry
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. Anand & Chatwal, Inorganic Pharmaceutical Chemistry
7. Indian Pharmacopoeia

## **BP105T.COMMUNICATION SKILLS (Theory)**

**30 Hours**

**Scope:** This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

### **Objectives:**

Upon completion of the course the student shall be able to

1. Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
2. Communicate effectively (Verbal and Non Verbal)
3. Effectively manage the team as a team player
4. Develop interview skills
5. Develop Leadership qualities and essentials

### **Course content:**

#### **UNIT – I**

**07 Hours**

- **Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context
- **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers
- **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment

#### **UNIT – II**

**07 Hours**

- **Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication
- **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style

**UNIT – III**

**07 Hours**

- **Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations
- **Effective Written Communication:** Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication
- **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message

**UNIT – IV**

**05 Hours**

- **Interview Skills:** Purpose of an interview, Do's and Dont's of an interview
- **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery

**UNIT – V**

**04 Hours**

- **Group Discussion:** Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

## **BP111P.COMMUNICATION SKILLS (Practical)**

**2 Hours / week**

The following learning modules are to be conducted using wordsworth<sup>®</sup> English language lab software

### **Basic communication covering the following topics**

Meeting People

Asking Questions

Making Friends

What did you do?

Do's and Dont's

### **Pronunciations covering the following topics**

Pronunciation (Consonant Sounds)

Pronunciation and Nouns

Pronunciation (Vowel Sounds)

### **Advanced Learning**

Listening Comprehension / Direct and Indirect Speech

Figures of Speech

Effective Communication

Writing Skills

Effective Writing

Interview Handling Skills

E-Mail etiquette

Presentation Skills

**Recommended Books: (Latest Edition)**

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2<sup>nd</sup> Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1<sup>st</sup>Edition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1<sup>st</sup>Edition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1<sup>st</sup>Edition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5<sup>th</sup>Edition, Pearson, 2013
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2<sup>nd</sup>Edition, New arrivals – PHI, 2011
8. Personality development and soft skills, Barun K Mitra, 1<sup>st</sup>Edition, Oxford Press, 2011
9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd, 2011
10. Soft skills and professional communication, Francis Peters SJ, 1<sup>st</sup>Edition, Mc Graw Hill Education, 2011
11. Effective communication, John Adair, 4<sup>th</sup>Edition, Pan Mac Millan,2009
12. Bringing out the best in people, Aubrey Daniels, 2<sup>nd</sup>Edition, Mc Graw Hill, 1999



## **BP 106RBT.REMEDIAL BIOLOGY (Theory)**

**30 Hours**

**Scope:** To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

**Objectives:** Upon completion of the course, the student shall be able to

- know the classification and salient features of five kingdoms of life
- understand the basic components of anatomy & physiology of plant
- know understand the basic components of anatomy & physiology animal with special reference to human

### **UNIT I**

**07 Hours**

#### **Living world:**

- Definition and characters of living organisms
- Diversity in the living world
- Binomial nomenclature
- Five kingdoms of life and basis of classification. Salient features of Monera, Protista, Fungi, Animalia and Plantae, Virus,

#### **Morphology of Flowering plants**

- Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed.
- General Anatomy of Root, stem, leaf of monocotyledons & Dicotyledones.

### **UNIT II**

**07 Hours**

#### **Body fluids and circulation**

- Composition of blood, blood groups, coagulation of blood
- Composition and functions of lymph
- Human circulatory system
- Structure of human heart and blood vessels
- Cardiac cycle, cardiac output and ECG

#### **Digestion and Absorption**

- Human alimentary canal and digestive glands
- Role of digestive enzymes
- Digestion, absorption and assimilation of digested food

#### **Breathing and respiration**

- Human respiratory system
- Mechanism of breathing and its regulation
- Exchange of gases, transport of gases and regulation of respiration
- Respiratory volumes

### **UNIT III**

**07 Hours**

#### **Excretory products and their elimination**

- Modes of excretion
- Human excretory system- structure and function
- Urine formation
- Rennin angiotensin system

#### **Neural control and coordination**

- Definition and classification of nervous system
- Structure of a neuron
- Generation and conduction of nerve impulse
- Structure of brain and spinal cord
- Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata

#### **Chemical coordination and regulation**

- Endocrine glands and their secretions
- Functions of hormones secreted by endocrine glands

#### **Human reproduction**

- Parts of female reproductive system
- Parts of male reproductive system
- Spermatogenesis and Oogenesis
- Menstrual cycle

### **UNIT IV**

**05 Hours**

#### **Plants and mineral nutrition:**

- Essential mineral, macro and micronutrients
- Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation

#### **Photosynthesis**

- Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.

### **UNIT V**

**04 Hours**

**Plant respiration:**Respiration, glycolysis, fermentation (anaerobic).

#### **Plant growth and development**

- Phases and rate of plant growth, Condition of growth,Introduction to plant growth regulators

#### **Cell - The unit of life**

- Structure and functions of cell and cell organelles.Cell division

#### **Tissues**

- Definition, types of tissues, location and functions.

**Text Books**

- a. Text book of Biology by S. B. Gokhale
- b. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

**Reference Books**

- a. A Text book of Biology by B.V. Sreenivasa Naidu
- b. A Text book of Biology by Naidu and Murthy
- c. Botany for Degree students By A.C.Dutta.
- d.Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthkrishnan.
- e. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

## **BP112RBP.REMEDIAL BIOLOGY (Practical)**

**30 Hours**

1. Introduction to experiments in biology
  - a) Study of Microscope
  - b) Section cutting techniques
  - c) Mounting and staining
  - d) Permanent slide preparation
2. Study of cell and its inclusions
3. Study of Stem, Root, Leaf, seed, fruit, flower and their modifications
4. Detailed study of frog by using computer models
5. Microscopic study and identification of tissues pertinent to Stem, Root  
Leaf, seed, fruit and flower
6. Identification of bones
7. Determination of blood group
8. Determination of blood pressure
9. Determination of tidal volume

### **Reference Books**

1. Practical human anatomy and physiology. by S.R.Kale and R.R.Kale.
2. A Manual of pharmaceutical biology practical by S.B.Gokhale, C.K.Kokate and S.P.Shriwastava.
3. Biology practical manual according to National core curriculum .Biology forum of Karnataka. Prof .M.J.H.Shafi

## BP 106RMT.REMEDIAL MATHEMATICS (Theory)

30 Hours

**Scope:** This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.

**Objectives:** Upon completion of the course the student shall be able to:-

1. Know the theory and their application in Pharmacy
2. Solve the different types of problems by applying theory
3. Appreciate the important application of mathematics in Pharmacy

### Course Content:

#### UNIT – I

06 Hours

- **Partial fraction**

Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics

- **Logarithms**

Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.

- **Function:**

Real Valued function, Classification of real valued functions,

- **Limits and continuity :**

Introduction, Limit of a function, Definition of limit of a function ( $\epsilon - \delta$

definition),  $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = na^{n-1}$ ,  $\lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} = 1$ ,

#### UNIT –II

06 Hours

- **Matrices and Determinant:**

Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley-Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations

### UNIT – III

06 Hours

- **Calculus**

**Differentiation** : Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function, Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of  $x^n$  w.r.t  $x$ , where  $n$  is any rational number, Derivative of  $e^x$ , Derivative of  $\log_e x$ , Derivative of  $a^x$ , Derivative of trigonometric functions from first principles (**without Proof**), Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application

### UNIT – IV

06 Hours

- **Analytical Geometry**

**Introduction:** Signs of the Coordinates, Distance formula,

**Straight Line** : Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line

**Integration:**

Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application

### UNIT-V

06 Hours

- **Differential Equations** : Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations**
- **Laplace Transform** : Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, **Application in solving Chemical kinetics and Pharmacokinetics equations**

### Recommended Books (Latest Edition)

1. Differential Calculus by Shanthinarayan
2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.
3. Integral Calculus by Shanthinarayan
4. Higher Engineering Mathematics by Dr.B.S.Grewal

## **Semester II**

## **BP 201T. HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)**

**45 Hours**

**Scope:** This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

**Objectives:** Upon completion of this course the student should be able to:

1. Explain the gross morphology, structure and functions of various organs of the human body.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume.
5. Appreciate coordinated working pattern of different organs of each system
6. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

### **Course Content:**

#### **Unit I**

**10 hours**

- **Nervous system**

Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.

Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid. structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)

#### **Unit II**

**06 hours**

- **Digestive system**

Anatomy of GI Tract with special reference to anatomy and functions of stomach, ( Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine



and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.

- **Energetics**

Formation and role of ATP, Creatinine Phosphate and BMR.

### **Unit III**

- **Respiratory system** **10 hours**

Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration

Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.

- **Urinary system**

Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.

### **Unit IV**

**10 hours**

- **Endocrine system**

Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.

### **Unit V**

**09 hours**

- **Reproductive system**

Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition

- **Introduction to genetics**

Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance

## **BP 207 P. HUMAN ANATOMY AND PHYSIOLOGY (Practical)**

**4 Hours/week**

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.

1. To study the integumentary and special senses using specimen, models, etc.,
2. To study the nervous system using specimen, models, etc.,
3. To study the endocrine system using specimen, models, etc
4. To demonstrate the general neurological examination
5. To demonstrate the function of olfactory nerve
6. To examine the different types of taste.
7. To demonstrate the visual acuity
8. To demonstrate the reflex activity
9. Recording of body temperature
10. To demonstrate positive and negative feedback mechanism.
  
11. Determination of tidal volume and vital capacity.
12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
13. Recording of basal mass index .
14. Study of family planning devices and pregnancy diagnosis test.
15. Demonstration of total blood count by cell analyser
16. Permanent slides of vital organs and gonads.

### **Recommended Books (Latest Editions)**

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA

4. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

**Reference Books:**

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterje ,Academic Publishers Kolkata

## BP202T. PHARMACEUTICAL ORGANIC CHEMISTRY –I (Theory)

45 Hours

**Scope:** This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.

**Objectives:** Upon completion of the course the student shall be able to

1. write the structure, name and the type of isomerism of the organic compound
2. write the reaction, name the reaction and orientation of reactions
3. account for reactivity/stability of compounds,
4. identify/confirm the identification of organic compound

### Course Content:

General methods of preparation and reactions of compounds superscripted with asterisk (\*) to be explained

To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

### UNIT-I

07 Hours

- **Classification, nomenclature and isomerism**

Classification of Organic Compounds

Common and IUPAC systems of nomenclature of organic compounds

(up to 10 Carbons open chain and carbocyclic compounds)

Structural isomerisms in organic compounds

### UNIT-II 10 Hours

- **Alkanes\*, Alkenes\* and Conjugated dienes\***

SP<sup>3</sup> hybridization in alkanes, Halogenation of alkanes, uses of paraffins.

Stabilities of alkenes, SP<sup>2</sup> hybridization in alkenes

E<sub>1</sub> and E<sub>2</sub> reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E<sub>1</sub> versus E<sub>2</sub> reactions, Factors affecting E<sub>1</sub> and E<sub>2</sub> reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation.

Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement

### UNIT-III 10 Hours

- **Alkyl halides\***

SN<sub>1</sub> and SN<sub>2</sub> reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations.

SN<sub>1</sub> versus SN<sub>2</sub> reactions, Factors affecting SN<sub>1</sub> and SN<sub>2</sub> reactions

Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.

- **Alcohols\***- Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol

#### **UNIT-IV 10 Hours**

- **Carbonyl compounds\* (Aldehydes and ketones)**

Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.

#### **UNIT-V**

**08 Hours**

- **Carboxylic acids\***

Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids, amide and ester

Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid

- **Aliphatic amines\*** - Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine

## **BP208P. PHARMACEUTICAL ORGANIC CHEMISTRY -I (Practical)**

**4 Hours / week**

1. Systematic qualitative analysis of unknown organic compounds like
  1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc.
  2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test
  3. Solubility test
  4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.
  5. Melting point/Boiling point of organic compounds
  6. Identification of the unknown compound from the literature using melting point/ boiling point.
  7. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.
  8. Minimum 5 unknown organic compounds to be analysed systematically.
2. Preparation of suitable solid derivatives from organic compounds
3. Construction of molecular models

### **Recommended Books (Latest Editions)**

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.
9. Reaction and reaction mechanism by Ahluwalia/Chatwal.

## BP203 T. BIOCHEMISTRY (Theory)

45 Hours

**Scope:** Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

**Objectives:** Upon completion of course student shall be able to

1. Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
2. Understand the metabolism of nutrient molecules in physiological and pathological conditions.
3. Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

### Course Content:

#### UNIT I

08 Hours

- **Biomolecules**

Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.

- **Bioenergetics**

Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential.

Energy rich compounds; classification; biological significances of ATP and cyclic AMP

#### UNIT II

10 Hours

- **Carbohydrate metabolism**

Glycolysis – Pathway, energetics and significance

Citric acid cycle- Pathway, energetics and significance

HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency

Glycogen metabolism Pathways and glycogen storage diseases (GSD)

Gluconeogenesis- Pathway and its significance

Hormonal regulation of blood glucose level and Diabetes mellitus

- **Biological oxidation**

Electron transport chain (ETC) and its mechanism.

Oxidative phosphorylation & its mechanism and substrate level phosphorylation

Inhibitors ETC and oxidative phosphorylation/Uncouplers

### **UNIT III**

**10 Hours**

- **Lipid metabolism**

- Oxidation of saturated fatty acid (Palmitic acid)



Formation and utilization of ketone bodies; ketoacidosis

De novo synthesis of fatty acids (Palmitic acid)

Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D

Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.

- **Amino acid metabolism**

General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders

Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, alcaptonuria, tyrosinemia)

Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline

Catabolism of heme; hyperbilirubinemia and jaundice

#### **UNIT IV**

**10 Hours**

- **Nucleic acid metabolism and genetic information transfer**

Biosynthesis of purine and pyrimidine nucleotides

Catabolism of purine nucleotides and Hyperuricemia and Gout disease

Organization of mammalian genome

Structure of DNA and RNA and their functions

DNA replication (semi conservative model)

Transcription or RNA synthesis

Genetic code, Translation or Protein synthesis and inhibitors

## UNIT V

07 Hours

- **Enzymes**

Introduction, properties, nomenclature and IUB classification of enzymes

Enzyme kinetics (Michaelis plot, Line Weaver Burke plot)

Enzyme inhibitors with examples

Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation

Therapeutic and diagnostic applications of enzymes and isoenzymes

Coenzymes –Structure and biochemical functions

### BP 209 P. BIOCHEMISTRY (Practical)

4 Hours / Week

1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
2. Identification tests for Proteins (albumin and Casein)
3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
4. Qualitative analysis of urine for abnormal constituents
5. Determination of blood creatinine
6. Determination of blood sugar
7. Determination of serum total cholesterol
8. Preparation of buffer solution and measurement of pH
9. Study of enzymatic hydrolysis of starch
10. Determination of Salivary amylase activity
11. Study the effect of Temperature on Salivary amylase activity.
12. Study the effect of substrate concentration on salivary amylase activity.

### **Recommended Books (Latest Editions)**

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murray, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by Stryer.
4. Biochemistry by D. Satyanarayan and U.Chakrapani
5. Textbook of Biochemistry by Rama Rao.
6. Textbook of Biochemistry by Deb.
7. Outlines of Biochemistry by Conn and Stumpf
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
11. Practical Biochemistry by Harold Varley.

### **BP 204T.PATHOPHYSIOLOGY (THEORY)**

**45Hours**

**Scope:** Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes. This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

**Objectives:** Upon completion of the subject student shall be able to –

1. Describe the etiology and pathogenesis of the selected disease states;
2. Name the signs and symptoms of the diseases; and
3. Mention the complications of the diseases.

#### **Course content:**

#### **Unit I**

**10Hours**

- **Basic principles of Cell injury and Adaptation:**  
Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage), Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia), Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis & Alkalosis, Electrolyte imbalance

- **Basic mechanism involved in the process of inflammation and repair:**  
Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis

**Unit II**

**10Hours**

- **Cardiovascular System:**  
Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis)
- **Respiratory system:** Asthma, Chronic obstructive airways diseases.
- **Renal system:** Acute and chronic renal failure .

**Unit II**

**10Hours**

- **Haematological Diseases:**  
Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia
- **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones
- **Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.
- **Gastrointestinal system:** Peptic Ulcer
- 

**Unit IV**

**8 Hours**

- Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease.
- **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout
- **Principles of cancer:** classification, etiology and pathogenesis of cancer
- **Diseases of bones and joints:** Rheumatoid Arthritis, Osteoporosis, Gout
- **Principles of Cancer:** Classification, etiology and pathogenesis of Cancer

**Unit V**

**7 Hours**

- **Infectious diseases:** Meningitis, Typhoid, Leprosy, Tuberculosis

Urinary tract infections

- **Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhoea

**Recommended Books (Latest Editions)**

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins & Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
2. Harsh Mohan; Text book of Pathology; 6<sup>th</sup> edition; India; Jaypee Publications; 2010.
3. Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12<sup>th</sup> edition; New York; McGraw-Hill; 2011.
4. Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; united states;
5. William and Wilkins, Baltimore; 1991 [1990 printing].
6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston; Davidson's Principles and Practice of Medicine; 21<sup>st</sup> edition; London; ELBS/Churchill Livingstone; 2010.
7. Guyton A, John .E Hall; Textbook of Medical Physiology; 12<sup>th</sup> edition; WB Saunders Company; 2010.
8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9<sup>th</sup> edition; London; McGraw-Hill Medical; 2014.
9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6<sup>th</sup> edition; Philadelphia; WB Saunders Company; 1997.
10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3<sup>rd</sup> edition; London; Churchill Livingstone publication; 2003.

#### **Recommended Journals**

1. The Journal of Pathology. ISSN: 1096-9896 (Online)
2. The American Journal of Pathology. ISSN: 0002-9440
3. Pathology. 1465-3931 (Online)
4. International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171 (Online)
5. Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

## BP205 T. COMPUTER APPLICATIONS IN PHARMACY (Theory)

30 Hrs (2 Hrs/Week)

**Scope:** This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

**Objectives:** Upon completion of the course the student shall be able to

1. know the various types of application of computers in pharmacy
2. know the various types of databases
3. know the various applications of databases in pharmacy

### Course content:

#### UNIT – I

06 hours

**Number system:** Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division

**Concept of Information Systems and Software :** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project

#### UNIT –II

06 hours

**Web technologies:** Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products

Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database

#### UNIT – III

06 hours

**Application of computers in Pharmacy** – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring

Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System

**UNIT – IV**

**06 hours**

**Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery

**UNIT-V**

**06 hours**

**Computers as data analysis in Preclinical development:**

Chromatographic data analysis(CDS), Laboratory Information management System (LIMS) and Text Information Management System(TIMMS)

### **BP210P. COMPUTER APPLICATIONS IN PHARMACY (Practical)**

1. Design a questionnaire using a word processing package to gather information about a particular disease.
2. Create a HTML web page to show personal information.
3. Retrieve the information of a drug and its adverse effects using online tools
4. Creating mailing labels Using Label Wizard , generating label in MS WORD
5. Create a database in MS Access to store the patient information with the required fields Using access
6. Design a form in MS Access to view, add, delete and modify the patient record in the database
7. Generating report and printing the report from patient database
8. Creating invoice table using – MS Access
9. Drug information storage and retrieval using MS Access
10. Creating and working with queries in MS Access
11. Exporting Tables, Queries, Forms and Reports to web pages
12. Exporting Tables, Queries, Forms and Reports to XML pages

#### **Recommended books (Latest edition):**

1. Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA
3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
4. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi - 110002



## **BP 206 T. ENVIRONMENTAL SCIENCES (Theory)**

**30 hours**

**Scope:**Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

**Objectives:** Upon completion of the course the student shall be able to:

1. Create the awareness about environmental problems among learners.
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate learner to participate in environment protection and environment improvement.
5. Acquire skills to help the concerned individuals in identifying and solving environmental problems.
6. Strive to attain harmony with Nature.

### **Course content:**

#### **Unit-I**

**10hours**

The Multidisciplinary nature of environmental studies

Natural Resources

Renewable and non-renewable resources:

Natural resources and associated problems

a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

#### **Unit-II**

**10hours**

Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

#### **Unit- III**

**10hours**

Environmental Pollution: Air pollution; Water pollution; Soil pollution

**Recommended Books (Latest edition):**

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clarendon Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down of Earth, Centre for Science and Environment

## **SEMESTER III**

## BP301T. PHARMACEUTICAL ORGANIC CHEMISTRY –II (Theory)

45 Hours

**Scope:** This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.

**Objectives:** Upon completion of the course the student shall be able to

1. write the structure, name and the type of isomerism of the organic compound
2. write the reaction, name the reaction and orientation of reactions
3. account for reactivity/stability of compounds,
4. prepare organic compounds

### Course Content:

General methods of preparation and reactions of compounds superscripted with asterisk (\*) to be explained

To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

#### UNIT I

10 Hours

- **Benzene and its derivatives**

- A. Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule
- B. Reactions of benzene - nitration, sulphonation, halogenation- reactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation.
- C. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction
- D. Structure and uses of DDT, Saccharin, BHC and Chloramine

#### UNIT II

10 Hours

- **Phenols\*** - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols
- **Aromatic Amines\*** - Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts
- **Aromatic Acids\*** -Acidity, effect of substituents on acidity and important reactions of benzoic acid.

#### UNIT III

10 Hours

- **Fats and Oils**
  - a. Fatty acids – reactions.

- b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.
- c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.

**UNIT IV**

**08 Hours**

- **Polynuclear hydrocarbons:**

- a. Synthesis, reactions
- b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives

**UNIT V**

**07 Hours**

- **Cyclo alkanes\***

Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only

## BP305P. PHARMACEUTICAL ORGANIC CHEMISTRY -II (Practical)

4 Hrs/week

- I Experiments involving laboratory techniques
- Recrystallization
  - Steam distillation
- II Determination of following oil values (including standardization of reagents)
- Acid value
  - Saponification value
  - Iodine value
- III Preparation of compounds
- Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by acylation reaction.
  - 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/
  - Acetanilide by halogenation (Bromination) reaction.
  - 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.
  - Benzoic acid from Benzyl chloride by oxidation reaction.
  - Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.
  - 1-Phenyl azo-2-naphthol from Aniline by diazotization and coupling reactions.
  - Benzil from Benzoin by oxidation reaction.
  - Dibenzal acetone from Benzaldehyde by Claisen Schmidt reaction
  - Cinnamic acid from Benzaldehyde by Perkin reaction
  - *P*-Iodo benzoic acid from *P*-amino benzoic acid

### Recommended Books (Latest Editions)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.

8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

**BP302T. PHYSICAL PHARMACEUTICS-I (Theory)**

**45Hours**

**Scope:** The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

**Objectives:** Upon the completion of the course student shall be able to

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

**Course Content:**

**UNIT-I**

**10 Hours**

**Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications

**UNIT-II**

**10Hours**

**States of Matter and properties of matter:** State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid-crystalline, amorphous & polymorphism.

**Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications

**UNIT-III**

**08 Hours**

**Surface and interfacial phenomenon:** Liquid interface, surface & interfacial tensions,

surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.

**UNIT-IV****08Hours**

**Complexation and protein binding:** Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.

**UNIT-V****07 Hours**

**pH, buffers and Isotonic solutions:** Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.



## **BP306P. PHYSICAL PHARMACEUTICS – I (Practical)**

**4 Hrs/week**

1. Determination the solubility of drug at room temperature
2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
3. Determination of Partition co- efficient of benzoic acid in benzene and water
4. Determination of Partition co- efficient of Iodine in CCl<sub>4</sub> and water
5. Determination of % composition of NaCl in a solution using phenol-water system by CST method
6. Determination of surface tension of given liquids by drop count and drop weight method
7. Determination of HLB number of a surfactant by saponification method
8. Determination of Freundlich and Langmuir constants using activated char coal
9. Determination of critical micellar concentration of surfactants
10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

### **Recommended Books: (Latest Editions)**

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C and ManavalanR.
8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
9. Physical Pharmaceutics by C.V.S. Subramanyam
10. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar

## **BP 303 T. PHARMACEUTICAL MICROBIOLOGY (Theory)**

**45Hours**

### **Scope:**

- Study of all categories of microorganisms especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc..

**Objectives:** Upon completion of the subject student shall be able to;

1. Understand methods of identification, cultivation and preservation of various microorganisms
2. To understand the importance and implementation of sterilization in pharmaceutical processing and industry
3. Learn sterility testing of pharmaceutical products.
4. Carried out microbiological standardization of Pharmaceuticals.
5. Understand the cell culture technology and its applications in pharmaceutical industries.

### **Course content:**

#### **Unit I**

**10 Hours**

Introduction, history of microbiology, its branches, scope and its importance.

Introduction to Prokaryotes and Eukaryotes

Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count).

Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.

#### **Unit II**

**10 Hours**

Identification of bacteria using staining techniques (simple, Gram's & Acid fast staining) and biochemical tests (IMViC).

Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization.

Evaluation of the efficiency of sterilization methods.

Equipments employed in large scale sterilization.

Sterility indicators.

### **Unit III**

**10 Hours**

Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses.

Classification and mode of action of disinfectants

Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions

Evaluation of bactericidal & Bacteriostatic.

Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

### **Unit IV**

**08 Hours**

Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification.

Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids.

Assessment of a new antibiotic.

### **Unit V**

**07Hours**

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage.

Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.

Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures.

Application of cell cultures in pharmaceutical industry and research.

## **BP 307P.PHARMACEUTICAL MICROBIOLOGY (Practical)**

**4 Hrs/week**

1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.
2. Sterilization of glassware, preparation and sterilization of media.
3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical).
5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
6. Microbiological assay of antibiotics by cup plate method and other methods
7. Motility determination by Hanging drop method.
8. Sterility testing of pharmaceuticals.
9. Bacteriological analysis of water
10. Biochemical test.

### **Recommended Books (Latest edition)**

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4<sup>th</sup> edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Pepler: Microbial Technology.
9. I.P., B.P., U.S.P.- latest editions.
10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
11. Edward: Fundamentals of Microbiology.
12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

## BP 304 T. PHARMACEUTICAL ENGINEERING (Theory)

**45 Hours**

**Scope:** This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

**Objectives:** Upon completion of the course student shall be able:

1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various test to prevent environmental pollution.
5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

### Course content:

#### UNIT-I

**10 Hours**

- **Flow of fluids:** Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.
- **Size Reduction:** Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.
- **Size Separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

#### UNIT-II

**10 Hours**

- **Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

- **Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of multiple effect evaporator.
- **Distillation:** Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

### UNIT- III

**08 Hours**

- **Drying:** Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.
- **Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier,

### UNIT-IV

**08 Hours**

- **Filtration:** Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.
- **Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

### UNIT- V

**07 Hours**

- **Materials of pharmaceutical plant construction, Corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

**Recommended Books: (Latest Editions)**

1. Introduction to chemical engineering – Walter L Badger & Julius Banchemo, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
3. Unit operation of chemical engineering – McCabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

## **BP308P - PHARMACEUTICAL ENGINEERING (Practical)**

**4 Hours/week**

- I. Determination of radiation constant of brass, iron, unpainted and painted glass.
- II. Steam distillation – To calculate the efficiency of steam distillation.
- III. To determine the overall heat transfer coefficient by heat exchanger.
- IV. Construction of drying curves (for calcium carbonate and starch).
- V. Determination of moisture content and loss on drying.
- VI. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method.
- VII. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
- VIII. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
- IX. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
- X. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
- XI. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity
- XII. To study the effect of time on the Rate of Crystallization.
- XIII. To calculate the uniformity Index for given sample by using Double Cone Blender.



## **SEMESTER IV**

## **BP401T. PHARMACEUTICAL ORGANIC CHEMISTRY –III (Theory)**

**45 Hours**

**Scope:** This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

**Objectives:** At the end of the course, the student shall be able to

1. understand the methods of preparation and properties of organic compounds
2. explain the stereo chemical aspects of organic compounds and stereo chemical reactions
3. know the medicinal uses and other applications of organic compounds

### **Course Content:**

**Note: To emphasize on definition, types, mechanisms, examples, uses/applications**

#### **UNIT-I**

**10 Hours**

##### **Stereo isomerism**

Optical isomerism –

Optical activity, enantiomerism, diastereoisomerism, meso compounds

Elements of symmetry, chiral and achiral molecules

DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers

Reactions of chiral molecules

Racemic modification and resolution of racemic mixture.

Asymmetric synthesis: partial and absolute

#### **UNIT-II**

**10 Hours**

Geometrical isomerism

Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems)

Methods of determination of configuration of geometrical isomers.

Conformational isomerism in Ethane, n-Butane and Cyclohexane.

Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.

Stereospecific and stereoselective reactions

#### **UNIT-III**

**10 Hours**

**Heterocyclic compounds:**

Nomenclature and classification

Synthesis, reactions and medicinal uses of following compounds/derivatives

Pyrrole, Furan, and Thiophene

Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene

**UNIT-IV****8 Hours**

Synthesis, reactions and medicinal uses of following compounds/derivatives

Pyrazole, Imidazole, Oxazole and Thiazole.

Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine

Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives

**UNIT-V****07 Hours****Reactions of synthetic importance**

Metal hydride reduction ( $\text{NaBH}_4$  and  $\text{LiAlH}_4$ ), Clemmensen reduction, Birch reduction, Wolff Kishner reduction.

Oppenauer-oxidation and Dakin reaction.

Beckmanns rearrangement and Schmidt rearrangement.

Claisen-Schmidt condensation

**Recommended Books (Latest Editions)**

1. Organic chemistry by I.L. Finar, Volume-I & II.
2. A text book of organic chemistry – Arun Bahl, B.S. Bahl.
3. Heterocyclic Chemistry by Raj K. Bansal
4. Organic Chemistry by Morrison and Boyd
5. Heterocyclic Chemistry by T.L. Gilchrist

## BP402T. MEDICINAL CHEMISTRY – I (Theory)

**45 Hours**

**Scope:** This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

**Objectives:** Upon completion of the course the student shall be able to

1. understand the chemistry of drugs with respect to their pharmacological activity
2. understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. know the Structural Activity Relationship (SAR) of different class of drugs
4. write the chemical synthesis of some drugs

### Course Content:

**Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (\*)**

### UNIT- I

**10 Hours**

#### Introduction to Medicinal Chemistry

#### History and development of medicinal chemistry

#### Physicochemical properties in relation to biological action

Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.

#### Drug metabolism

Drug metabolism principles- Phase I and Phase II.

Factors affecting drug metabolism including stereo chemical aspects.

### UNIT- II

**10 Hours**

#### Drugs acting on Autonomic Nervous System

#### Adrenergic Neurotransmitters:

Biosynthesis and catabolism of catecholamine.

Adrenergic receptors (Alpha & Beta) and their distribution.

#### Sympathomimetic agents: SAR of Sympathomimetic agents

Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine\*, Dopamine,

Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol\*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline.

- Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine.
- Agents with mixed mechanism: Ephedrine, Metaraminol.

#### **Adrenergic Antagonists:**

**Alpha adrenergic blockers:** Tolazoline\*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.

**Beta adrenergic blockers:** SAR of beta blockers, Propranolol\*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.

### **UNIT-III**

**10 Hours**

#### **Cholinergic neurotransmitters:**

Biosynthesis and catabolism of acetylcholine.

Cholinergic receptors (Muscarinic & Nicotinic) and their distribution.

#### **Parasympathomimetic agents: SAR of Parasympathomimetic agents**

**Direct acting agents:** Acetylcholine, Carbachol\*, Bethanechol, Methacholine, Pilocarpine.

**Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):** Physostigmine, Neostigmine\*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorophate, Echothiophate iodide, Parathione, Malathion.

**Cholinesterase reactivator:** Pralidoxime chloride.

#### **Cholinergic Blocking agents: SAR of cholinolytic agents**

**Solanaceous alkaloids and analogues:** Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide\*.

**Synthetic cholinergic blocking agents:** Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride\*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride\*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

### **UNIT- IV**

**08 Hours**

#### **Drugs acting on Central Nervous System**

### **A. Sedatives and Hypnotics:**

**Benzodiazepines:** SAR of Benzodiazepines, Chlordiazepoxide, Diazepam\*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem

**Barbiturates:** SAR of barbiturates, Barbitol\*, Phenobarbital, Mephobarbital, Amobarbital, Butobarbital, Pentobarbital, Secobarbital

#### **Miscellaneous:**

Amides & imides: Glutethimide.

Alcohol & their carbamate derivatives: Meprobamate, Ethchlorvynol.

Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.

### **B. Antipsychotics**

**Phenothiazines:** SAR of Phenothiazines - Promazine hydrochloride, Chlorpromazine hydrochloride\*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.

**Ring Analogues of Phenothiazines:** Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.

**Fluoro buterophenones:** Haloperidol, Droperidol, Risperidone.

**Beta amino ketones:** Molindone hydrochloride.

**Benzamides:** Sulpieride.

**C. Anticonvulsants:** SAR of Anticonvulsants, mechanism of anticonvulsant action

**Barbiturates:** Phenobarbitone, Methobarbital. **Hydantoins:**

Phenytoin\*, Mephenytoin, Ethotoin **Oxazolindione diones:**

Trimethadione, Paramethadione **Succinimides:**

Phensuximide, Methsuximide, Ethosuximide\* **Urea and**

**monoacylureas:** Phenacemide, Carbamazepine\*

**Benzodiazepines:** Clonazepam

**Miscellaneous:** Primidone, Valproic acid, Gabapentin, Felbamate

**UNIT – V**

**07 Hours**

**Drugs acting on Central Nervous System**

**General anesthetics:**

**Inhalation anesthetics:** Halothane\*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.

**Ultra short acting barbiturates:** Methohexital sodium\*, Thiopental sodium, Thiopental sodium.

**Dissociative anesthetics:** Ketamine hydrochloride.\*

**Narcotic and non-narcotic analgesics**

**Morphine and related drugs:** SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate\*, Methadone hydrochloride\*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate.

**Narcotic antagonists:** Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.

**Anti-inflammatory agents:** Sodium salicylate, Aspirin, Mefenamic acid\*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepiac, Diclofenac, Ketorolac, Ibuprofen\*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.

**BP406P. MEDICINAL CHEMISTRY – I (Practical)**

**4 Hours/Week**

**I Preparation of drugs/ intermediates**

- 1 1,3-pyrazole
- 2 1,3-oxazole
- 3 Benzimidazole
- 4 Benztriazole
- 5 2,3- diphenyl quinoxaline
- 6 Benzocaine
- 7 Phenytoin
- 8 Phenothiazine
- 9 Barbiturate

**II Assay of drugs**

- 1 Chlorpromazine
- 2 Phenobarbitone
- 3 Atropine
- 4 Ibuprofen
- 5 Aspirin
- 6 Furosemide

**III Determination of Partition coefficient for any two drugs**

**Recommended Books (Latest Editions)**

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.



7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

## BP 403 T. PHYSICAL PHARMACEUTICS-II (Theory)

45Hours

**Scope:** The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

**Objectives:** Upon the completion of the course student shall be able to

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

### Course Content:

#### UNIT-I

07 Hours

**Colloidal dispersions:** Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action.

#### UNIT-II

10 Hours

**Rheology:** Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers

**Deformation of solids:** Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus

#### UNIT-III

10 Hours

**Coarse dispersion:** Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.

**UNIT-IV****10Hours**

**Micromeritics:** Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.

**UNIT-V****10 Hours**

**Drug stability:** Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention

## **BP 407P. PHYSICAL PHARMACEUTICS- II (Practical)**

**3 Hrs/week**

1. Determination of particle size, particle size distribution using sieving method
2. Determination of particle size, particle size distribution using Microscopic method
3. Determination of bulk density, true density and porosity
4. Determine the angle of repose and influence of lubricant on angle of repose
5. Determination of viscosity of liquid using Ostwald's viscometer
6. Determination sedimentation volume with effect of different suspending agent
7. Determination sedimentation volume with effect of different concentration of single suspending agent
8. Determination of viscosity of semisolid by using Brookfield viscometer
9. Determination of reaction rate constant first order.
10. Determination of reaction rate constant second order
11. Accelerated stability studies

### **Recommended Books: (Latest Editions)**

1. Physical Pharmacy by Alfred Martin, Sixth edition
2. Experimental pharmaceuticals by Eugene, Parott.
3. Tutorial pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C, and Manavalan R.

## BP 404 T. PHARMACOLOGY-I (Theory)

45 Hrs

**Scope:** The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

**Objectives:** Upon completion of this course the student should be able to

1. Understand the pharmacological actions of different categories of drugs
2. Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.
3. Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
4. Observe the effect of drugs on animals by simulated experiments
5. Appreciate correlation of pharmacology with other bio medical sciences

### Course Content:

#### UNIT-I

08 hours

##### 1. General Pharmacology

- a. Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists( competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.
- b. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination

#### UNIT-II

12 Hours

##### General Pharmacology

- a. Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.
- b. Adverse drug reactions.
- c. Drug interactions (pharmacokinetic and pharmacodynamic)
- d. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.

**UNIT-III****10 Hours****2. Pharmacology of drugs acting on peripheral nervous system**

- a. Organization and function of ANS.
- b. Neurohumoral transmission, co-transmission and classification of neurotransmitters.
- c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.
- d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).
- e. Local anesthetic agents.
- f. Drugs used in myasthenia gravis and glaucoma

**UNIT-IV****08 Hours****3. Pharmacology of drugs acting on central nervous system**

- a. Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.
- b. General anesthetics and pre-anesthetics.
- c. Sedatives, hypnotics and centrally acting muscle relaxants.
- d. Anti-epileptics
- e. Alcohols and disulfiram

**UNIT-V****07 Hours****3. Pharmacology of drugs acting on central nervous system**

- a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens.
- b. Drugs used in Parkinsons disease and Alzheimer's disease.
- c. CNS stimulants and nootropics.
- d. Opioid analgesics and antagonists
- e. Drug addiction, drug abuse, tolerance and dependence.

## BP 408 P.PHARMACOLOGY-I (Practical)

4Hrs/Week

1. Introduction to experimental pharmacology.
2. Commonly used instruments in experimental pharmacology.
3. Study of common laboratory animals.
4. Maintenance of laboratory animals as per CPCSEA guidelines.
5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
6. Study of different routes of drugs administration in mice/rats.
7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
8. Effect of drugs on ciliary motility of frog oesophagus
9. Effect of drugs on rabbit eye.
10. Effects of skeletal muscle relaxants using rota-rod apparatus.
11. Effect of drugs on locomotor activity using actophotometer.
12. Anticonvulsant effect of drugs by MES and PTZ method.
13. Study of stereotype and anti-catatonic activity of drugs on rats/mice.
14. Study of anxiolytic activity of drugs using rats/mice.
15. Study of local anesthetics by different methods

*Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos*

### Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology

6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert,
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,



## **BP 405 T.PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)**

**45 Hours**

**Scope:** The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

**Objectives:** Upon completion of the course, the student shall be able

1. to know the techniques in the cultivation and production of crude drugs
2. to know the crude drugs, their uses and chemical nature
3. know the evaluation techniques for the herbal drugs
4. to carry out the microscopic and morphological evaluation of crude drugs

### **Course Content:**

#### **UNIT-I**

**10 Hours**

##### **Introduction to Pharmacognosy:**

- (a) Definition, history, scope and development of Pharmacognosy
- (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture
- (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).

##### **Classification of drugs:**

Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs

##### **Quality control of Drugs of Natural Origin:**

Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties.

Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida.

#### **UNIT-II**

**10 Hours**

##### **Cultivation, Collection, Processing and storage of drugs of natural origin:**

Cultivation and Collection of drugs of natural origin  
Factors influencing cultivation of medicinal plants.  
Plant hormones and their applications.  
Polyploidy, mutation and hybridization with reference to medicinal plants

##### **Conservation of medicinal plants**

#### **UNIT-III**

**07 Hours**

##### **Plant tissue culture:**

Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance.

Applications of plant tissue culture in pharmacognosy.

Edible vaccines

#### **UNIT IV**

**10 Hours**

##### **Pharmacognosy in various systems of medicine:**

Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.

##### **Introduction to secondary metabolites:**

Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins

#### **UNIT V**

**08 Hours**

Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs

##### **Plant Products:**

Fibers - Cotton, Jute, Hemp

Hallucinogens, Teratogens, Natural allergens

##### **Primary metabolites:**

General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites:

**Carbohydrates:** Acacia, Agar, Tragacanth, Honey

**Proteins and Enzymes :** Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).

**Lipids(Waxes, fats, fixed oils) :** Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax

##### **Marine Drugs:**

Novel medicinal agents from marine sources



### **BP408 P. PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)**

**4 Hours/Week**

1. Analysis of crude drugs by chemical tests: (i)Tragacanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil
2. Determination of stomatal number and index
3. Determination of vein islet number, vein islet termination and palisade ratio.
4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer
5. Determination of Fiber length and width
6. Determination of number of starch grains by Lycopodium spore method
7. Determination of Ash value
8. Determination of Extractive values of crude drugs
9. Determination of moisture content of crude drugs
10. Determination of swelling index and foaming

#### **Recommended Books: (Latest Editions)**

1. W.C.Evans, Trease and Evans Pharmacognosy, 16<sup>th</sup> edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9<sup>th</sup> Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37<sup>th</sup> Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), 1<sup>st</sup> Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar

**SEMESTER V**

## BP501T. MEDICINAL CHEMISTRY – II (Theory)

45 Hours

**Scope:** This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

**Objectives:** Upon completion of the course the student shall be able to

1. Understand the chemistry of drugs with respect to their pharmacological activity
2. Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. Know the Structural Activity Relationship of different class of drugs
4. Study the chemical synthesis of selected drugs

### Course Content:

**Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (\*)**

#### UNIT- I

10 Hours

**Antihistaminic agents:** Histamine, receptors and their distribution in the humanbody

**H<sub>1</sub>-antagonists:** Diphenhydramine hydrochloride\*, Dimenhydrinate, Doxylamines succinate, Clemastine fumarate, Diphenylpyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride\*, Phenidamine tartarate, Promethazine hydrochloride\*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium

**H<sub>2</sub>-antagonists:** Cimetidine\*, Famotidine, Ranitidin.

**Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole

**Anti-neoplastic agents:**

**Alkylating agents:** Meclorothamine\*, Cyclophosphamide, Melphalan,

Chlorambucil, Busulfan, Thiotepa

**Antimetabolites:** Mercaptopurine\*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate\*, Azathioprine

**Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin

**Plant products:** Etoposide, Vinblastin sulphate, Vincristin sulphate

**Miscellaneous:** Cisplatin, Mitotane.

## UNIT – II

**10 Hours**

### **Anti-anginal:**

**Vasodilators:** Amyl nitrite, Nitroglycerin\*, Pentaerythritol tetranitrate, Isosorbide dinitrite\*, Dipyridamole.

**Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.

### **Diuretics:**

Carbonic anhydrase inhibitors: Acetazolamide\*, Methazolamide, Dichlorphenamide.

Thiazides: Chlorthiazide\*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide,

Loop diuretics: Furosemide\*, Bumetanide, Ethacrynic acid.

Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride.

Osmotic Diuretics: Mannitol

**Anti-hypertensive Agents:** Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,\* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.

## UNIT- III

**10 Hours**

**Anti-arrhythmic Drugs:** Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate\*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcaïnide hydrochloride, Amiodarone, Sotalol.

**Anti-hyperlipidemic agents:** Clofibrate, Lovastatin, Cholesteramine and Cholestipol

**Coagulant & Anticoagulants:** Menadione, Acetomenadione, Warfarin\*, Anisindione, clopidogrel

**Drugs used in Congestive Heart Failure:** Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.





**UNIT- IV****08 Hours****Drugs acting on Endocrine system**

Nomenclature, Stereochemistry and metabolism of steroids

**Sex hormones:** Testosterone, Nandralone, Progesterones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol.

**Drugs for erectile dysfunction:** Sildenafil, Tadalafil.

**Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrol

**Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone

**Thyroid and antithyroid drugs:** L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.

**UNIT – V****07 Hours****Antidiabetic agents:**

Insulin and its preparations

Sulfonyl ureas: Tolbutamide\*, Chlorpropamide, Glipizide, Glimepiride.

Biguanides: Metformin.

Thiazolidinediones: Pioglitazone, Rosiglitazone.

Meglitinides: Repaglinide, Nateglinide.

Glucosidase inhibitors: Acarbose, Voglibose.

**Local Anesthetics: SAR of Local anesthetics**

**Benzoic Acid derivatives;** Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine.

**Amino Benzoic acid derivatives:** Benzocaine\*, Butamben, Procaine\*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.

**Lidocaine/Anilide derivatives:** Lignocaine, Mepivacaine, Prilocaine, Etidocaine.

**Miscellaneous:** Phenacaine, Dipiperodon, Dibucaine.\*

**Recommended Books (Latest Editions)**

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1to 5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.



## BP 502 T. Industrial PharmacyI (Theory)

**45 Hours**

**Scope:** Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.

**Objectives:** Upon completion of the course the student shall be able to

1. Know the various pharmaceutical dosage forms and their manufacturing techniques.
2. Know various considerations in development of pharmaceutical dosage forms
3. Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality

### Course content:

**3 hours/ week**

#### UNIT-I

**07 Hours**

**Preformulation Studies:** Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.

*a. Physical properties:* Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism

*b. Chemical Properties:* Hydrolysis, oxidation, reduction, racemisation, polymerization

BCS classification of drugs & its significant

Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.

#### UNIT-II

**10 Hours**

##### Tablets:

- a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling.
- b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.
- c. Quality control tests: In process and finished product tests

**Liquid orals:** Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia

### UNIT-III

08 Hours

#### Capsules:

- a. **Hard gelatin capsules:** Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.
- b. **Soft gelatin capsules:** Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.

**Pellets:** Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets

### UNIT-IV

10 Hours

#### Parenteral Products:

- a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity
- b. Production procedure, production facilities and controls, aseptic processing
- c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.
- d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

**Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations

### UNIT-V

10 Hours

**Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.

**Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.

**Packaging Materials Science:** Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.

## **BP 506 P. Industrial PharmacyI (Practical)**

**4 Hours/week**

1. Preformulation studies on paracetamol/asparin/or any other drug
2. Preparation and evaluation of Paracetamol tablets
3. Preparation and evaluation of Aspirin tablets
4. Coating of tablets- film coating of tables/granules
5. Preparation and evaluation of Tetracycline capsules
6. Preparation of Calcium Gluconate injection
7. Preparation of Ascorbic Acid injection
8. Qulaity control test of (as per IP) marketed tablets and capsules
9. Preparation of Eye drops/ and Eye ointments
10. Preparation of Creams (cold / vanishing cream)
11. Evaluation of Glass containers (as per IP)

### **Recommended Books: (Latest Editions)**

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman &J.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman
7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition
8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5<sup>th</sup>edition, 2005
9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

## BP503.T. PHARMACOLOGY-II (Theory)

45 Hours

**Scope:** This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.

**Objectives:** Upon completion of this course the student should be able to

1. Understand the mechanism of drug action and its relevance in the treatment of different diseases
2. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
3. Demonstrate the various receptor actions using isolated tissue preparation
4. Appreciate correlation of pharmacology with related medical sciences

### Course Content:

#### UNIT-I

10hours

##### 1. Pharmacology of drugs acting on cardio vascular system

- a. Introduction to hemodynamic and electrophysiology of heart.
- b. Drugs used in congestive heart failure
- c. Anti-hypertensive drugs.
- d. Anti-anginal drugs.
- e. Anti-arrhythmic drugs.
- f. Anti-hyperlipidemic drugs.

#### UNIT-II

10hours

##### 1. Pharmacology of drugs acting on cardio vascular system

- a. Drug used in the therapy of shock.
- b. Hematinics, coagulants and anticoagulants.
- c. Fibrinolytics and anti-platelet drugs
- d. Plasma volume expanders

##### 2. Pharmacology of drugs acting on urinary system

- a. Diuretics
- b. Anti-diuretics.

#### UNIT-III

10hours

##### 3. Autocoids and related drugs

- a. Introduction to autocoids and classification
- b. Histamine, 5-HT and their antagonists.
- c. Prostaglandins, Thromboxanes and Leukotrienes.
- d. Angiotensin, Bradykinin and Substance P.
- e. Non-steroidal anti-inflammatory agents
- f. Anti-gout drugs
- g. Antirheumatic drugs

**UNIT-IV****08hours****5. Pharmacology of drugs acting on endocrine system**

- a. Basic concepts in endocrine pharmacology.
- b. Anterior Pituitary hormones- analogues and their inhibitors.
- c. Thyroid hormones- analogues and their inhibitors.
- d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.
- d. Insulin, Oral Hypoglycemic agents and glucagon.
- e. ACTH and corticosteroids.

**UNIT-V****07hours****5. Pharmacology of drugs acting on endocrine system**

- a. Androgens and Anabolic steroids.
- b. Estrogens, progesterone and oral contraceptives.
- c. Drugs acting on the uterus.

**6. Bioassay**

- a. Principles and applications of bioassay.
- b. Types of bioassay
- c. Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT

## BP 507 P. PHARMACOLOGY-II (Practical)

4Hrs/Week

1. Introduction to *in-vitro* pharmacology and physiological salt solutions.
2. Effect of drugs on isolated frog heart.
3. Effect of drugs on blood pressure and heart rate of dog.
4. Study of diuretic activity of drugs using rats/mice.
5. DRC of acetylcholine using frog rectus abdominis muscle.
6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively.
7. Bioassay of histamine using guinea pig ileum by matching method.
8. Bioassay of oxytocin using rat uterine horn by interpolation method.
9. Bioassay of serotonin using rat fundus strip by three point bioassay.
10. Bioassay of acetylcholine using rat ileum/colon by four point bioassay.
11. Determination of  $PA_2$  value of prazosin using rat anococcygeus muscle (by Schild's plot method).
12. Determination of  $PD_2$  value using guinea pig ileum.
13. Effect of spasmogens and spasmolytics using rabbit jejunum.
14. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.
15. Analgesic activity of drug using central and peripheral methods

*Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos*

### Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins.
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert.
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.





## BP504 T. PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory)

45Hours

**Scope:** The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine

**Objectives:** Upon completion of the course, the student shall be able

1. to know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
2. to understand the preparation and development of herbal formulation.
3. to understand the herbal drug interactions
4. to carryout isolation and identification of phytoconstituents

### Course Content:

#### UNIT-I

7 Hours

##### Metabolic pathways in higher plants and their determination

- a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.
- b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

#### UNIT-II

14 Hours

General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:

**Alkaloids:** Vinca, Rauwolfia, Belladonna, Opium,

**Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta

**Steroids, Cardiac Glycosides & Triterpenoids:** Liquorice, Dioscorea, Digitalis

**Volatile oils:** Mentha, Clove, Cinnamon, Fennel, Coriander,

**Tannins:** Catechu, Pterocarpus

**Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony

**Glycosides:** Senna, Aloes, Bitter Almond

**Iridoids, Other terpenoids & Naphthaquinones:** Gentian, Artemisia, taxus, carotenoids

#### UNIT-III

06 Hours

Isolation, Identification and Analysis of Phytoconstituents

- a) Terpenoids: Menthol, Citral, Artemisin
- b) Glycosides: Glycyrrhetic acid & Rutin
- c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine
- d) Resins: Podophyllotoxin, Curcumin

#### UNIT-IV

10 Hours

Industrial production, estimation and utilization of the following phytoconstituents:

Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine

#### UNIT V

8 Hours

##### Basics of Phytochemistry

Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.

**BP 508 P. PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)**

**4 Hours/Week**

1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander
2. Exercise involving isolation & detection of active principles
  - a. Caffeine - from tea dust.
  - b. Diosgenin from Dioscorea
  - c. Atropine from Belladonna
  - d. Sennosides from Senna
3. Separation of sugars by Paper chromatography
4. TLC of herbal extract
5. Distillation of volatile oils and detection of phytoconstituents by TLC
6. Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh

**Recommended Books: (Latest Editions)**

1. W.C.Evans, Trease and Evans Pharmacognosy, 16<sup>th</sup> edition, W.B. Saunders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37<sup>th</sup> Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), 1<sup>st</sup> Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, 1<sup>st</sup> edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.



## **BP 505 T. PHARMACEUTICAL JURISPRUDENCE (Theory)**

**45 Hours**

**Scope:** This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.

**Objectives:** Upon completion of the course, the student shall be able to understand:

1. The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
2. Various Indian pharmaceutical Acts and Laws
3. The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
4. The code of ethics during the pharmaceutical practice

### **Course Content:**

#### **UNIT-I**

**10 Hours**

##### **Drugs and Cosmetics Act, 1940 and its rules 1945:**

Objectives, Definitions, Legal definitions of schedules to the Act and Rules

Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties.

Manufacture of drugs – Prohibition of manufacture and sale of certain drugs,

Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.

#### **UNIT-II**

**10 Hours**

##### **Drugs and Cosmetics Act, 1940 and its rules 1945.**

Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA)

Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties

Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties.

Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors

#### **UNIT-III**

**10 Hours**

- **Pharmacy Act –1948:** Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and

## Penalties

- **Medicinal and Toilet Preparation Act –1955:** Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties.
- **Narcotic Drugs and Psychotropic substances Act-1985 and Rules:** Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties

## UNIT-IV

**08 Hours**

- **Study of Salient Features of Drugs and Magic Remedies Act and its rules:** Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties
- **Prevention of Cruelty to animals Act-1960:** Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties
- **National Pharmaceutical Pricing Authority:** Drugs Price Control Order (DPCO)-2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM)

## UNIT-V

**07 Hours**

- **Pharmaceutical Legislations** – A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee
- **Code of Pharmaceutical ethics** Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath
- **Medical Termination of Pregnancy Act**
- **Right to Information Act**
- **Introduction to Intellectual Property Rights (IPR)**

### **Recommended books: (Latest Edition)**

1. Forensic Pharmacy by B. Suresh

2. Text book of Forensic Pharmacy by B.M. Mithal
3. Hand book of drug law-by M.L. Mehra
4. A text book of Forensic Pharmacy by N.K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
6. Medicinal and Toilet preparations act 1955 by Govt. of India publications.
7. Narcotic drugs and psychotropic substances act by Govt. of India publications
8. Drugs and Magic Remedies act by Govt. of India publication
9. Bare Acts of the said laws published by Government. Reference books (Theory)

**SEMESTER VI**



## BP601T. MEDICINAL CHEMISTRY – III (Theory)

45 Hours

**Scope:** This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

**Objectives:** Upon completion of the course student shall be able to

1. Understand the importance of drug design and different techniques of drug design.
2. Understand the chemistry of drugs with respect to their biological activity.
3. Know the metabolism, adverse effects and therapeutic value of drugs.
4. Know the importance of SAR of drugs.

### Course Content:

**Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (\*)**

#### UNIT – I

10 Hours

##### Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

**-Lactam antibiotics:** Penicillin, Cephalosporins, - Lactamase inhibitors, Monobactams

**Aminoglycosides:** Streptomycin, Neomycin, Kanamycin

**Tetracyclines:** Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

#### UNIT – II

10 Hours

##### Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

**Macrolide:** Erythromycin Clarithromycin, Azithromycin.

**Miscellaneous:** Chloramphenicol\*, Clindamycin.

**Prodrugs:** Basic concepts and application of prodrugs design.

**Antimalarials:** Etiology of malaria.

**Quinolines:** SAR, Quinine sulphate, Chloroquine\*, Amodiaquine, Primaquine phosphate, Pamaquine\*, Quinacrine hydrochloride, Mefloquine.

**Biguanides and dihydro triazines:** Cycloguanil pamoate, Proguanil.

**Miscellaneous:** Pyrimethamine, Artesunate, Artemether, Atovaquone.

### UNIT – III

**10 Hours**

#### **Anti-tubercular Agents**

**Synthetic anti tubercular agents:** Isoniazid\*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.\*

**Anti tubercular antibiotics:** Rifampicin, Rifabutin, Cycloserine Streptomycine, Capreomycin sulphate.

#### **Urinary tract anti-infective agents**

**Quinolones:** SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin\*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin

**Miscellaneous:** Furazolidine, Nitrofurantoin\*, Methanamine.

#### **Antiviral agents:**

Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir\*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

### UNIT – IV

**08 Hours**

#### **Antifungal agents:**

**Antifungal antibiotics:** Amphotericin-B, Nystatin, Natamycin, Griseofulvin.

**Synthetic Antifungal agents:** Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconazole, Miconazole\*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate\*.

**Anti-protozoal Agents:** Metronidazole\*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine.

**Anthelmintics:** Diethylcarbamazine citrate\*, Thiabendazole, Mebendazole\*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin.

### **Sulphonamides and Sulfones**

Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfoxazole, Sulphamethizine, Sulfacetamide\*, Sulphapyridine, Sulfamethoxazole\*, Sulphadiazine, Mefenide acetate, Sulfasalazine.

**Folate reductase inhibitors:** Trimethoprim\*, Cotrimoxazole.

**Sulfones:** Dapsone\*.

## **UNIT – V**

**07 Hours**

### **Introduction to Drug Design**

Various approaches used in drug design.

Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis.

Pharmacophore modeling and docking techniques.

**Combinatorial Chemistry:** Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis.

## BP607P. MEDICINAL CHEMISTRY- III (Practical)

4 Hours / week

### **I Preparation of drugs and intermediates**

- 1 Sulphanilamide
- 2 7-Hydroxy, 4-methyl coumarin
- 3 Chlorobutanol
- 4 Triphenyl imidazole
- 5 Tolbutamide
- 6 Hexamine

### **II Assay of drugs**

- 1 Isonicotinic acid hydrazide
- 2 Chloroquine
- 3 Metronidazole
- 4 Dapsone
- 5 Chlorpheniramine maleate
- 6 Benzyl penicillin

### **III Preparation of medicinally important compounds or intermediates by Microwave irradiation technique**

### **IV Drawing structures and reactions using chem draw®**

### **V Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5)**

### **Recommended Books (Latest Editions)**

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.

7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

## BP602 T. PHARMACOLOGY-III (Theory)

45 Hours

**Scope:** This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition, emphasis on the principles of toxicology and chronopharmacology.

**Objectives:** Upon completion of this course the student should be able to:

1. understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
2. comprehend the principles of toxicology and treatment of various poisonings and
3. appreciate correlation of pharmacology with related medical sciences.

### Course Content:

#### UNIT-I

10hours

##### 1. Pharmacology of drugs acting on Respiratory system

- a. Anti -asthmatic drugs
- b. Drugs used in the management of COPD
- c. Expectorants and antitussives
- d. Nasal decongestants
- e. Respiratory stimulants

##### 2. Pharmacology of drugs acting on the Gastrointestinal Tract

- a. Antiulcer agents.
- b. Drugs for constipation and diarrhoea.
- c. Appetite stimulants and suppressants.
- d. Digestants and carminatives.
- e. Emetics and anti-emetics.

#### UNIT-II

10hours

##### 3. Chemotherapy

- a. General principles of chemotherapy.
- b. Sulfonamides and cotrimoxazole.
- c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides

#### UNIT-III

10hours

##### 3. Chemotherapy

- a. Antitubercular agents
- b. Antileprotic agents

- c. Antifungal agents
- d. Antiviral drugs
- e. Anthelmintics
- f. Antimalarial drugs
- g. Antiamoebic agents

#### **UNIT-IV**

**08hours**

#### **3. Chemotherapy**

- l. Urinary tract infections and sexually transmitted diseases.
- m. Chemotherapy of malignancy.

#### **4. Immunopharmacology**

- a. Immunostimulants
- b. Immunosuppressant

Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

#### **UNIT-V**

**07hours**

#### **5. Principles of toxicology**

- a. Definition and basic knowledge of acute, subacute and chronic toxicity.
- b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity
- c. General principles of treatment of poisoning
- d. Clinical symptoms and management of barbiturates, morphine, organophosphorus compound and lead, mercury and arsenic poisoning.

#### **6. Chronopharmacology**

- a. Definition of rhythm and cycles.
- b. Biological clock and their significance leading to chronotherapy.

## BP 608 P. PHARMACOLOGY-III (Practical)

4Hrs/Week

1. Dose calculation in pharmacological experiments
2. Antiallergic activity by mast cell stabilization assay
3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.
4. Study of effect of drugs on gastrointestinal motility
5. Effect of agonist and antagonists on guinea pig ileum
6. Estimation of serum biochemical parameters by using semi- autoanalyser
7. Effect of saline purgative on frog intestine
8. Insulin hypoglycemic effect in rabbit
9. Test for pyrogens ( rabbit method)
10. Determination of acute oral toxicity (LD50) of a drug from a given data
11. Determination of acute skin irritation / corrosion of a test substance
12. Determination of acute eye irritation / corrosion of a test substance
13. Calculation of pharmacokinetic parameters from a given data
14. Biostatistics methods in experimental pharmacology( student's t test, ANOVA)
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)

*\*Experiments are demonstrated by simulated experiments/videos*

### Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs. The Point Lippincott Williams & Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert,
8. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata,
9. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,
10. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology.



## **BP 603 T. HERBAL DRUG TECHNOLOGY (Theory)**

**45 hours**

**Scope:** This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs

**Objectives:** Upon completion of this course the student should be able to:

1. understand raw material as source of herbal drugs from cultivation to herbal drug product
2. know the WHO and ICH guidelines for evaluation of herbal drugs
3. know the herbal cosmetics, natural sweeteners, nutraceuticals
4. appreciate patenting of herbal drugs, GMP .

### **Course content:**

#### **UNIT-I**

**11 Hours**

##### **Herbs as raw materials**

Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation

Source of Herbs

Selection, identification and authentication of herbal materials

Processing of herbal raw material

##### **Biodynamic Agriculture**

Good agricultural practices in cultivation of medicinal plants including Organic farming.

Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.

##### **Indian Systems of Medicine**

a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy

b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika, Churna, Lehya and Bhasma.

#### **UNIT-II**

**7 Hours**

##### **Nutraceuticals**

General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases.

Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina

**Herbal-Drug and Herb-Food Interactions:** General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

#### **UNIT-III**

**10 Hours**

##### **Herbal Cosmetics**

Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.

**Herbal excipients:**

Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.

**Herbal formulations :**

Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes

**UNIT- IV**

**10 Hours**

**Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs  
Stability testing of herbal drugs.

**Patenting and Regulatory requirements of natural products:**

- a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy
- b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.

**Regulatory Issues** - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.

**UNIT-V**

**07 Hours**

**General Introduction to Herbal Industry**

Herbal drugs industry: Present scope and future prospects.

A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.

**Schedule T – Good Manufacturing Practice of Indian systems of medicine**

Components of GMP (Schedule – T) and its objectives

Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.

## **BP 609 P. HERBAL DRUG TECHNOLOGY (Practical)**

**4 hours/ week**

1. To perform preliminary phytochemical screening of crude drugs.
2. Determination of the alcohol content of Asava and Arista
3. Evaluation of excipients of natural origin
4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.
5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.
6. Monograph analysis of herbal drugs from recent Pharmacopoeias
7. Determination of Aldehyde content
8. Determination of Phenol content
9. Determination of total alkaloids

### **Recommended Books: (Latest Editions)**

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale
4. Essential of Pharmacognosy by Dr.S.H.Ansari
5. Pharmacognosy & Phytochemistry by V.D.Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

## BP 604 T. BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory)

45 Hours

**Scope:** This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arising therein.

**Objectives:** Upon completion of the course student shall be able to:

1. Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
2. Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
3. To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
4. Understand various pharmacokinetic parameters, their significance & applications.

### Course Content:

#### UNIT-I Hours

10

#### Introduction to Biopharmaceutics

**Absorption:** Mechanisms of drug absorption through GIT, factors influencing drug absorption through GIT, absorption of drug from Non per oral extra-vascular routes, **Distribution** Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs

#### UNIT- II Hours

10

**Elimination:** Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs

**Bioavailability and Bioequivalence:** Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

#### UNIT- III

10 Hours

**Pharmacokinetics:** Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters -  $K_E$ ,  $t_{1/2}$ ,  $V_d$ ,  $AUC$ ,  $K_a$ ,  $Cl_t$  and  $CL_R$ - definitions methods of eliminations, understanding of their significance and application

**UNIT- IV****08 Hours**

**Multicompartment models:** Two compartment open model. IV bolus

Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.

**UNIT- V****07 Hours**

**Nonlinear Pharmacokinetics:** a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.

**Recommended Books: (Latest Editions)**

1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.
2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari
3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition, Prentice-Hall International edition. USA
4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal, Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: By Milo Gibaldi Donald, R. Mercei Dekker Inc.
6. Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
7. Biopharmaceutics; By Swarbrick
8. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company, Pennsylvania 1989.
11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Robert F Notari Marcel Dekker Inc, New York and Basel, 1987.
12. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvania



## **BP 605 T. PHARMACEUTICAL BIOTECHNOLOGY (Theory)**

**45 Hours**

### **Scope:**

- Biotechnology has a long promise to revolutionize the biological sciences and technology.
- Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technology makes the subject interesting.
- Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs.
- Biotechnology has already produced transgenic crops and animals and the future promises lot more.
- It is basically a research-based subject.

**Objectives:** Upon completion of the subject student shall be able to;

1. Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
2. Genetic engineering applications in relation to production of pharmaceuticals
3. Importance of Monoclonal antibodies in Industries
4. Appreciate the use of microorganisms in fermentation technology

### **Unit I**

**10 Hours**

- a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.
- b) Enzyme Biotechnology- Methods of enzyme immobilization and applications.
- c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries.
- d) Brief introduction to Protein Engineering.
- e) Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.
- f) Basic principles of genetic engineering.

### **Unit II**

**10 Hours**

- a) Study of cloning vectors, restriction endonucleases and DNA ligase.
- b) Recombinant DNA technology. Application of genetic engineering in medicine.
- c) Application of r DNA technology and genetic engineering in the production of:
  - i) Interferon
  - ii) Vaccines- hepatitis- B
  - iii) Hormones-Insulin.
- d) Brief introduction to PCR

### **Unit III**

**10 Hours**

Types of immunity- humoral immunity, cellular immunity

- a) Structure of Immunoglobulins
- b) Structure and Function of MHC
- c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.
- d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.
- e) Storage conditions and stability of official vaccines
- f) Hybridoma technology- Production, Purification and Applications
- g) Blood products and Plasma Substitutes.

### **Unit IV**

**08Hours**

- a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting.
- b) Genetic organization of Eukaryotes and Prokaryotes
- c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.
- d) Introduction to Microbial biotransformation and applications.
- e) Mutation: Types of mutation/mutants.

### **Unit V**

**07 Hours**

- a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.
- b) Large scale production fermenter design and its various controls.
- c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,
- d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substitutes.

#### **Recommended Books (Latest edition):**

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C.
2. RA Goldshy et. al., : Kuby Immunology.
3. J.W. Goding: Monoclonal Antibodies.
4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal



Society of Chemistry.

5. Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio.
6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication.
7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

## **BP606TPHARMACEUTICAL QUALITY ASSURANCE (Theory)**

**45 Hours**

**Scope:** This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.

**Objectives:** Upon completion of the course student shall be able to:

- understand the cGMP aspects in a pharmaceutical industry
- appreciate the importance of documentation
- understand the scope of quality certifications applicable to pharmaceutical industries
- understand the responsibilities of QA & QC departments

**Course content:**

### **UNIT – I**

**10 Hours**

**Quality Assurance and Quality Management concepts:** Definition and concept of Quality control, Quality assurance and GMP

**Total Quality Management (TQM):** Definition, elements, philosophies

**ICH Guidelines:** purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines

**Quality by design (QbD):** Definition, overview, elements of QbD program, tools

**ISO 9000 & ISO14000:** Overview, Benefits, Elements, steps for registration

**NABL accreditation :** Principles and procedures

### **UNIT - II**

**10 Hours**

**Organization and personnel:** Personnel responsibilities, training, hygiene and personal records.

**Premises:** Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.

**Equipments and raw materials:** Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.

### **UNIT – III**

**10 Hours**

**Quality Control:** Quality control test for containers, rubber closures and secondary packing

materials.

**Good Laboratory Practices:** General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities

#### **UNIT – IV**

**08 Hours**

**Complaints:** Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.

**Document maintenance in pharmaceutical industry:** Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.

#### **UNIT – V**

**07 Hours**

**Calibration and Validation:** Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.

**Warehousing:** Good warehousing practice, materials management

#### **Recommended Books: (Latest Edition)**

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations, 2<sup>nd</sup> Edition, Sandy Weinberg Vol. 69.
3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications.
4. A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's – P P Sharma.
6. ISO 9000 and Total Quality Management – Sadhank G Ghosh
7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
8. Good laboratory Practices – Marcel Deckker Series
9. ICH guidelines, ISO 9000 and 14000 guidelines

**SEMESTER VII**

## **BP701T. INSTRUMENTAL METHODS OF ANALYSIS (Theory)**

**45 Hours**

**Scope:** This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

**Objectives:** Upon completion of the course the student shall be able to

1. Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
2. Understand the chromatographic separation and analysis of drugs.
3. Perform quantitative & qualitative analysis of drugs using various analytical instruments.

### **Course Content:**

#### **UNIT –I**

**10 Hours**

##### **UV Visible spectroscopy**

Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations.

Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode.

Applications - Spectrophotometric titrations, Single component and multi component analysis

##### **Fluorimetry**

Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications

#### **UNIT –II**

**10 Hours**

##### **IR spectroscopy**

Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations

Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications

**Flame Photometry**-Principle, interferences, instrumentation and applications

**Atomic absorption spectroscopy-** Principle, interferences, instrumentation and applications

**Nepheloturbidometry-** Principle, instrumentation and applications

**UNIT –III**

**10 Hours**

**Introduction to chromatography**

**Adsorption and partition column chromatography-**Methodology, advantages, disadvantages and applications.

**Thin layer chromatography-** Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications.

**Paper chromatography-**Introduction, methodology, development techniques, advantages, disadvantages and applications

**Electrophoresis–** Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications

**UNIT –IV**

**08 Hours**

**Gas chromatography -** Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications

**High performance liquid chromatography (HPLC)-**Introduction, theory, instrumentation, advantages and applications.

**UNIT –V**

**07 Hours**

**Ion exchange chromatography-** Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications

**Gel chromatography-** Introduction, theory, instrumentation and applications

**Affinity chromatography-** Introduction, theory, instrumentation and applications

## **BP705P. INSTRUMENTAL METHODS OF ANALYSIS (Practical)**

**4 Hours/Week**

- 1 Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds
- 2 Estimation of dextrose by colorimetry
- 3 Estimation of sulfanilamide by colorimetry
- 4 Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy
- 5 Assay of paracetamol by UV- Spectrophotometry
- 6 Estimation of quinine sulfate by fluorimetry
- 7 Study of quenching of fluorescence
- 8 Determination of sodium by flame photometry
- 9 Determination of potassium by flame photometry
- 10 Determination of chlorides and sulphates by nephelo turbidometry
- 11 Separation of amino acids by paper chromatography
- 12 Separation of sugars by thin layer chromatography
- 13 Separation of plant pigments by column chromatography
- 14 Demonstration experiment on HPLC
- 15 Demonstration experiment on Gas Chromatography

### **Recommended Books (Latest Editions)**

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

## BP 702 T. INDUSTRIAL PHARMACYII (Theory)

45 Hours

**Scope:** This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market

**Objectives:** Upon completion of the course, the student shall be able to:

1. Know the process of pilot plant and scale up of pharmaceutical dosage forms
2. Understand the process of technology transfer from lab scale to commercial batch
3. Know different Laws and Acts that regulate pharmaceutical industry
4. Understand the approval process and regulatory requirements for drug products

### Course Content:

#### UNIT-I

10 Hours

**Pilot plant scale up techniques:** General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology

#### UNIT-II

10 Hours

**Technology development and transfer:** WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues

#### UNIT-III

10 Hours

**Regulatory affairs:** Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals

**Regulatory requirements for drug approval:** Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies.



**UNIT-IV****08 Hours**

**Quality management systems:** Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP

**UNIT-V****07 Hours**

**Indian Regulatory Requirements:** Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.

**Recommended Books: (Latest Editions)**

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7<sup>th</sup> April available at [http://en.wikipedia.org/wiki/Regulatory\\_Affairs](http://en.wikipedia.org/wiki/Regulatory_Affairs).
2. International Regulatory Affairs Updates, 2005. available at <http://www.iraup.com/about.php>
3. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.
4. Regulatory Affairs brought by learning plus, inc. available at <http://www.cgmp.com/ra.htm>.

## **BP 703T. PHARMACY PRACTICE (Theory)**

**45 Hours**

**Scope:** In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. In community pharmacy, students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up.

**Objectives:** Upon completion of the course, the student shall be able to

1. know various drug distribution methods in a hospital
2. appreciate the pharmacy stores management and inventory control
3. monitor drug therapy of patient through medication chart review and clinical review
4. obtain medication history interview and counsel the patients
5. identify drug related problems
6. detect and assess adverse drug reactions
7. interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states
8. know pharmaceutical care services
9. do patient counseling in community pharmacy;
10. appreciate the concept of Rational drug therapy.

### **Unit I:**

**10 Hours**

#### **a) Hospital and its organization**

Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions.

#### **b) Hospital pharmacy and its organization**

Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.

#### **c) Adverse drug reaction**

Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting

drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.

**d) Community Pharmacy**

Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.

**Unit II:**

**10 Hours**

**a) Drug distribution system in a hospital**

Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs.

**b) Hospital formulary**

Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.

**c) Therapeutic drug monitoring**

Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring.

**d) Medication adherence**

Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.

**e) Patient medication history interview**

Need for the patient medication history interview, medication interview forms.

**f) Community pharmacy management**

Financial, materials, staff, and infrastructure requirements.

**Unit III:**

**10 Hours**

**a) Pharmacy and therapeutic committee**

Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation.

**b)  
information services**

**Drug**

Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.

**c) Patient counseling**

Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist

**d) Education and training program in the hospital**

Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education.

**e) Prescribed medication order and communication skills**

Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients.

**Unit IV 8 Hours**

**a) Budget preparation and implementation**

Budget preparation and implementation

**b) Clinical Pharmacy**

Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care.

Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern.

**c) Over the counter (OTC) sales**

Introduction and sale of over the counter, and Rational use of common over the counter medications.

**Unit V 7 Hours**

**a) Drug store management and inventory control**

Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure

**b) Investigational use of drugs**

Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.

**c) Interpretation of Clinical Laboratory Tests**

Blood chemistry, hematology, and urinalysis

**Recommended Books (Latest Edition):**

1. Merchant S.H. and Dr. J.S.Quadry. *A textbook of hospital pharmacy*, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.
2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. *A textbook of Clinical Pharmacy Practice- essential concepts and skills*, 1<sup>st</sup> ed. Chennai: Orient Longman Private Limited; 2004.
3. William E. Hassan. *Hospital pharmacy*, 5th ed. Philadelphia: Lea & Febiger; 1986.
4. Tipnis Bajaj. *Hospital Pharmacy*, 1<sup>st</sup> ed. Maharashtra: Career Publications; 2008.
5. Scott LT. *Basic skills in interpreting laboratory data*, 4th ed. American Society of Health System Pharmacists Inc; 2009.
6. Parmar N.S. *Health Education and Community Pharmacy*, 18th ed. India: CBS Publishers & Distributers; 2008.

**Journals:**

1. Therapeutic drug monitoring. ISSN: 0163-4356
2. Journal of pharmacy practice. ISSN : 0974-8326
3. American journal of health system pharmacy. ISSN: 1535-2900 (online)
4. Pharmacy times (Monthly magazine)

## **BP 704T: NOVEL DRUG DELIVERY SYSTEMS (Theory)**

**45 Hours**

**Scope:** This subject is designed to impart basic knowledge on the area of novel drug delivery systems.

**Objectives:** Upon completion of the course student shall be able

1. To understand various approaches for development of novel drug delivery systems.
2. To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation

### **Course content:**

#### **Unit-I**

**10 Hours**

**Controlled drug delivery systems:** Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations

**Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.

#### **Unit-II**

**10 Hours**

**Microencapsulation:** Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications

**Mucosal Drug Delivery system:** Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems

**Implantable Drug Delivery Systems:** Introduction, advantages and disadvantages, concept of implants and osmotic pump

#### **Unit-III**

**10 Hours**

**Transdermal Drug Delivery Systems:** Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches

**Gastroretentive drug delivery systems:** Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications

**Nasopulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers

#### **Unit-IV**

**08 Hours**

**Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications

**Unit-V**

**07 Hours**

**Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts

**Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications

**Recommended Books: (Latest Editions)**

1. Y W. Chien, Novel Drug Delivery Systems, 2<sup>nd</sup> edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

**Journals**

1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian Drugs (IDMA)
3. Journal of Controlled Release (Elsevier Sciences)
4. Drug Development and Industrial Pharmacy (Marcel & Decker)
5. International Journal of Pharmaceutics (Elsevier Sciences)

**SEMESTER VIII**



## **BP801T. BIOSTATISTICS AND RESEARCH METHODOLOGY (Theory)**

**45 Hours**

**Scope:** To understand the applications of Biostatistics in Pharmacy. This subject deals with descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, Non Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R and MINITAB statistical software's, analyzing the statistical data using Excel.

**Objectives:** Upon completion of the course the student shall be able to

- Know the operation of M.S. Excel, SPSS, R and MINITAB<sup>®</sup>, DoE (Design of Experiment)
- Know the various statistical techniques to solve statistical problems
- Appreciate statistical techniques in solving the problems.

### **Course content:**

#### **Unit-I**

**10 Hours**

**Introduction:** Statistics, Biostatistics, Frequency distribution

**Measures of central tendency:** Mean, Median, Mode- Pharmaceutical examples

**Measures of dispersion:** Dispersion, Range, standard deviation, Pharmaceutical problems

**Correlation:** Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples

#### **Unit-II**

**10 Hours**

**Regression:** Curve fitting by the method of least squares, fitting the lines  $y = a + bx$  and  $x = a + by$ , Multiple regression, standard error of regression- Pharmaceutical Examples

**Probability:** Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties - problems

Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples

**Parametric test:** t-test(Sample, Pooled or Unpaired and Paired), ANOVA, (One way and Two way), Least Significance difference

#### **Unit-III**

**10 Hours**

**Non Parametric tests:** Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test

**Introduction to Research:** Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism

**Graphs:** Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph

**Designing the methodology:** Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.

#### **Unit-IV**

**8 Hours**

Blocking and confounding system for Two-level factorials

**Regression modeling:** Hypothesis testing in Simple and Multiple regression models

**Introduction to Practical components of Industrial and Clinical Trials Problems:**

Statistical Analysis Using Excel, SPSS, MINITAB<sup>®</sup>, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach

#### **Unit-V**

**7Hours**

**Design and Analysis of experiments:**

**Factorial Design:** Definition,  $2^2$ ,  $2^3$  design. Advantage of factorial design

**Response Surface methodology:** Central composite design, Historical design, Optimization Techniques

#### **Recommended Books (Latest edition):**

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. New York.
2. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha
3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam,
4. Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery

## **BP 802T SOCIAL AND PREVENTIVE PHARMACY**

**Hours: 45**

### **Scope:**

The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmes. The roles of the pharmacist in these contexts are also discussed.

### **Objectives:**

After the successful completion of this course, the student shall be able to:

- Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.
- Have a critical way of thinking based on current healthcare development.
- Evaluate alternative ways of solving problems related to health and pharmaceutical issues

### **Course content:**

#### **Unit I:**

**10 Hours**

**Concept of health and disease:** Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick.

**Social and health education:** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.

**Sociology and health:** Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health

**Hygiene and health:** personal hygiene and health care; avoidable habits

#### **Unit II:**

**10 Hours**

**Preventive medicine:** General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse

#### **Unit III:**

**10 Hours**

**National health programs, its objectives, functioning and outcome of the following:** HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National

programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.

**Unit IV:**

**08 Hours**

National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program

**Unit V:**

**07 Hours**

Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.

**Recommended Books (Latest edition):**

1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2<sup>nd</sup> Edition, 2010, ISBN: 9789380704104, JAYPEE Publications
2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4<sup>th</sup> Edition, 2013, ISBN: 9789350901878, JAYPEE Publications
3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6<sup>th</sup> Edition, 2014, ISBN: 9789351522331, JAYPEE Publications
4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2<sup>nd</sup> Edition, 2012, ISBN: 9789350250440, JAYPEE Publications
5. Park Textbook of Preventive and Social Medicine, K Park, 21<sup>st</sup> Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS.
6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

**Recommended Journals:**

1. Research in Social and Administrative Pharmacy, Elsevier, Ireland

## **BP803ET. PHARMA MARKETING MANAGEMENT (Theory)**

**45 Hours**

### **Scope:**

The pharmaceutical industry not only needs highly qualified researchers, chemists and, technical people, but also requires skilled managers who can take the industry forward by managing and taking the complex decisions which are imperative for the growth of the industry. The Knowledge and Know-how of marketing management groom the people for taking a challenging role in Sales and Product management.

**Course Objective:** The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.

### **Unit I**

**10 Hours**

#### **Marketing:**

Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior.

#### **Pharmaceutical market:**

Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation & targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.

### **Unit II**

**10 Hours**

#### **Product decision:**

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

### **Unit III**

**10 Hours**

#### **Promotion:**

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

**Unit IV****10 Hours****Pharmaceutical marketing channels:**

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

**Professional sales representative (PSR):**

Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.

**Unit V****10 Hours****Pricing:**

Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).

**Emerging concepts in marketing:**

Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.

**Recommended Books: (Latest Editions)**

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



## **BP804 ET: PHARMACEUTICAL REGULATORY SCIENCE (Theory)**

**45Hours**

**Scope:** This course is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like US, EU, Japan, Australia, UK etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

**Objectives:** Upon completion of the subject student shall be able to;

1. Know about the process of drug discovery and development
2. Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
3. Know the regulatory approval process and their registration in Indian and international markets

### **Course content:**

#### **Unit I**

**10Hours**

##### **New Drug Discovery and development**

Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

#### **Unit II**

**10Hours**

##### **Regulatory Approval Process**

Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.

##### **Regulatory authorities and agencies**

Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)

#### **Unit III**

**10Hours**

##### **Registration of Indian drug product in overseas market**

Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical



Document (eCTD), ASEAN Common Technical Document (ACTD)research.

#### **Unit IV**

**08Hours**

##### **Clinical trials**

Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials

#### **Unit V**

**07Hours**

##### **Regulatory Concepts**

Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book

##### **Recommended books (Latest edition):**

1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences, Vol.185. Informa Health care Publishers.
3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5<sup>th</sup> edition, Drugs and the Pharmaceutical Sciences, Vol.190.
4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons. Inc.
5. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus.
6. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143
7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams
8. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene
9. Drugs: From Discovery to Approval, Second Edition By Rick Ng

## **BP 805T: PHARMACOVIGILANCE (Theory)**

**45 hours**

**Scope:** This paper will provide an opportunity for the student to learn about development of pharmacovigilance as a science, basic terminologies used in pharmacovigilance, global scenario of Pharmacovigilance, train students on establishing pharmacovigilance programme in an organization, various methods that can be used to generate safety data and signal detection. This paper also develops the skills of classifying drugs, diseases and adverse drug reactions.

### **Objectives:**

*At completion of this paper it is expected that students will be able to (know, do, and appreciate):*

1. Why drug safety monitoring is important?
2. History and development of pharmacovigilance
3. National and international scenario of pharmacovigilance
4. Dictionaries, coding and terminologies used in pharmacovigilance
5. Detection of new adverse drug reactions and their assessment
6. International standards for classification of diseases and drugs
7. Adverse drug reaction reporting systems and communication in pharmacovigilance
8. Methods to generate safety data during pre clinical, clinical and post approval phases of drugs' life cycle
9. Drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation
10. Pharmacovigilance Program of India (PvPI) requirement for ADR reporting in India
11. ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning
12. CIOMS requirements for ADR reporting
13. Writing case narratives of adverse events and their quality.

## **Course Content**

### **Unit I**

**10 Hours**

#### **Introduction to Pharmacovigilance**

- History and development of Pharmacovigilance
- Importance of safety monitoring of Medicine
- WHO international drug monitoring programme
- Pharmacovigilance Program of India(PvPI)

#### **Introduction to adverse drug reactions**

- Definitions and classification of ADRs
- Detection and reporting
- Methods in Causality assessment
- Severity and seriousness assessment
- Predictability and preventability assessment
- Management of adverse drug reactions

#### **Basic terminologies used in pharmacovigilance**

- Terminologies of adverse medication related events
- Regulatory terminologies

## **Unit II**

**10 hours**

### **Drug and disease classification**

- Anatomical, therapeutic and chemical classification of drugs
- International classification of diseases
- Daily defined doses
- International Non proprietary Names for drugs

### **Drug dictionaries and coding in pharmacovigilance**

- WHO adverse reaction terminologies
- MedDRA and Standardised MedDRA queries
- WHO drug dictionary
- Eudravigilance medicinal product dictionary

### **Information resources in pharmacovigilance**

- Basic drug information resources
- Specialised resources for ADRs

### **Establishing pharmacovigilance programme**

- Establishing in a hospital
- Establishment & operation of drug safety department in industry
- Contract Research Organisations (CROs)
- Establishing a national programme

## **Unit III**

**10 Hours**

### **Vaccine safety surveillance**

- Vaccine Pharmacovigilance
- Vaccination failure
- Adverse events following immunization

### **Pharmacovigilance methods**

- Passive surveillance – Spontaneous reports and case series
- Stimulated reporting
- Active surveillance – Sentinel sites, drug event monitoring and registries
- Comparative observational studies – Cross sectional study, case control study and cohort study
- Targeted clinical investigations

### **Communication in pharmacovigilance**

- Effective communication in Pharmacovigilance
- Communication in Drug Safety Crisis management
- Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media

## Unit IV

8 Hours

### Safety data generation

- Pre clinical phase
- Clinical phase
- Post approval phase (PMS)

### ICH Guidelines for Pharmacovigilance

- Organization and objectives of ICH
- Expedited reporting
- Individual case safety reports
- Periodic safety update reports
- Post approval expedited reporting
- Pharmacovigilance planning
- Good clinical practice in pharmacovigilance studies

## Unit V

7 hours

### Pharmacogenomics of adverse drug reactions

- Genetics related ADR with example focusing PK parameters.

### Drug safety evaluation in special population

- Paediatrics
- Pregnancy and lactation
- Geriatrics

### CIOMS

- CIOMS Working Groups
- CIOMS Form

### CDSCO (India) and Pharmacovigilance

- D&C Act and Schedule Y
- Differences in Indian and global pharmacovigilance requirements

### Recommended Books (Latest edition):

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.
2. Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.
3. Mann's Pharmacovigilance: Elizabeth B. Andrews, Nicholas, Wiley Publishers.
4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers.
5. An Introduction to Pharmacovigilance: Patrick Waller, Wiley Publishers.
6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert, Jones & Bartlett Publishers.
7. Textbook of Pharmacoepidemiology edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy, Wiley Publishers.
8. A Textbook of Clinical Pharmacy Practice -Essential Concepts and Skills: G. Parthasarathi, Karin Nyfort Hansen, Milap C. Nahata
9. National Formulary of India
10. Text Book of Medicine by Yashpal Munjal

11. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna

12. <http://www.who/umc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=7297>
13. <http://www.ich.org/>
14. <http://www.cioms.ch/>
15. <http://cdsco.nic.in/>
16. [http://www.who.int/vaccine\\_safety/en/](http://www.who.int/vaccine_safety/en/)
17. [http://www.ipc.gov.in/PvPI/pv\\_home.html](http://www.ipc.gov.in/PvPI/pv_home.html)

## **BP 806 ET. QUALITY CONTROL AND STANDARDIZATION OF HERBALS (Theory)**

**Scope:** In this subject the student learns about the various methods and guidelines for evaluation and standardization of herbs and herbal drugs. The subject also provides an opportunity for the student to learn cGMP, GAP and GLP in traditional system of medicines.

**Objectives:** Upon completion of the subject student shall be able to;

1. know WHO guidelines for quality control of herbal drugs
2. know Quality assurance in herbal drug industry
3. know the regulatory approval process and their registration in Indian and international markets
4. appreciate EU and ICH guidelines for quality control of herbal drugs

### **Unit I**

**10 hours**

Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms

WHO guidelines for quality control of herbal drugs.

Evaluation of commercial crude drugs intended for use

### **Unit II**

**10 hours**

**Quality assurance in herbal drug industry** of cGMP, GAP, GMP and GLP in traditional system of medicine.

WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines

WHO Guidelines on GACP for Medicinal Plants.

### **Unit III**

**10 hours**

EU and ICH guidelines for quality control of herbal drugs.

Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines

### **Unit IV**

**08 hours**

Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products.

Preparation of documents for new drug application and export registration

GMP requirements and Drugs & Cosmetics Act provisions.

## Unit V

07 hours

Regulatory requirements for herbal medicines.

WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems

Comparison of various Herbal Pharmacopoeias.

Role of chemical and biological markers in standardization of herbal products

### Recommended Books: (Latest Editions)

1. Pharmacognosy by Trease and Evans
2. Pharmacognosy by Kokate, Purohit and Gokhale
3. Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I , Carrier Pub., 2006.
4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.
5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products,
6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.
8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.
9. WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981.
10. WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.
11. WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.
12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.



## BP 807 ET. COMPUTER AIDED DRUG DESIGN (Theory)

45 Hours

**Scope:** This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.

**Objectives:** Upon completion of the course, the student shall be able to understand

- Design and discovery of lead molecules
- The role of drug design in drug discovery process
- The concept of QSAR and docking
- Various strategies to develop new drug like molecules.
- The design of new drug molecules using molecular modeling software

### Course Content:

#### UNIT-I

10 Hours

##### Introduction to Drug Discovery and Development

Stages of drug discovery and development

##### Lead discovery and Analog Based Drug Design

Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.

**Analog Based Drug Design:** Bioisosterism, Classification, Bioisosteric replacement. Any three case studies

#### UNIT-II

10 Hours

##### Quantitative Structure Activity Relationship (QSAR)

SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammett's substituent constant and Taft's steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

#### UNIT-III

10 Hours

##### Molecular Modeling and virtual screening techniques

**Virtual Screening techniques:** Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening,

**Molecular docking:** Rigid docking, flexible docking, manual docking, Docking based screening. *De novo* drug design.

**UNIT-IV****08 Hours****Informatics & Methods in drug design**

Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.

**UNIT-V****07 Hours**

**Molecular Modeling:** Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minima determination.

**Recommended Books (Latest Editions)**

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Park Press Baltimore.
2. Martin YC. "Quantitative Drug Design" Dekker, New York.
3. Delgado JN, Remers WA eds "Wilson & Gisvold's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.
4. Foye WO "Principles of Medicinal chemistry 'Lea & Febiger.
5. Koro Ikovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.
6. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" John Wiley & Sons, New York.
7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
8. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.
9. Silverman R.B. "The organic Chemistry of Drug Design and Drug Action" Academic Press New York.

**BP808ET: CELL AND MOLECULAR BIOLOGY (Elective subject)**

**45 Hours**

**Scope:**

- Cell biology is a branch of biology that studies cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function.
- This is done both on a microscopic and molecular level.
- Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organisms such as humans, plants, and sponges.

**Objectives:** Upon completion of the subject student shall be able to;

- Summarize cell and molecular biology history.
- Summarize cellular functioning and composition.
- Describe the chemical foundations of cell biology.
- Summarize the DNA properties of cell biology.
- Describe protein structure and function.
- Describe cellular membrane structure and function.
- Describe basic molecular genetic mechanisms.
- Summarize the Cell Cycle

**Course content:**

**Unit I**

**10Hours**

- a) Cell and Molecular Biology: Definitions theory and basics and Applications.
- b) Cell and Molecular Biology: History and Summation.
- c) Properties of cells and cell membrane.
- d) Prokaryotic versus Eukaryotic
- e) Cellular Reproduction
- f) Chemical Foundations – an Introduction and Reactions (Types)

**Unit II**

**10 Hours**

- a) DNA and the Flow of Molecular Information
- b) DNA Functioning
- c) DNA and RNA
- d) Types of RNA
- e) Transcription and Translation

**Unit III**

**10 Hours**

- a) Proteins: Defined **and** Amino Acids
- b) Protein Structure

- c) Regularities in Protein Pathways
- d) Cellular Processes
- e) Positive Control and significance of Protein Synthesis

**Unit IV**

**08 Hours**

- a) Science of Genetics
- b) Transgenics and Genomic Analysis
- c) Cell Cycle analysis
- d) Mitosis and Meiosis
- e) Cellular Activities and Checkpoints

**Unit V**

**07 Hours**

- a) Cell Signals: Introduction
- b) Receptors for Cell Signals
- c) Signaling Pathways: Overview
- d) Misregulation of Signaling Pathways
- e) Protein-Kinases: Functioning

**Recommended Books (latest edition):**

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4<sup>th</sup> edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Pepler: Microbial Technology.
9. Edward: Fundamentals of Microbiology.
10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
11. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company
12. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C.
13. RA Goldshy et. al., : Kuby Immunology.

## BP809ET. COSMETIC SCIENCE(Theory)

45Hours

### UNIT I

10Hours

Classification of cosmetic and cosmeceutical products

Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs

**Cosmetic excipients:** Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application

**Skin:** Basic structure and function of skin.

**Hair:** Basic structure of hair. Hair growth cycle.

**Oral Cavity:** Common problem associated with teeth and gums.

### UNIT II

10 Hours

**Principles of formulation and building blocks of skin care products:**

Face wash,

Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals.

**Antiperspirants & deodorants-** Actives & mechanism of action.

**Principles of formulation and building blocks of Hair care products:**

Conditioning shampoo, Hair conditioner, anti-dandruff shampoo.

Hair oils.

Chemistry and formulation of Para-phenylene diamine based hair dye.

Principles of formulation and building blocks of oral care products:

Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.

### UNIT III

10 Hours

Sun protection, Classification of Sunscreens and SPF.

**Role of herbs in cosmetics:**

Skin Care: Aloe and turmeric

Hair care: Henna and amla.

Oral care: Neem and clove

**Analytical cosmetics:** BIS specification and analytical methods for shampoo, skin-cream and toothpaste.

### UNIT IV

08 Hours.

Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties

Soaps, and syndet bars. Evolution and skin benefits.

## **UNIT V**

**07 Hours**

Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis.

Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes

Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor.

Antiperspirants and Deodorants- Actives and mechanism of action

### **References**

- 1) Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin.
- 2) Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4<sup>th</sup> Edition, Vandana Publications Pvt. Ltd., Delhi.
- 3) Text book of cosmeticology by Sanju Nanda & Roop K. Khar, Tata Publishers.

## BP810 ET. PHARMACOLOGICAL SCREENING METHODS

45 Hours

**Scope:** This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.

### Objectives

Upon completion of the course the student shall be able to,

- Appreciate the applications of various commonly used laboratory animals.
- Appreciate and demonstrate the various screening methods used in preclinical research
- Appreciate and demonstrate the importance of biostatistics and research methodology
- Design and execute a research hypothesis independently

<b>Unit –I</b>	<b>08 Hours</b>
<b>Laboratory Animals:</b> Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.	
<b>Unit –II</b>	<b>10 Hours</b>
<b>Preclinical screening models</b> a. Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. b. <b>Study of screening animal models for</b> Diuretics, nootropics, anti-Parkinson's, antiasthmatics, <b>Preclinical screening models:</b> for CNS activity- analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease	

<p><b>Unit –III</b></p> <p><b>Preclinical screening models:</b> for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics</p>	
<p><b>Unit –IV</b></p> <p><b>Preclinical screening models:</b> for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslipidemic, anti aggregatory, coagulants, and anticoagulants</p> <p>Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.</p>	
<p><b>Research methodology and Bio-statistics</b></p> <p>Selection of research topic, review of literature, research hypothesis and study design</p> <p>Pre-clinical data analysis and interpretation using Students ‘t’ test and One-way ANOVA. Graphical representation of data</p>	<b>05 Hours</b>

**Recommended Books (latest edition):**

1. Fundamentals of experimental Pharmacology-by M.N.Ghosh
2. Hand book of Experimental Pharmacology-S.K.Kulakarni
3. CPCSEA guidelines for laboratory animal facility.
4. Drug discovery and Evaluation by Vogel H.G.
5. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta
6. Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard



## **BP 811 ET. ADVANCED INSTRUMENTATION TECHNIQUES**

**45 Hours**

**Scope:** This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic hyphenated techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

**Objectives:** Upon completion of the course the student shall be able to

- understand the advanced instruments used and its applications in drug analysis
- understand the chromatographic separation and analysis of drugs.
- understand the calibration of various analytical instruments
- know analysis of drugs using various analytical instruments.

### **Course Content:**

#### **UNIT-I**

**10 Hours**

##### **Nuclear Magnetic Resonance spectroscopy**

Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications

**Mass Spectrometry-** Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications

#### **UNIT-II**

**10 Hours**

**Thermal Methods of Analysis:** Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)

**X-Ray Diffraction Methods:** Origin of X-rays, basic aspects of crystals, X-ray

Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications.

#### **UNIT-III**

**10 Hours**

**Calibration and validation-**as per ICH and USFDA guidelines

##### **Calibration of following Instruments**

Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer,

Fluorimeter, Flame Photometer, HPLC and GC

**UNIT-IV**

**08 Hours**

**Radio immune assay:**Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay

**Extraction techniques:**General principle and procedure involved in the solid phase extraction and liquid-liquid extraction

**UNIT-V**

**07 Hours**

**Hyphenated techniques-LC-MS/MS, GC-MS/MS, HPTLC-MS.**

**Recommended Books (Latest Editions)**

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

## **BP 812 ET. DIETARY SUPPLEMENTS AND NUTRACEUTICALS**

**No. of hours :3**

**Tutorial:1**

**Credit point:4**

### **Scope :**

This subject covers foundational topics that are important for understanding the need and requirements of dietary supplements among different groups in the population.

### **Objective:**

This module aims to provide an understanding of the concepts behind the theoretical applications of dietary supplements. By the end of the course, students should be able to :

1. Understand the need of supplements by the different group of people to maintain healthy life.
2. Understand the outcome of deficiencies in dietary supplements.
3. Appreciate the components in dietary supplements and the application.
4. Appreciate the regulatory and commercial aspects of dietary supplements including health claims.

### **UNIT I**

**07 hours**

- a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc.
- b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.
- c. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds

### **UNIT II**

**15 hours**

Phytochemicals as nutraceuticals: Occurrence and characteristic features(chemical nature medicinal benefits) of following

- a) Carotenoids- and -Carotene, Lycopene, Xanthophylls, leutin
- b) Sulfides: Diallyl sulfides, Allyl trisulfide.
- c) Polyphenolics: Resveratrol
- d) Flavonoids- Rutin , Naringin, Quercetin, Anthocyanidins, catechins, Flavones
- e) Prebiotics / Probiotics.: Fructo oligosaccharides, Lacto bacillum
- f) Phyto estrogens : Isoflavones, daidzein, Geobustin, lignans
- g) Tocopherols
- h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.

### **UNIT III**

**07 hours**

- a) Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids.

- b) Dietary fibres and complex carbohydrates as functional food ingredients..

#### **UNIT IV**

**10 hours**

- a) Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing.
- b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, - Lipoic acid, melatonin  
Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole.
- c) Functional foods for chronic disease prevention

#### **UNIT V**

**06 hours**

- a) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals.
- b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods.
- c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.

#### **References:**

1. Dietetics by Sri Lakshmi
2. Role of dietary fibres and nutraceuticals in preventing diseases by K.T Agusti and P.Faizal: BSPublication.
3. Advanced Nutritional Therapies by Cooper. K.A., (1996).
4. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).
5. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2<sup>nd</sup> Edn., Avery Publishing Group, NY (1997).
6. G. Gibson and C.williams Editors *2000 Functional foods* Woodhead Publ.Co.London.
7. Goldberg, I. *Functional Foods*. 1994. Chapman and Hall, New York.
8. Labuza, T.P. 2000 Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf Life Testing in *Essentials of Functional Foods* M.K. Sachmidl and T.P. Labuza eds. Aspen Press.
9. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)
10. Shils, ME, Olson, JA, Shike, M. 1994 *Modern Nutrition in Health and Disease*. Eighth edition. Lea and Febiger

**Semester VIII – Elective course on Pharmaceutical Product Development**

**No of Hours: 3**

**Tutorial:1**

**Credit points:4**

**Unit-I**

**10 Hours**

Introduction to pharmaceutical product development, objectives, regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms

**Unit-II**

**10 Hours**

An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories

- i. Solvents and solubilizers
- ii. Cyclodextrins and their applications
- iii. Non - ionic surfactants and their applications
- iv. Polyethylene glycols and sorbitols
- v. Suspending and emulsifying agents
- vi. Semi solid excipients

**Unit-III**

**10 Hours**

An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories

- i. Tablet and capsule excipients
- ii. Directly compressible vehicles
- iii. Coat materials
- iv. Excipients in parenteral and aerosols products
- v. Excipients for formulation of NDDS

Selection and application of excipients in pharmaceutical formulations with specific industrial applications

**Unit-IV**

**08 Hours**

Optimization techniques in pharmaceutical product development. A study of various optimization techniques for pharmaceutical product development with specific examples. Optimization by factorial designs and their applications. A study of QbD and its application in pharmaceutical product development.

**Unit-V**

**07 Hours**

Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.



### **Recommended Books (Latest editions)**

1. Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, CharlesBon; Marcel Dekker Inc.
2. Encyclopedia of Pharmaceutical Technology, edited by James swarbrick, Third Edition, Informa Healthcare publishers.
3. Pharmaceutical Dosage Forms, Tablets, Volume II, edited by Herbert A. Lieberman andLeon Lachman; Marcel Dekker, Inc.
4. The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by Roop kKhar, S P Vyas, Farhan J Ahmad, Gaurav K Jain; CBS Publishers and Distributors Pvt.Ltd. 2013.
5. Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition, edited by Patrick J. Sinko, BI Publications Pvt. Ltd.
6. Targeted and Controlled Drug Delivery, Novel Carrier Systems by S. P. Vyas and R. K.Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2012.
7. Pharmaceutical Dosage Forms and Drug Delivery Systems, Loyd V. Allen Jr., Nicholas B.Popovich, Howard C. Ansel, 9th Ed. 40
8. Aulton's Pharmaceutics – The Design and Manufacture of Medicines, Michael E. Aulton,3rd Ed.
9. Remington – The Science and Practice of Pharmacy, 20th Ed.
10. Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, A. Liberman, Leon Lachman andJoseph B. Schwartz
11. Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, H.A. Liberman, Martin, M.R and Gilbert S. Banker.
12. Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 & 2, Kenneth E. Avis andH.A. Libermann.
13. Advanced Review Articles related to the topics.