



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

Course Structure & Syllabus for B.Pharm.(Regular)
R13 Regulations

B. PHARMACY

I YEAR

S.No	Course Code	Subject	Th	Tu/	Lab.	Credits
1.	13R00101	Remedial Mathematics (for Bi.P.C stream)	3	1	-	5
	13R00102	Remedial Biology (for M.P.C stream)	(2)	(1)	-	(3)
	13R00107	Remedial Biology Lab(for M.P.C stream)*	-	-	(2)	(2)
2.	13R52101	Communicative English	2	-	-	3
3.	13R00103	General and Dispensing Pharmacy	3	1	-	5
4.	13R00104	Pharmaceutical Inorganic Chemistry	3	1	-	5
5.	13R00105	Pharmaceutical Organic Chemistry -I	3	1	-	5
6.	13R00106	Anatomy, Physiology and Health education	3	1	-	5
7.	13R00108	General and Dispensing Pharmacy Lab	-	-	3	3
8.	13R00109	Pharmaceutical Inorganic Chemistry Lab	-	-	3	3
9.	13R00110	Pharmaceutical Organic Chemistry -I Lab	-	-	3	3
10.	13R00111	Anatomy, Physiology and Health Education Lab	-	-	3	3
Total Credits						40

*** Remedial biology lab for M.P.C stream students shall be in alternate weeks while the evaluation of internal and end examination shall be as an independent lab.**

II - I Semester

S.No	Course code	Subject	Theory	Tu / Lab	Credits
1	13R00301	Pharmaceutical Analysis-I	3	1 -	3
2	13R00302	Pharmaceutical Engineering-I	2	1 -	2
3	13R00303	Pharmaceutical Organic Chemistry-II	3	1 -	3
4	13R00304	Physical Pharmacy-I	3	1 -	3
5	13R00305	Anatomy, Physiology & Pathophysiology	3	1 -	3
6	13R00306	Pharmaceutical Analysis-I Lab	-	- 3	2
7	13R00307	Pharmaceutical Organic Chemistry-II Lab	-	- 3	2
8	13R00308	Physical Pharmacy-I Lab	-	- 3	2
9	13R00309	Anatomy, Physiology & Pathophysiology Lab	-	- 3	2
Total Credits					22

II - II Semester

S.No	Course code	Subject	Theory	Tu / Lab	Credits
1	13R00401	Environmental Science and Ethics	2	1 -	2
2	13R00402	Pharmaceutical Engineering-II	3	1 -	3
3	13R00403	Pharmaceutical Biochemistry	3	1 -	3
4	13R00404	Pharmacognosy-I	3	1 -	3
5	13R00405	Physical Pharmacy-II	3	1 -	3
6	13R00406	Pharmaceutical Engineering-II Lab	-	- 3	2
7	13R00407	Pharmaceutical Biochemistry Lab	-	- 3	2
8	13R00408	Pharmacognosy-I Lab	-	- 3	2
9	13R00409	Physical Pharmacy-II Lab	-	- 3	2
Total Credits					22

III - I Semester

S.No	Course code	Subject	Theory	Tu / Lab	Credits
1	13R00501	Medicinal Chemistry-I	3	1 -	3
2	13R00502	Pharmaceutical Microbiology	3	1 -	3
3	13R00503	Pharmacognosy-II	3	1 -	3
4	13R00504	Pharmaceutical Technology-I	3	1 -	3
5	13R00505	Pharmacology-I	2	1 -	2
6	13R00506	Medicinal Chemistry-I Lab	-	- 3	2
7	13R00507	Pharmaceutical Microbiology Lab	-	- 3	2
8	13R00508	Pharmacognosy-II Lab	-	- 3	2
9	13R00509	Pharmaceutical Technology-I Lab	-	- 3	2
Total Credits					22

III - II Semester

S.No	Course code	Subject	Theory	Tu / Lab	Credits
1	13R00601	Medicinal Chemistry-II	3	1 -	3
2	13R00602	Pharmaceutical Technology-II	3	1 -	3
3	13R00603	Pharmacology-II	3	1 -	3
4	13R00604	Pharmaceutical Analysis-II	3	1 -	3
5	13R00605	Pharmaceutical Jurisprudence	2	1 -	2
6	13R00606	Medicinal Chemistry-II Lab	-	- 3	2
7	13R00607	Pharmaceutical Technology-II Lab	-	- 3	2
8	13R00608	Pharmacology-II Lab	-	- 3	2
9	13R00609	Pharmaceutical Analysis-II Lab	-	- 3	2
10	13R52601	Communication Skills Lab (Audit Course)	-	- 3	-
Total Credits					22

IV - I Semester

S.No	Course code	Subject	Theory	Tu / Lab	Credits
1	13R00701	Pharmacognosy-III	3	1 -	3
2	13R00702	Biopharmaceutics and Pharmacokinetics	3	1 -	3
3	13R00703	Pharmacology-III	3	1 -	3
4	13R00704	Medicinal Chemistry-III	3	1 -	3
5	13R00705	Pharmaceutical Industry Management and Quality Assurance	2	1 -	2
6	13R00706	Pharmacognosy-III Lab	-	- 3	2
7	13R00707	Biopharmaceutics and Pharmacokinetics Lab	-	- 3	2
8	13R00708	Pharmacology-III Lab	-	- 3	2
9	13R00709	Medicinal Chemistry-III Lab	-	- 3	2
10	13R00710	Industrial Visit (Audit Course)	-	- -	-
Total Credits					22

IV - II Semester

S.No	Course code	Subject	Theory	Tu / Lab	Credits
1	13R00801	Novel Drug Delivery Systems	3	1 -	3
2	13R00802	Pharmaceutical Biotechnology	3	1 -	3
3	13R00803	Chemistry of Natural Drugs	3	1 -	3
4	13R00804	Statistical Methods and Computer Applications	3	1 -	3
5	13R00805	Clinical and Hospital Pharmacy	2	1 -	2
6	13R00806	Novel Drug Delivery Systems Lab	-	- 3	2
7	13R00807	Pharmaceutical Biotechnology Lab	-	- 3	2
8	13R00808	Chemistry of Natural Drugs Lab	-	- 3	2
9	13R00809	Statistical Methods and Computer Applications Lab	-	- 3	2
	13R00810	Project Work	-	- -	8
Total Credits					30

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	REMEDIAL MATHEMATICS	Code	13R00101
Course year	B. Pharm I year	Semester	N/A
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	5	Pre-requisite	Biology at 10+2 level

UNIT I: Algebra

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

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.

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.*
3. *Grewal B. S. Numerical Methods Khanna Publishers.*
4. *Steve Dobbs & Jane, Miller Advanced Level Mathematics Statistics, Cambridge University Press.*
5. *Adams Dany Spencer Laboratory Mathematics Carrol & Graphs.*
6. *Jenny Olive Maths. A Students Survival Guide Cambridge University Press.*
7. *James R Barrante Applied Mathematics for Physical Chemistry (II ED.) Prentice Hall Incorporations.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	REMEDIAL BIOLOGY	Code	13R00102
Course year	B. Pharm I year	Semester	N/A
Theory	2 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
credits	3	Pre-requisite	Maths at 10+2 level

UNIT I

Plant and animal cell: Detailed structure. Structure, types and functions of chromosomes. Structure, types and functions of nucleic acids. Cell cycle and its regulators. Mitosis, meiosis, different types of 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. Simple and compound microscopes used in biology; section cutting; staining and mounting of sections.

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. Comparative gross anatomical features of frog, rat and rabbit.

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.*
4. *A manual for pharmaceutical biology practicals by S.B.Gokhale and C.K.Gokhale.*
5. *A text book of botany by Linda R. Berg.*
6. *Cell and molecular biology by Peter J. Russel, Stephen L. Wolfe, Paul E. Hertz.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	COMMUNICATIVE ENGLISH	Code	13R52101
Course year	B. Pharm I year	Semester	N/A
Theory	2 hrs/week	Tutorial	NIL
End exam	70 marks	Internal	30 marks
Credits	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 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 Technology. The prescribed books serve the purpose of preparing them for everyday communication and to face global competitions in future.

The first 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 student-centered. They should be encouraged to participate in the classroom activities keenly.

The text for non-detailed study is meant for extensive reading/reading for pleasure by the students. They may be encouraged to read some selected topics on their own, which could lead into a classroom discussion. In addition to the exercises from the texts done in the class, the teacher can bring variety by using authentic materials such as newspaper articles, advertisements, promotional material etc.

Course Objective:

- 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 for pleasure.
- To enhance the study skills of the students with emphasis on LSRW skills.

Learning Outcome:

- The students will get the required training in LSRW skills through the prescribed texts and develop communicative competence.

UNIT I

Chapter entitled ‘Humour’ from “Using English”

Chapter entitled ‘Biography - (Homi Jehangir Bhabha)’ from “New Horizons”

Listening - Techniques - Importance of phonetics

L- Meet & Greet and Leave taking, Introducing Oneself and Others (Formal and Informal situations)

R- Reading Strategies -Skimming and Scanning

W- Writing strategies- sentence structures

G-Parts of Speech –Noun-number, pronoun-personal pronoun, verb- analysis

V-Affixes-prefix and suffix, root words, derivatives

UNIT II

Chapter entitled ‘Inspiration’ from “Using English”

Chapter entitled ‘Biography - (Jagadish Chandra Bose)’ from “New Horizons”

L- Listening to details

S- Apologizing, Interrupting, Requesting and Making polite conversations

R- Note making strategies

W- Paragraph-types- topic sentences, unity, coherence, length , linking devices
G-Auxiliary verbs and question tags
V- synonyms-antonyms, homonyms, homophones, homographs, words often confused

UNIT III

Chapter entitled ‘Sustainable Development’ from “Using English”

Chapter entitled ‘Short Story - (The Happy Prince)’ from “New Horizons”

L- Listening to themes and note taking

S- Giving instructions and Directions, making suggestions, Accepting ideas, fixing a time and Advising

R- Reading for details -1

W- Resume and cover letter

G- Tenses – Present tense, Past tense and Future tense

V-Word formation and One-Word Substitutes

UNIT IV

Chapter entitled ‘Relationships’ from “Using English”

Chapter entitled ‘Poem - (IF by Rudyard Kipling)’ from “New Horizons”

L- Listening to news

S- Narrating stories, Expressing ideas and opinions and telephone skills

R- Reading for specific details and Information

W- Technical Report writing-strategies, formats-types-technical report writing

G- Voice and Subject–Verb Agreement

V- Idioms and prepositional Phrases

UNIT V

Chapter entitled ‘Science and Humanism’ from “Using English”

Chapter entitled ‘Autobiography - (My Struggle for an Education by Booker T.Washington)’ from “New Horizons”

L- Listening to speeches

S- Making Presentations and Group Discussions

R- Reading for Information

W- E-mail drafting

G- Conditional clauses and conjunctions

V- Collocations and Technical Vocabulary and using words appropriately

TEXT BOOKS:

1. *Using English* published by Orient Black Swan.
2. *New Horizons* published by Pearson.

REFERENCES:

1. *Raymond Murphy’s English Grammar with CD*, Murphy, Cambridge University Press, 2012.
2. *English Conversation Practice* –Grant Taylor, Tata McGraw Hill, 2009.
3. *Communication Skills*, Sanjay Kumar & Pushpalatha Oxford University Press, 2012.
4. *A Course in Communication Skills*- Kiranmai Dutt & co. Foundation Books, 2012.
5. *Living English Structures*- William Standard Allen-Pearson, 2011.
6. *Current English Grammar and Usage*, S M Gupta, PHI, 2013.
7. *Modern English Grammar*-Krishna SWAMI,McMillan, 2009.
8. *Powerful Vocabulary Builder*- Anjana Agarwal, New Age International Publishers, 2011.Basic Communication Skills for Technology, Andrea J Ruthurford, Pearson Education, Asia.
9. Longman Dictionary of Contemporary English with DVD, Pearson Longman.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Subject	GENERAL AND DISPENSING PHARMACY	Code	13R00103
Course year	B. Pharm I year	Semester	N/A
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal	30 marks
Credits	5		

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

Extraction and Galenical products: Principle and methods of extraction, dry and soft liquid extracts. (Infusion, decoction, maceration and percolation)

UNIT V Incompatibilities

Introduction, definitions, classifications, Physical, chemical and therapeutic incompatibilities – methods of overcoming and handling of prescriptions with 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.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL INORGANIC CHEMISTRY	Code	13R00104
Course year	B. Pharm I year	Semester	N/A
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	5		

UNIT I Basic concepts of Pharmaceutical inorganic chemistry

Introduction to various 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* / Limit tests* of the compounds mentioned in Unit III to Unit V (*ONLY FOR COMPOUNDS OFFICIAL IN INDIAN PHARMACOPOEIA)*

UNIT III Electrolytes, Mineral supplements and Dental products

Electrolytes: Sodium chloride, compound sodium chloride solution (Ringer's solution), potassium chloride, ORS, calcium gluconate, dibasic calcium phosphate, calcium chloride, sodium bicarbonate, sodium lactate, sodium citrate/potassium citrate, sodium acetate, 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, calcium phosphate, sodium metaphosphate, zinc oxide 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: Dicalcium phosphate, magnesium stearate, talc and calcium carbonate (Precipitated chalk), bentonite, colloidal silica. titanium oxide, ferric oxide.

UNIT V Gastro-intestinal agents and other medicinal agents

Dilute hydrochloric acid, sodium acid phosphate, sodium bicarbonate, aluminium hydroxide gel, dried aluminium hydroxide gel, magnesium oxide (Magnesia), magnesium hydroxide mixture, magnesium trisilicate. Light kaolin, heavy kaolin and activated charcoal. Magnesium sulphate,

sodium phosphate, potassium antimony tartarate, copper sulphate, sodium thiosulphate, sodium nitrite, ammonium chloride and potassium iodide.

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.*

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 Yark 1984*
5. *Indian Pharmacopoeia 1996, 2007.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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<i>Subject</i>	PHARMACEUTICAL ORGANIC CHEMISTRY-I	<i>Code</i>	13R00105
<i>Course year</i>	B. Pharm I year	<i>Semester</i>	N/A
<i>Theory</i>	3 hrs/week	<i>Tutorial</i>	1hr/week
<i>End exam</i>	70 marks	<i>Internal exam</i>	30 marks
<i>Credits</i>	5		

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^3 , SP^2 , 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 effects in organic molecules: inductive effect, electromeric, mesomeric effect, hyperconjugation, concept of resonance and stability. Types of organic reagents and reactions.

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

UNIT II Study of Hydrocarbons:

Alkenes: Electrophilic addition reactions of alkenes, Markovnikow's rule, anti-Markovnikow's rule, Kharasch effect, Bayer's oxidation (cis-hydroxylation, polymerisation).

Alkadienes: stability of conjugated dienes, 1,2 and 1,4 addition reactions of conjugated alkadienes.

Alkynes: Acidity of 1-alkynes, formation of metal acetylides, stereo specific reduction of alkynes, addition of hydrogen halide (HCl), 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 SN^2 , Walden inversion, elimination reaction and Saytzeff's rule.

UNIT III

Aromatic Hydrocarbons: Kekule's structure of benzene, bond lengths, heats 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.

Halogen Compounds-Aromatic: Nomenclature, low reactivity of halobenzenes towards nucleophilic substitution, arenes, Benzyne ion concept.

Polynuclear aromatic hydrocarbons: Nomenclature, structure and aromatic character of naphthalene, anthracene, phenanthrene and naphthacene resonance structures, electron density and reactivity, electrophilic substitution, oxidation and reduction reactions.

UNIT IV

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 Ponderff Verley reduction.

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

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.

Nitro compounds: Nomenclature, acidity of nitro compounds containing α - 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.

UNIT V

Carbonyl Compounds, Carboxylic acids and their derivatives:

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.

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.

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. *Organic chemistry*, Bruice 6th Edition, Pearson Publisher, 2010.
2. *Reactions and Mechanism*, Jerry March, 4th edition Wiley Publication.
3. *Organic chemistry*, Carey, 8th 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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Subject	ANATOMY PHYSIOLOGY AND HEALTH EDUCATION	Code	13R00106
Course year	B. Pharm I year	Semester	N/A
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	5		

UNIT I: Cells and tissues

Scope of anatomy and physiology, basic terminology used in these subjects. Structure of cell, its components and their functions. Body fluids, biological molecules and homeostasis. Elementary tissues of the human body: epithelial, connective, muscular and nervous tissues, their sub types and characteristics.

Haemopoietic system: Composition and functions of blood and its elements, blood groups and their significance and mechanism of blood coagulation.

UNIT II: Cardiovascular system

Basic anatomy of the heart, physiology of heart, blood vessels and circulation. Basic pulmonary, coronary and hepatic system. Understanding of cardiac cycle, heart sounds and electrocardiogram. Blood pressure and its regulation.

Lymph and Lymphatic System: Composition, formation and circulation of lymph; Basic anatomy and physiology of spleen.

UNIT III: Musculoskeletal system

Structure, composition and functions of skeleton, Joints, classification of joints, types of movements of synovial joints, gross anatomy and physiology of muscle contraction and physiological properties of skeletal muscles.

UNIT IV:

Digestive System: Gross anatomy of the gastro-intestinal tract, functions of its different parts including those of liver, pancreas and gall bladder, various gastrointestinal secretions and their role in the absorption and digestion of food.

Respiratory System: Gross anatomy of respiratory tract, functions of its different parts; mechanism and regulation of respiration, respiratory volumes and vital capacity.

UNIT V:

Concepts of health & disease: Disease causing agents and prevention of disease. Balanced diet and nutritional deficiency disorders.

First Aid: Emergency treatment of shock, snakebites, burns, poisoning, fractures and resuscitation methods.

Demography and family planning: Demography cycle, population problem, family planning and various contraceptive methods.

Brief outline of communicable diseases: Causative agents, modes of transmission and prevention of the following diseases- Chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis, poliomyelitis, hepatitis, cholera, typhoid, food poisoning, helminthiasis, malaria, filariasis, rabies, trachoma, tetanus, leprosy, syphilis, gonorrhoea and AIDS.

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 13th Edition.*

4. *Textbook of Medical Physiology, Guyton, AC Guyton WB Saunders Company, 1995. 12th Edition*
Saunders's – Elsevier.

REFERENCES:

1. *Essential of Human Anatomy & Physiology, Elaine N. Marieb 6th Edition Benjamin eumming's.*
2. *Fundamentals of Anatomy & Physiology, Rizzo, Cengage learning (2009) 3rd Edition.*
3. *Human Anatomy, Mc Kinley, Mc Graw Hill 2009.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

<i>Subject</i>	REMEDIAL BIOLOGY LAB	<i>Code</i>	13R00107
<i>Course year</i>	B. Pharm I year	<i>Semester</i>	N/A
<i>Practical</i>	3 hrs/week	<i>Tutorial</i>	NIL
<i>End exam</i>	50 marks	<i>Internal</i>	25 marks
<i>Credits</i>	2		

I. EXPERIMENTS:

- a) Care and uses of microscope
- b) Gross identification of permanent slides of structure and life cycle of plants/animals mentioned in the theory syllabus.
- c) Morphology of plant parts indicated in theory.
- d) Preparation, Microscopic Examination of stem, root and leaf of mono and dicot leaves.
- e) Structure of human parasites and insects mentioned in the theory with the help of specimen.
- f) Anatomical features of different organs of frog and rabbit using charts.

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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	GENERAL AND DISPENSING PHARMACY LAB	Code	13R00108
Course year	B. Pharm I year	Semester	N/A
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
Credits	3		

I. EXPERIMENTS

- a) Dispensing of prescriptions falling under the categories: Mixtures, syrups, solutions, emulsions, creams, ointments, powders, lotions, liniments, elixirs, tincture, paints, gargles, gels and mouthwash (minimum two prescriptions from each class).
- b) Identification of physical and chemical incompatibilities in a prescription, and dispensing of such prescriptions (10 Exercise).
- c) Dispensing procedures involving pharmaceutical calculations, and dosage calculations for paediatric and geriatric patients (10 calculations).
- d) Preparation of normal saline and dextrose solutions (4 preparations).

II. DEMO/WORKSHOP

Preparation of Pharmacopoeial extracts and galenical products utilizing various methods of extraction.

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.

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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL INORGANIC CHEMISTRY LAB	Code	13R00109
Course year	B. Pharm I year	Semester	N/A
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
Credits	3		

I. Experiments:

1. Limit tests for the following as per the procedure given in Indian Pharmacopoeia (1996 including the latest addenda)
 - a) Chlorides
 - b) Sulphates
 - c) Heavy metals
 - d) Iron
 - e) Arsenic
 - f) Modifications in limit test for chlorides and sulphates in potassium permanaganate, sodium bicarbonates, sodium benzoates and sodium salicylates.
2. Balances and Weighing: Calibration of weights, Pipette and Burette.
3. Preparation and standardization of Hydrochloric acid solution (0.1N).
4. Preparation and standardization of Potassium permanganate solution(0.1N & 0.1M).
5. Preparation of a primary standard solution of 0.1N Potassium hydrogen-phthalate.
6. Preparation and standardization of 0.1N EDTA solution.
7. Preparation and purification of Boric acid.
8. Preparation and purification of Sodium citrate.
9. Preparation and purification of Potash alum.
10. Preparation and purification of Magnesium stearate.
11. Assay of sodium bicarbonate and assay of Boric acid (Neutralization).
12. Assay of calcium gluconate (or) any calcium compounds (Complexometry).
13. Assay of copper sulphate (Redox titration).
14. Assay of sodium acetate (Non-aqueous titration).
15. Assay of ferrous sulphate (Oxidation-reduction / Redox titration).
16. Swelling power of bentonite
17. Test for purity (Ammonium salts in potash alum, presence of iodates in KI)

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 rule.

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 EQUIPMENTS 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
ANANTHAPURAMU**

Subject	PHARMACEUTICAL ORGANIC CHEMISTRY-I LAB	Code	13R00110
Course year	B. Pharm I year	Semester	N/A
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
Credits	3		

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. α -Halogenation : Preparation of Iodoform from Oxidation of Acetone / Ethanol.
 11. Sulphonation : Preparation of Toluene para sulphonic acid from toluene.
 12. Bromination : Tribromoaniline from Phenol or Aniline.
 13. Addition / elimination : Preparation of phenyl hydrazone or oxime from Benzaldehyde.
- C.** 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, melting point for different crystals of same compound, laboratory safety exercises, atomic models emphasizing hybridization / organic molecules.

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, 5th Edition Pearson.
2. Laboratory Manual of Organic Chemistry, R.K. Bansal, New Age International 5th Edition 2007.
3. Advanced Practical Organic Chemistry, O.P. Agarwal, 3rd Edition Goel Publication.
4. Practical Organic Chemistry, F.G.Mann & B.C. Saunders, Pearson 4th 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

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	ANATOMY, PHYSIOLOGY & HEALTH EDUCATION LAB	Code	13R00111
Course year	B. Pharm I year	Semester	N/A
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
Credits	3		

I. EXPERIMENTS:

1. Study of compound microscope.
2. Microscopic study of different tissues.
3. Study of human skeleton.
4. Estimation of Haemoglobin in blood.
5. Determination of bleeding time.
6. Determination of clotting time.
7. Study of neubar's chamber.
8. Estimation of R.B.C. count.
9. Estimation of W.B.C count.
10. Estimation of D.L.C.
11. Recording of body temperature.
12. Recording of pulse rate and blood pressure.
13. Experiments on spirometry - Determination of vital capacity etc.,
14. Study of different family planning appliances.

II. DEMO/ WORK SHOP

1. Study of different systems with the help of charts and models.
2. Study of ECG : basic understanding of electrocardiogram-PQRST waves and their significance.

III. SEMINAR/ ASSIGNMENT/ GROUP DISCUSSION

1. Lysosomal storage disorders.
2. Vaccination and vaccination schedule.

REFERENCES

1. Practical human anatomy and physiology, S.R.Kale & R.R.Kale, latest edition.
2. Practical Biochemistry, Plummer.
3. Human Anatomy & Physiology, Elaine N. Marieb.
4. Human Physiology, A.K. Chatterjee.

LIST OF LABORATORY REQUIREMENTS

1. Microscopes
2. Glass slides
3. Hemocytometer with micropipettes
4. Sahli's hemoglobinometer
5. Hutchinson's spirometer
6. Sphygmomanometer
7. Stethoscope
8. Permanent slides for various tissues
9. Models for various organs and system
10. Specimens of various organs and systems
11. Skeleton and bones
12. Clinical thermometers
13. ECG graphs
14. Stop clocks
15. Different contraceptive devices and models

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL ANALYSIS – I	Code	13R00301
Course year	B. Pharm. II year	Semester	I
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

a) 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.

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 2007 and 2010.

UNIT II

a) General principles, theory and examples of **oxidation-reduction methods**, permanganometry, cerimetry, 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

a. Principle, instrumentation and applications (IP 2007 and 2010) involved in the following

i. Refractometry ii. Polarimetry

b). Physical and chemical methods of determination of moisture content (including Karl-Fisher method, LOD, IR balance).

c) **Basic Principles (exothermic and endothermic reactions) and applications** of differential thermal analysis (DTA), thermo gravimetric analysis (TGA) and differential scanning calorimetry (DSC)

UNIT V

Study of separations, introduction to chromatography, classifications, types, various stationary and mobile phase in the following techniques and their applications in pharmacy (IP 2007 and 2010).

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

b) Thin layer chromatography: Principle, 1D and 2D techniques, preparation of plates, R_f , R_x , R_m values and detection techniques.

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

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.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL ENGINEERING – I	Code	13R00302
Course year	B. Pharm. II year	Semester	I
Theory	2 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	2		

UNIT I

Introductory concepts: Unit operation / Unit processes, material and energy balance, equilibrium state, rate process, steady and unsteady states, dimensionless groups.

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

UNIT II

Material handling systems

- a. Liquid handling - Study of different types of pumps such as Reciprocating pumps, Turbine pumps and centrifugal pumps.
- b. Gas handling - various types of fans, blowers and compressors.
- c. Solid handling – Conveyor.

UNIT III

Filtration and Centrifugation: Theory of filtration, Factors affecting filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, Air filtration, EQUIPMENTSs and mechanism.

Principles of centrifugation, industrial centrifugal filters, centrifugal filters and centrifugal sediment. Concept of Clarification.

Crystallization: Characteristics of crystals like; purity, size, shape, geometry, habit, forms, Miller indices and factors affecting it. Solubility curves and calculation of yields. Supersaturation theory and its limitations. Nucleation mechanisms, crystal growth. Study of various types of crystallizers such as Swenson walker crystalizer, vacuum crystalizer, Krystal crystalizer. Caking of crystals and its prevention.

UNIT IV

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.

UNIT V

Materials of Construction: General study of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel, glass and polymers.

Industrial hazards and safety precautions: Mechanical, Chemical, Electrical, fire and dust hazards. Industrial dermatities, accident records etc. Basic safety measures.

TEXT BOOKS:

1. S.J. Carter, Cooper and Gunn's Tutorial Pharmacy 6th ed CBS publisher, Delhi.
2. C.V.S. Subramanayam, Pharmaceutial Unit Operation, Vallabh Prakashan
3. K. Samba Murthy, Pharmaceutical Engineering. New Age International Publishers Ltd.
4. Badjer & Banchemo, Introduction to Chemical Engineering. Mc Graw-Hill.
5. Pharmaceutical engineering-I 5th edition 2007-2008 by Girish k.jani.
6. Lachmen L., Lieberman H. A., The Theory and Practice of Industrial Pharmacy, Lee & Febiger, Philadelphia

REFERENCE BOOKS:

1. *Perry's Handbook of Chemical Engineering. 8th Edition Mc Graw-Hill.*
2. *Unit Operations by Mc Cabe & Smith. 5th Edition Mc Graw-Hill.*
3. *Mc Cabe & Smith, Elements of Chemical Engineering. 4th Edition Prentice Hall International.*
4. *Lippincott Williams and Wilkins: Remington Pharmaceutical Sciences.*
5. *EA Rawlins, Bently's Text Book of Pharmaceutics, 8th edition, ELBS*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL ORGANIC CHEMISTRY – II	Code	13R00303
Course year	B. Pharm. II year	Semester	I
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

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 and pericyclic reactions. Optical activity of biphenyl compounds. Octant rule.

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, α , β – glycosidic linkages, enzymatic hydrolysis, structure and physiological importance of Anthraquinone glycosides.

UNIT IV

Amino acids and Proteins: Definition, classification, configuration, methods of preparation of amino acids, 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, 5th 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, 6th Pearson education*
5. *O.P Agarwal, A Textbook of Organic Chemistry*
6. *Eliel, Stereochemistry of Organic compounds.*
7. *Organic reactions, Stereo chemistry & mechanizam by PS Kalsi*

REFERENCE BOOKS:

1. *Jerry March, Advanced Organic Chemistry 4th 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. 6th Edition.*
4. *Solomons, Organic Chemistry 9th Edition Wiley Publication.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHYSICAL PHARMACY – I	Code	13R00304
Course year	B. Pharm. II year	Semester	I
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

Intermolecular forces and states of matter: Binding forces between molecules, the states of matter, the gaseous state, the liquid state, liquid crystalline state and solid state.

Phase rule: Definition and explanation. One component(water system), reduced phase rule equation - two compartment system (phenol - water system).

UNIT II

Thermodynamics: The first law of thermodynamics. The second law of thermodynamics. The 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 their molecular determination) , molecular weight determinations.

Solutions of Electrolytes: Properties of solutions of electrolytes. The Arrhenius theory of electrolyte dissociation. The modern theory of strong electrolytes and other coefficients for expressing colligative properties.

UNIT IV

Ionic equilibria: Activity co-efficient and ionic strength, modern theories of acids, bases and salts, Sorensen's pH scale, concentration as a function of pH, calculation of pH and acidity constants.

UNIT V

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

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*, Vallabh Prakashan.
3. Derle D.V., *Essentials of Physical Pharmacy Pharma Med Press*.
4. Manavalan & Ramaswamy. *Physical pharmaceuticals*. 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. T. Florence and D. Attwood *Physicochemical Principles of Pharmacy*. – 3rd ed. Pharmaceutical Press, 2004.
5. James Swarbrick, *Encyclopedia of pharmaceutical technology*, 3rd ed, informa healthcare
6. Shotton E and Ridgaway K, *Physical Pharmaceuticals Oxford University Press, London*.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY	Code	13R00305
Course year	B. Pharm. II year	Semester	I
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

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, reflex action, electroencephalogram, Specialized functions of the brain, 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.

UNIT II

a. Urinary System: Various parts, structures and functions of the kidney and urinary tract. Physiology of urine formation and acid base balance.

b. Reproductive Systems: Male and Female reproductive systems and their hormones, physiology of menstruation, coitus and fertilization. Sex differentiation, spermatogenesis & oogenesis, pregnancy its maintenance and parturition.

UNIT III

a. Endocrine System: Basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenals, pancreas, testes and ovary, their hormones and functions.

b. Study of sense organs: Structure of eye, ear, nose, skin and tongue along with their detailed functioning.

UNIT IV

a. Basic Principles of Cell Injury, Adaptation & process of inflammation: Causes of cellular injury, pathogenesis, and morphology of cell injury. Cellular adaptations, atrophy, hypertrophy. acute and chronic inflammation, mediators of inflammation, brief outline of the process of repair.

b. Cancer: Classification of tumours, difference between benign and malignant tumours, disturbances of growth of cells, etiology and pathogenesis of cancer, invasions, metastasis and patterns of spread of cancer and histological diagnosis of malignancy.

UNIT V

Pathophysiology of common diseases like epilepsy, psychosis, depression, mania, hypertension, angina, congestive cardiac failure, atherosclerosis, myocardial infarction, rheumatoid arthritis, gout, peptic ulcer, asthma, hepatic disorders, T.B, UTIs and STDs.

TEXT BOOKS:

1. Harsh mohan, text book of pathology, latest edition.
2. Sherword- Principles of Human Physiology. Cenage learning.
3. Ross & Willson, Principles of anatomy and physiology, John wiley & Sons
4. C.C.Chatterjee, Human Physiology, Pub by Medical allied agency, Delhi, India.
5. M.P. Rang, M.N.Dale, J.M Riter Anotomy & Physiology.

REFERENCE BOOKS:

1. Robbins, SL & Kumar, Basic Pathology. 8th Edition Elsewier.
2. Mary V. Buras, Pathophysiology: A self Instructional programme. Prentice Hall.
3. Mary Lou Mulvihill, Human Diseases: A Systemic approach. Prentice Hall 6th Edition.
4. A.C Guyton, Textbook of medicinal physiology by W.B.Prism books Pvt. Ltd., Delhi.
5. Joseph Dipiro, Pathophysiology and applied therapeutics.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL ANALYSIS – I LAB	Code	13R00306
Course year	B. Pharm. II year	Semester	I
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 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-Fischer reagent.
- 13 Identification of amino acids by Ascending/radial paper chromatography.
- 14 Identification of Paracetamol by TLC as per IP-2007.

II. Demo/work shop

1. Demonstration of 2-D TLC of any plant extract.
2. Preparation of column by wet packing method and elution of components either by isocratic or gradient elution technique.

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?

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Fluorimeter
2. Flame photometer
3. Abbe's refractometer
4. Nephelometer and turbidometer
5. Conductivity meter
6. Potentiometer
7. Digital electronic balance
8. Adequate glassware's including iodine flasks.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL ORGANIC CHEMISTRY-II LAB	Code	13R00307
Course year	B. Pharm . II year	Semester	I
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 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, 5th Edition Pearson*.
4. *Laboratory Manual of Organic Chemistry, R.K. Bansal, New Age International 5th Edition 2007*.
5. *Advanced Practical Organic Chemistry, O.P. Agarwal, 3rd Edition Goel Publication*.
6. *Practical Organic Chemistry, F.G.Mann & B.C. Saunders, Pearson 4th 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*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHYSICAL PHARMACY – I LAB	Code	13R00308
Course year	B. Pharm. II year	Semester	I
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
Credits	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. Effect of impurities (1% NaCl) on CST.
9. Lower consolute temperature – TEA (Tri Ethyl Amine) and Water.
9. Phase diagram -Phenol – Water, Effect of Impurities.
10. Ternary phase diagram.
11. Preparation of phosphate Buffers and their Buffer Capacity Determination.

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
3. Polarimeter
4. Abbe's refractometer
5. CST apparatus
6. pH meter
7. Colorimeter
8. Digital balances

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

<i>Subject</i>	ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY – LAB	<i>Code</i>	13R00309
<i>Course year</i>	B. Pharm. II year	<i>Semester</i>	I
<i>Theory</i>	3 hrs/week	<i>Tutorial</i>	NIL
<i>End exam</i>	50 marks	<i>Internal</i>	25 marks
<i>Credits</i>	2		

I. EXPERIMENTAL PART:

1. Study of male and female reproductive systems with the help of charts and models
2. Microscopic studies of abnormal tissue sections.
3. Simple experiments involved in the analysis of normal and abnormal urine; collection of specimen, appearance, determination of pH, sugars, proteins, urea and creatinine.

II. DEMO/ WORK SHOP

1. Physiological experiments on nerve-muscle preparations.
2. Study of simple muscle curve.
3. Study the effect of temperature on muscle contraction.
4. Study the effect of load and after load on muscle contraction.
5. Study the fatigue curve.

III. SEMINAR/ ASSIGNMENT/ GROUP DISCUSSION

1. Advances in the diagnosis of cancer.
2. Advances in the diagnosis of CNS and CVS disorders.
3. Dengue fever and Swine flu.

REFERENCES

1. Plummer, Practical Biochemistry 3rd Edition. Tata-Mc Graw-Hall 2006.
2. Chatterjee, Human Physiology 13th Edition, Rosen Educational Publishing.
3. Practical human anatomy and physiology, S.R.Kale & R.R.Kale, latest edition.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Sherrington's drum
2. Student kymograph
3. Muscle electrodes
4. Lucos moist chamber
5. Myographic lever
6. Stimulator
7. Microscopes
8. pH meter
9. Glass slides for abnormal tissues
10. Adequate glasswares
11. Thermometers

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

<i>Subject</i>	ENVIRONMENTAL SCIENCE AND ETHICS	<i>Code</i>	13R00401
<i>Course year</i>	B. Pharm. II year	<i>Semester</i>	II
<i>Theory</i>	2 hrs/week	<i>Tutorial</i>	1 hr/week
<i>End exam</i>	70 marks	<i>Internal exam</i>	30 marks
<i>Credits</i>	2		

UNIT I

The Multidisciplinary nature of environmental studies: Definition, scope and importance.

Natural Resources and their conservation:

- a. **Forest resources:** Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- b. **Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
- c. **Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d. **Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies
- e. **Energy resources:** Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources, case studies.
- f. **Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

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:

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

UNIT III

Biodiversity and its conservation: Introduction, definition: genetic species and ecosystem diversity.

Biogeographically, classification of India. Value of biodiversity: consumptive use, productive use, and 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 conservation of biodiversity

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.

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.

UNIT IV

Environmental Pollution

Definition, causes, effects and control measures of:

- a) Air pollution, b) Water pollution, c) Soil pollution, d) Marine pollution, e) Noise pollution, f) Thermal pollution and 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.

Environment protection Act- The air (prevention and control of pollution) act 1981. The Water (prevention and control of pollution) act 1974. The wildlife protection Act 1972. The Forest conservation Act 1980. Issues involved in enforcement of environmental legislation. Public awareness.

Human population and the Environment

Population growth, variation among nations. Population explosion – Family welfare programme. 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.

UNIT V

Ethics and morality: Concept of ethics, law, rule and act. Amoralist, subjectivism-first and further thoughts and morality interlude, goodness and role, god, morality, prudence, utilitarianism, moral standards and distinguishing mark of a man.

TEXT BOOKS:

1. *Environmental studies* by K.Mukkanti, S.Chand
2. *Environmental studies*, Dr.R.J.Ranjit Daniel, Dr.Jagadhish Krishnaswamy Wiley India Pvt. Ltd, 2009.
3. *M. Anji Reddy, Text Book of Environmental Sciences & Technology, BS Publications*
4. *Connor, Basic Concepts of Environmental Chemistry, Lewis Publications.*
5. *D.K Asthana and Meera, Text book of Environmental studies. S.Chand 2009.*
6. *Y. Anjaneyulu, Introduction to Environmental Science, B.S. Publication, Hyderabad*
7. *C. Manohar Chary, P Jayram Reddy, Principles of Environmental Studies, Pharma book syndicate.*
8. *Morality: an introduction to ethics by Bernard Williams. Cambridge university press.*

REFERENCE BOOKS:

1. *William P. Cunningham & Mary Ann Cunningham, Principles of Environmental Science - Inquiry & Applications. Mc Graw – Hill.*
2. *W. P. Cooper & et al, Environmental Encyclopedia, Jaico Publishing House, Mumbai.*
3. *K. C. Agarwal, Environmental Biology, Nidi Publishers Ltd, Bikaner.*
4. *Environmental Protection and laws, Himalaya Publ House, New Delhi.*
5. *R.Rajagopalan, Environmental Studies, Oxford University Press.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL ENGINEERING – II	Code	13R00402
Course year	B. Pharm. II year	Semester	II
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

Heat Transfer: Source of heat, heat transfer, steam and electricity as heating media, brief knowledge of heat exchangers. Determination of requirement of amount of steam/electrical energy, steam pressure, boiler capacity, mathematical problems on heat transfer. Reactors and fundamentals of reactors design for chemical reactions.

UNIT II

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

Distillation: Raoult's law, phase diagrams, volatility, simple steam and flash distillations, principles of rectification, Azeotropic, extractive and Molecular distillation

UNIT III

Drying: 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 IV

Size Reduction: Definition, theory and objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mill. Concept of micronization. A brief study of ball mill, hammer mill, fluid energy mill, co mill and multi mill.

Size Separation: Official standards for powders, sieves, modes of motion in size separation. Sieve Analysis – Testing of powders. Equipments for size separation-vibrating screens, cyclone separators.

UNIT V

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.

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. Mc Cabe & Smith. Unit Operations. Mc Graw-Hill.
5. Pharmaceutical Engineering-II 5th edition 2007-2008 by Girish K.Jani.
6. L. Lachman, H. Lieberman & J.B.Schwartz. Pharmaceutical dosage forms volume-II, 2nd ed., marcel dekker Inc.

REFERENCE BOOKS:

1. W.I. Macebe and J. C. Smith Macro, Unit Operations to Chemical Engineering, Hill Int. Book Co., London. Mc Graw-Hill.
2. L. Lachman, H. Lieberman & J. L Kaniz, The Theory And Practice Of Industrial Pharmacy, Lee & Febiger Philadelphia, USA
3. Badzer & Banchoro, Introduction to Chemical Engineering. Tata – Mc Graw Hill.
4. Perry's Handbook of Chemical Engineering Mc Graw – Hill.
5. M.E.Aulton, Pharmaceutics- The science of dosage form design, 2nd edition Churchill Livingstone.
6. E.A. Rawlin's, Bentley's Text Book of Pharmaceutics, 8th ed ELBS

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL BIOCHEMISTRY	Code	13R00403
Course year	B. Pharm . II year	Semester	II
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I: Cell Processes, Bioenergetic and Cellular Reactions

Bio chemical organization of the cell, molecular constituents of membrane, active & passive transport process, sodium and potassium pumps, osmoregulation and homeostasis. The concept of free energy, determination of change in free energy from equilibrium constant & reduction potential. Production of ATP and its biological significance. Redox reactions, redox potential, the respiratory chain & its role in energy capture & its control. Oxidative phosphorylation & its energetics & E.T.C mechanism.

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 drug action, Isoenzymes, Coenzymes from Vitamins, Nucleotides and non-nucleotides. clinical importance of 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' 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 aminoacids, concept of essential and nonessential amino acids and their importance in deamination, Trans-amination, 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 Mc Graw 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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACOGNOSY-I	Code	13R00404
Course year	B. Pharm. II year	Semester	II
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

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

UNIT II

Classification of drugs of natural origin.

- A) 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

Adulteration: Definition, types, Evaluation of bio drugs-Macroscopic, Microscopic, physical, Chemical and biological.

UNIT IV

- 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.
 B) Definition, classification and properties of tannins. Study of tannins & tannin containing drugs-Gambir, Black catechu, Myrobalan & Arjuna.

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, spermaceti and olive oil.

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. Peach K and Tracey MV, *Modern methods of Plant analysis*, Narose publishing house, New Delhi.
4. *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.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHYSICAL PHARMACY – II	Code	13R00405
Course year	B. Pharm. II year	Semester	II
Theory	3 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

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: Types, classification, mechanism of complex formation, advantages of complexations. Metal complexes, organic molecular complexes, inclusion complexes, methods of analysis and drug action.

UNIT II

Kinetics: Introduction to the concept of kinetics and their application in pharmacy. Concept of zero order, first order, and pseudo order reactions. Determination of reaction order. Half life period ($t_{1/2}$), period 90 (t_{90}) and their usefulness. Influence of temperature and Arrhenious theory. Decomposition and stabilization of medicinal agents, accelerated stability testing of drugs and determination of shelf life period.

UNIT III

Interfacial Phenomena: Liquid interfaces, 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 scale. Adsorption at solid interfaces. Electrical properties of interfaces.

UNIT IV

Micromeritics: Particle size and size distribution, methods for determining surface area, methods for determining particle size, pore size, particle shape and surface area, derived properties of powders.

Rheology: Newtons law of flow, Newtonian systems, non-Newtonian systems, thixotropy, measurement and applications in formulations. Determination of viscosity and its applications.

UNIT V

Colloids: Introduction, types of colloidal systems, solubilization, Stability of colloids, optical properties, kinetic properties, electrical properties and Donnan Membrane equilibrium.

Coarse Dispersions:

Suspensions: Types and theories of suspensions, interfacial properties of suspended particles, stability evaluation, settling in suspensions and formulation of suspensions.

Emulsions: Theories of emulsification, physical stability of emulsions, preservation of emulsions, Rheological properties of emulsions and suspensions.

TEXT BOOKS:

1. Patrick J. Sinko, *Martin's Physical Pharmacy and Pharmaceutical Sciences 5th Edition*. Lippincott Williams.
2. CVS Subhramanyam, *Physical Pharmacy, Vallabh prakashan*.
3. Manavalan & Ramaswamy. *Physical pharmaceutics. 2nd ed*. Vignesh publisher, 2008.
4. Derle D.V., *Essentials of Physical Pharmacy. Pharma Med Press*

REFERENCE BOOKS:

1. *Lippincott Williams and Wilkins, Remington Pharmaceutical Sciences*
2. *M.E. Aulton, Pharmaceutics – The science of dosage form design, 2nd edition Churchill Livingstone.*
3. *L. Lachman, H. Lieberman The Theory And Practice Of Industrial Pharmacy J. L Kaniz Lee & Febiger Philadelphia, USA.*
4. *T. Florence and D. Attwood Physicochemical Principles of Pharmacy. 3rd ed. Pharmaceutical Press, 2004.*
5. *James Swarbrick, Encyclopedia of pharmaceutical technology, 3 rd ed, informa healthcare.*
6. *Shotton E and Ridgaway K, Physical Pharmaceuticals Oxford University Press, London.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL ENGINEERING – II LAB	Code	13R00406
Course year	B. Pharm. II year	Semester	II
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
Credits	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 Stoke's law and 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. Extraction of volatile oil by steam distillation.
7. Determination of rate of drying, free moisture content and bound moisture content.
8. Experiments to illustrate the influence of various parameters on construction of drying curves.
9. Experiments to illustrate principles of size reduction, Laws governing energy and power requirements of a size reduction (Ball mill).
10. Experiments to illustrate solid-solid mixing, determination of mixing efficiency using different types of mixers.
11. 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. Sieve 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. Anderson's pipette
12. Autoclave
13. Steam distillation still

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL BIOCHEMISTRY LAB	Code	13R00407
Course year	B. Pharm. II year	Semester	II
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
Credits	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 targetting

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
ANANTHAPURAMU**

Subject	PHARMACOGNOSY-I LAB	Code	13R00408
Course year	B. Pharm. II year	Semester	II
practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
Credits	2		

EXPERIMENTS:

1. Collection and preparation of herbarium/laminated photos/ specimens of natural drugs.
2. Study of various morphological characters of the drugs mentioned in theory under carbohydrates, lipids and tannins.
3. Qualitative chemical tests for various primary and secondary metabolites.
4. Chemical tests for Acacia, Tragacanth, Guar gum, Agar , Starch
5. Chemical tests for Castor oil, Linseed oil, Shark liver oil, Cod liver oil.
6. Chemical tests for Gambir, Black catechu, Myrobalan.
7. Determination of Saponification value of Fixed mentioned in theory.
8. Determination of Acid value of Fixed oils mentioned in theory.
9. Determination of dimensions of starch grains using eye piece micro meter and Camera Lucida method.
10. Determination of length and width of fibers using eye piece micro meter and Camera Lucida method.
11. Determination of Stomatal index of leaf.
12. Determination of Palisade ratio & Vein islet number
13. Determination of swelling factor of mucilage containing herbal drug.
14. Extraction of crude drug using Soxhlet apparatus. (Demonstration only)

Seminar/Assignment related to theory

Collect various parts of various medicinal plants and study their organoleptic characters

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-Scientechics, 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
5. Micrometers
6. Eyepiece micrometer
7. Camera lucida

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHYSICAL PHARMACY – II LAB	Code	13R00409
Course year	B. Pharm II year	Semester	II
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
Credits	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
 - a) Iodine between water and carbon tetrachloride
 - b) Show that the Benzoic acid is acting as a dimer when it is distributed between benzene and water.
6. Determination of sedimentation volume and degree of flocculation.
7. Show that the hydrolysis of an ester is a first order kinetics (Methyl acetate).
8. Effect of temperature on first order kinetics and to find the energy of activation.
9. Effect of addition of Salt/pH/co-solvent on the solubility
10. Surface tension using Stalagmometer.
11. HLB value estimation of surfactants.
12. Viscosity – by Ostwald Viscometer.

II. DEMO/ WORKSHOP

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

III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION

Viscoelasticity, solublistation 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. *Andreason pipetter*
9. *Adequate glasswares*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	MEDICINAL CHEMISTRY – I	Code	13R00501
Course year	B. Pharm III year	Semester	I
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

Physico chemical properties of drug molecules in relation to biological activity – Solubility, lipophilicity, partition-coefficient, Ionization, hydrogen bonding, Chelation, redox potential and surface activity, Bioisosterism and steric features of drugs, drug distribution and protein binding. Mechanisms of Drug action: Introduction, 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 and criteria for drug latention approach.

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.

UNIT II Drugs acting on ANS

Adrenergic and antiadrenergic agents: Adrenergic agonist: Chemistry and metabolism of neurotransmitters, Dopamine, Epinephrine, Ephedrine*, Phenylephrine, Isoprenaline*, Naphazoline, Oxymetazoline*, Terbutaline, Salbutamol*, Salmeterol, metarminol. Adrenergic antagonist: Classification, Phenoxy benzamine*, Prazosin*, Tamsulosin, Propranolol, Atenolol*, Metoprolol, Labetolol, Esmolol. SAR- Sympathomimetics (Catecholamines)

Cholinergic and anti-cholinergic agents: Cholinergic receptor and neuro chemistry and concept of neuro muscular blocking agents. Succinylcholine*, Methacholine, carbachol, pilocarpine*, Physostigmine, pyridostigmine, Neostigmine, Malathion, Pralidoxime, Propantheline, Nicotine, Dicyclomine*, Biperiden*, Decamethonium*, pancuronium. SAR- Cholinergic agonists, Anti-cholinergics, Neuro muscular blockers.

UNIT III

CNS system Depressants and Central dopaminergic signalling agents

Anxiolytics, Sedatives and Hypnotics: Benzodiazepines (Diazepam*, Oxazepam, Nitrazepam, Clonazepam, Midazolam, Alprazolam*), Barbiturates (Phenobarbital*, Amobarbital, Pentobarbital, Secobarbital), Glutethimide*, Meprobamate*, methocarbamol, Methyprylon. SAR- Benzodiazepines, Barbiturates.

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

Anti-convulsants: Phenytoin*, Valproic acid, Carbamazepine*, Primidone, Ethosuximide*, Gabapentin, Lamotrigine, Levetiracetam, Zonisamide, Topiramate. SAR- Hydantoin, Oxazolinediones, Succinimides.

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

UNIT IV

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

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

Miscellaneous: Psilocybin, Dimethyltryptamine, Mescaline, Lysergic acid and Tetrahydro cannabinol.

UNIT V Anaesthetics

General anaesthetics: Chemical classification, Inhaled and Injectable, Meyer-Overton theory, Halothane*, Isoflurane, Sevoflurane, Triflurane, Propofol, Ketamine, Etomidate, Thiopental sodium*. Local anaesthetics: Cocaine, Lignocaine*, Procaine*, benzocaine, Ropivacaine, Bupivacaine, Articaine. Adjuvant to local anaesthetics. SAR- Esters and amides.

Reference 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.
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.
5. Hansch, *Comprehensive medicinal chemistry*, Vol 1 – 6 Elsevier pergmon press, Oxford
6. D. Abraham (Ed), *Burger Medicinal chemistry ad Drug discovery*, Vol. 1 & 2. John Wiley & Sons, New York 2003, 6th Ed.
7. M. Atherden, *Bentley and Driver's Textbook of Pharmaceutical Chemistry Ed: 1.*Oxford University Press, Delhi.
8. Daniel lednicer, *Strategies for Organic Drug Synthesis and Design*, John Wiley, N. Y. 1998.
9. D. Lednicer, *Organic drug synthesis*, Vol, 1 – 6, J.Wiley N.Y.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL MICROBIOLOGY	Code	13R00502
Course year	B. Pharm III year	Semester	I
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

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, three domains 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. Introduction to Microbiology of water, air and Milk. Methods of Quantitative evaluation of microbial contamination. Microbial limit test official in IP.

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 pharmaceutical products** 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, “*Industrial Microbiology*” 2nd Ed, Mc Graw hill Book Company Inc.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACOGNOSY II	Code	13R00503
Course year	B. Pharm III year	Semester	I
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

Volatile Oils and Resins

A) Introduction, definition, classification, different physical, chemical properties, extraction methods, chemical tests for the Volatile oils. Systemic Pharmacognostic study of the following volatile oils and resins: Mentha, Coriander, Cinnamon, Lemon Oil, Nutmeg, Eucalyptus, Cardamom, Lemon Grass, Caraway, Cumin, Dill, Clove and Fennel.

B) Definition, classification and properties of resins. Study of drugs containing resin & resin combinations-Benzoin, Asafoetida, Balsam of tolu and Podophyllum.

UNIT II Glycosides

Definition, properties, general tests of saponin, cardioactive, anthraquinone and bitter 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 III Alkaloids.

Definition, 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, Aswagandha
- f. **Quinoline-Isoquinoline**-Cinchona, Ipecac, Opium
- g. **Alkaloidal amine**-Ephedra, Colchicum
- h. **Glycoalkaloid**-Solanum
- i. **Purine**-Coffee, Tea, Kola
- j. **Quinazoline** -Vasaka

UNIT IV

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.

UNIT V Enzymes

Biological sources, preparation, identification tests and uses of the following enzymes- Diastase, Papain, Trypsin, Pepsin and Pancreatic.

Text Books:

1. Kokate CK, Purohit A.P. & Gokhale; *Pharmacognosy, Nirali Prakashan, New Delhi.*
2. *Text book of Pharmacognosy By Handa and Kapoor. Peach K and Tracey MV, Modern methods of Plant analysis, Narose publishing house, New Delhi.*

3. *Pharmacognosy by Robert, Tyler.*
4. *Tutorial Pharmacy by Cooper and Gunn.*
5. *General Pharmacy by Cooper and Gunn*

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. *USP, IP and BP.*
6. *Ayurvedic Pharmacopoeia of India, Published by Govt. of India.*
7. *Herbal Drug Industry by Eastern Publishers.*
8. *Peach K and Tracey MV, Modern methods of Plant analysis, Narose publishing house, New Delhi.*
9. *Biosynthesis of Natural products by Manitto P*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL TECHNOLOGY-I	Code	13R00504
Course year	B. Pharm III year	Semester	I
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

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.

Ophthalmic Preparations: 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, 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

Cosmeticology and Cosmetic Preparations: Fundamentals of cosmetic science. Formulation, preparation and packaging of cosmetics for skin (face powders, compact face powders, body powders, cleansing lotions, emollient lotions and sunscreen lotions), hair (shampoos, hair colorants, epilatories and depilatories) and manicure preparations like nail polish, lipsticks, eye lashes, baby care products etc.

Formulation, preparation, evaluation & packaging of dentifrices like tooth powders, pastes, gels etc.

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.
5. B.M.Mithal & R.N.Saha. *A hand book of cosmetics*, 1st ed., vallabh prakashan, 2004.

Reference Books:

1. Sagarin & MS Balsam, *Cosmetics Sciences & Technology Vol.1, 2 & 3 Wiley India Pvt. Ltd.*
2. *Lippincott Williams and Wilkins, Remington Pharmaceutical Sciences.*
3. *E.A.Rawlkins, Bentley's Text Book of Pharmaceutics, Elbs publ*
4. *Banker and Rhodes, Modern pharmaceuticals, marcel dekker series.*
5. *L. Lachman, H.A, Lieberman and J.L. Kanig, Tablet vol I. marcel dekker series.*
6. *James Swarbrick, Encyclopedia of pharmaceutical technology, 3 rd edi, informa healthcare.*
7. *NK Jain, Pharmaceutical product development, CBS publishers.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACOLOGY-I	Code	13R00505
Course year	B. Pharm IIIyear	Semester	I
Theory	2 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	2		

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.

b. Pharmacology of drugs used in neurodegenerative disorders like parkinsonism and Alzheimer's disease.

c. Pharmacology of drugs used in behavioral disorders like psychosis.

d. Pharmacology of drugs used in epilepsy

UNIT V

a. Analgesics, Antipyretics, Anti-inflammatory and Anti migraine drugs.

b. Narcotic analgesics and antagonists.

Text Books:

1. *Tripathi, Essentials of Medical Pharmacology, Jaypee Brother's, Latest Edition*
2. *H.P Rang, M. M. dale & J.M. Ritter, Pharmacology, Churchill living stone, 4th Ed.*
3. *David E.Golan, Armen H.Tashjian, April W.Armstrong, Principles of pharmacology, Latest edition*
4. *Bertram. G. Katzung, Basic and clinical pharmacology, 9th Edn; Prentice Hall International*
5. *Sathoskar, Pharmacology and pharmaco therapeutics Vol. 1 & 2, Publ by Popular Prakashan, Mumbai.*

Reference Books:

1. *J.G. Hardman and Lee E. Limbard, Good Mann & Gilman, The Pharmacological basis of therapeutics, Mc Grawhill, Health Professions Dvn.*
2. *J. Crossland, Lewis 's Pharmacology, Church living stone.*
3. *Ruth Woodrow, Essentials of Pharmacology for Health Occupations. Delmar Cenage Learning*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	MEDICINAL CHEMISTRY – I LAB	Code	13R00506
Course year	B. Pharm III year	Semester	I
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

I. EXPERIMENTS

- Synthesis of Barbituric acid from Diethyl Malonate
 - Synthesis of Phenyton from Benzoin or Benzil
 - Synthesis of Diphenyl quinoxaline from o-phenylene diamine and benzil
 - Synthesis of phenothiazine from o-phenylene diamine
 - Synthesis of Benzocaine from Para amino benzoic acid
 - Synthesis of Dibromo succinic acid from malic acid
 - Synthesis of Benzoxazine from Anthranilic acid
 - Monograph analysis of Caffeine
 - Monograph analysis of Phenytoin
 - Monograph analysis of Barbituric acid
 - Monograph analysis of Benzocaine
 - Monograph analysis of Lignocaine gel
- (Literature, Journal reported lead compounds synthesis relevant to theory can also be included)

II Demo/Workshop

- Stereo models of some drugs relevant to theory.
- 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, high throughput screening, combinatorial chemistry, In silico drug design.

References:

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

LIST OF MINIMUM EQUIPMENTS REQUIRED

- Water bath
- Suction pumps
- Analytical/physical balance
- Triple beam balance
- Reflux flask with condenser
- Hot plates
- Refrigerator
- Mechanical and magnetic stirrer with thermostat
- Distillation unit
- Oven
- Adequate glass wares

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

<i>Subject</i>	PHARMACEUTICAL MICROBIOLOGY LAB	<i>Code</i>	13R00507
<i>Course year</i>	B. Pharm III year	<i>Semester</i>	I
<i>Theory</i>	3 hrs/week	<i>Tutorial</i>	NIL
<i>End exam</i>	50 marks	<i>Internal</i>	25 marks
<i>credits</i>	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:
 - 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).

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACOGNOSY II LAB	Code	13R00508
Course year	B. Pharm III year	Semester	I
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

S.No	Name of the experiment
1	Study of various morphological characters of the drugs mentioned in theory under volatile oils and glycosides.
2	Study of various morphological characters of the drugs mentioned in theory under alkaloids and resins.
3	Microscopy (Transverse section & powder) of Fennel, Coriander.
4	Microscopy (Transverse section & powder) Cinnamon, Clove.
5	Microscopy (Transverse section & powder) of Digitalis, Squill
6	Microscopy (Transverse section & powder) of Senna, Liquorice.
7	Microscopy (Transverse section & powder) of Ephedra, Ipecac
8	Microscopy (Transverse section & powder) of Nux vomica, Datura
9	Microscopy (Transverse section & powder) of Cinchona, Kurchi
10	Chemical evaluation of atropine in extract of Datura.
11	Chemical evaluation of citral in Lemon oil
12	Chemical evaluation of quinine in Cinchona extract.
13	Chemical tests for Asafoetida, Benzoin, Tolu Balsam.

II. Workshop/Demo

Isolation of volatile oil from a plant material

III. Seminar / Assignment/Group Discussion

Seminar/Assignment related to theory

REFERENCES

1. *Practical Pharmacognosy*, CK 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-Scientechinics, Bristol.
5. *Indian Pharmacopoeia*. 1966.
6. *Peach K and Tracey MV, Modern methods of Plant analysis*, Narose publishing house, New Delhi.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

<i>Subject</i>	PHARMACEUTICAL TECHNOLOGY – I LAB	<i>Code</i>	13R00509
<i>Course year</i>	B. Pharm III year	<i>Semester</i>	I
<i>Theory</i>	3 hrs/week	<i>Tutorial</i>	NIL
<i>End exam</i>	50 marks	<i>Internal</i>	25 marks
<i>credits</i>	2		

I. EXPERIMENTS:

1. Preparation, evaluation and packaging of
 - a) Solutions: Paracetamol syrup, codeine phosphate linctus
 - b) Suspensions: Milk of magnesia,
 - c) Emulsions: o/w or w/o type
 - d) Ointments: Benzoic acid ointment
 - e) Suppositories: Boric acid,
 - f) Eye drops: Gentamycin.
 - g) Eye ointments: Chloramphenicol.
 - h) Cream: Cetrimide
2. Formulation of various types of cosmetics:
 - a) Lipsticks
 - b) Toothpowder and toothpaste
 - c) Shampoo
 - d) Cold cream and vanishing cream
3. Preparation of gels
4. Formulation of baby powder, lotion

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) Marketed cosmetics and their composition.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

<i>Subject</i>	MEDICINAL CHEMISTRY – II	<i>Code</i>	13R00601
<i>Course year</i>	B. Pharm III year	<i>Semester</i>	II
<i>Theory</i>	3 hrs/week	<i>Tutorial</i>	1hr/week
<i>End exam</i>	70 marks	<i>Internal exam</i>	30 marks
<i>Credits</i>	3		

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.

UNIT I Drugs acting on renal system

Renin-Angiotensin system inhibitors: Captopril*, Lisinopril, Enalapril*, Ramipril, Benzapril, Losartan*, Candesartan, Telmisartan, Valsartan, Aliskiren.

Diuretics: Acetazolamide*, Methazolamide, Dichlorphenamide, Hydrochlorthiazide*, Benzthiazide, Furosemide*, bumetanide, Newer- Piretanide, Ethacrynic acid*, Indacrinone, Spironolactone, Aldosterone, Amiloride, Triamterene and Mannitol. SAR- Carbonic anhydrase inhibitors, Thiazides, Loop diuretics, Phenoxy acetic acid derivatives.

UNIT II Drugs acting on CVS

Anti anginal agents & vasodilators: Nitroglycerin, Isosorbide dinitrate, Erithrityl tetranitrate*, pentaerythritol tetranitrate. **Ion channel blockers-** Verapamil, Diltiazem, Nifedipine, Amlodipine*, Felodipine, Nicardipine, Bepridil, Ranolazine.

Antithrombotic agents- Aspirin, Dipyridamole, Clopidogrel* and Ticlopidine

Antiarrhythmic drugs: Quinidine, Procainamide*, Disopyramide, Lidocaine, Mexiletine*, Propafenone, Amiodarone, Bretylium, Sotalol.

Antihypertensive agents: classification, Reserpine, Guanethidine, Prazosin, Terazosin, Methyldopa, Clonidine, Hydralazine, Sodium nitroprusside, Sildenafil citrate, Minoxidil, Amrinone, Milrinone. SAR- beta-blockers

Antihyperlipidemic agents: Clofibrate, Fenofibrate*, Dextrothyroxine, Cholestyramine resin, Colestipol, Nicotinic acid, β -Sitosterol, Probuco, Ezetimibe, Simvastatin*, Lovastatin, Pravastatin, Fluvastatin, Atorvastatin, Rosuvastatin. SAR-HMG CO-A inhibitors

UNIT III Drugs acting on Blood, hypoglycemic agents and thyroid.

Anticoagulants: Factors, Warfarin sodium*, Dicumarol, Anisindione

Synthetic hypoglycemic agents: Tolbutamide*, Tolazamide, Chlorpropamide, Acetohexamide, Glipizide, Glyburide, Glimepiride, Gliclazide, Repaglinide, Pioglitazone, Metformin*, Acarbose, Miglitol.

Thyroid and antithyroid drugs: Levothyroxine, Liothyronine, Propylthiouracil, Methimazole.

UNIT IV Analgesic, antipyretic and anti-inflammatory agents

Opioids: Levorphanol, Dextromethorphan, Pentazocine, Meperidine, Loperamide, Fentanyl, Methadone, Tramadol*, Butorphanol, Buprenorphine.

Opioid antagonist: Naltrexone, Naloxane, Methylnaltrexone.

NSAIDs: A note on prostaglandins and leukotrienes. Aspirin, Indomethacin, Sulindac*, Tolmetin, Ketorolac, Ibuprofen*, Naproxen, Fenoprofen, Mefenamic acid, Diclofenac*, Lumiracoxib, Piroxicam, Meloxicam, Celecoxib, Paracetamol*.

Management of Gout and Hyperuricemia: Colchicine, Allopurinol*, Probenecid, Sulfinpyrazole.

Antimigraine drugs: Sumatriptan, Zolmitriptan. SAR – Salicylates, Aryl propionic acids, oxicams.

UNIT V Antibiotics

β- Lactams: Penicillin G, Penicillin V, Methicillin, Oxacillin, Cloxacillin*, Dicloxacillin, Ampicillin*, Amoxicillin, piperacillin. *β- Lactamase inhibitors:* Clavulanate potassium, Sulbactam, Tazobactam, Newer-Meropenem, Biapenem, *Cephalosporins:* Cephalexin*, Cefadroxil, Cefazolin, Cefaclor, Cefuroxime, Cefpodoxime, Cefixime, Cefotaxime, Ceftriaxone, Cefepime. SAR-Penicillins and Cephalosporin

Aminoglycosides and Tetracyclines: Streptomycin, Neomycin, Kenamycin, Amikacin, Gentamicin, Tobramycin, Tetracycline, Chlortetracycline, oxytetracycline, Doxycycline, Minocycline. SAR-Aminoglycosides and tetracyclines.

Macrolides and Lincomycins: Erythromycin, Clarithromycin, Azithromycin Lincomycin, Clindamycin.

Miscellaneous: Vancomycin, Bacitracin, Polymyxin B, Chloramphenicol, Novobiocin, Mupirocin, Fosfomycin tromethamine, Tigecycline, Aztreonam, Ertapenem.

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.
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. 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: 1.*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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

<i>Subject</i>	PHARMACEUTICAL TECHNOLOGY – II	<i>Code</i>	13R00602
<i>Course year</i>	B. Pharm III year	<i>Semester</i>	II
<i>Theory</i>	3 hrs/week	<i>Tutorial</i>	1hr/week
<i>End exam</i>	70 marks	<i>Internal exam</i>	30 marks
<i>Credits</i>	3		

UNIT I

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 II

Microencapsulation: Types of microencapsulation and importance of microencapsulation in pharmacy, microcapsulation by coacervation phase separator, multi orifice centrifugal separation. Spray drying, spray congealing, polymerization complex emulsion, air suspension technique, and pan coating techniques, evaluation of microcapsules.

UNIT III

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. Physics of tablet making. 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 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, packing testing. Methods of packing of solid, liquid and semi-solid dosage forms, Factors influencing packing material, stability aspects of packaging.

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.
5. U.K.Jain, D.C.Goupale & S.Nayak. *Pharmaceutical packing technology*. 1st ed, pharmamed press, 2009.

Reference Books:

1. Sagarin & MS Balsam, *Cosmetics Sciences &Technology Vol.1, 2 & 3* Wiley India Pvt. Ltd.
2. Lippincott Williams and Wilkins, *Remington Pharmaceutical Sciences*.
3. E.A.Rawlkins, *Bentley's Text Book of Pharmaceutics*, Elbs publ
4. Banker and Rhodes, *Modern pharmaceuticals*, marcel dekker series.
5. L. Lachman, H.A, Lieberman and J.L. Kanig, *Tablet vol I,II and III*. marcel dekker series.
6. James Swarbrick, *Encyclopedia of pharmaceutical technology*, 3 rd edi, informa healthcare.
7. NK Jain, *Pharmaceutical product development*, CBS publishers.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACOLOGY – II	Code	13R00603
Course year	B. Pharm III year	Semester	II
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I Drugs acting on cardiovascular System

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

UNIT II Drugs acting on hematopoietic system

- a. Coagulants, anticoagulants
- b. Fibrinolytics, anti fibrinolytics, anti platelet drugs
- c. Haematinics and plasma expanders

UNIT III

a. Drugs acting on urinary system

- i) Fluid and electrolyte balance
- ii) Diuretics and anti diuretics

b. Drugs acting on respiratory system

- i) Antiasthmatics including bronchodilators
- ii) Antitussives and expectorants
- iii) respiratory stimulants

UNIT IV Autacoids

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

UNIT V Hormones and hormone anatagonists

- a. Insulin, Oral hypoglycemic agents
- b. Thyroid and antithyroid drugs
- c. Adrenocortical steroids and their analogues
- d. Uterine stimulants and relaxants
- e. Oestrogens, progesterones, androgens, anabolic steroids and oral contraceptives

Text Books:

1. Tripathi, *Essentials of Medical Pharmacology*, Jaypee Brother's, Latest Edition
2. H.P Rang, M. M. dale & J.M. Ritter, *Pharmacology*, Churchill living stone, 4th Ed.
3. David E.Golan, Armen H.Tashjian, April W.Armstrong, *Principles of pharmacology*, Latest edition
4. Bertram. G. Katzung, *Basic and clinical pharmacology*, 9th Edn; Prentice Hall International

Reference Books:

1. Sathoskar, *Pharmacology and pharmaco therapeutics Vol. 1 & 2*, Publ by Popular Prakashan, Mumbai.
2. J.G. Hardman and Lee E. Limbard, Good Mann & Gilmann, *The Pharmacological basis of therapeutics*, Mc Grawhill, Health Professions Dvn.
3. J. Crossland, *Lewis's Pharmacology*, Church living stone.
4. Ruth Woodrow, *Essentials of Pharmacology for Health Occupations*. Delmar Cenage Learning

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL ANALYSIS – II	Code	13R00604
Course year	B. Pharm III year	Semester	II
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

UV and Visible Spectroscopy: EMR, Molecular energy, types of electronic transition during UV-Visible light absorption, Beer-Lambert's law & deviations, chromophores, Auxochromes, isobestic point, instrumentation – Construction of single beam and double beam spectrophotometers, Woodward's rules for calculation of λ - max, quantitative applications (calibration method, $A1\%cm$, single and double point standardization, simultaneous equation method) to dosage forms.

IR Spectroscopy: Vibrational energy in bond, types of vibrations, Hook's law, sample preparation, instrumentation – FT- IR (single and double beam), ATR, determination of functional group by IR spectra, Application of IR spectra in monograph analysis as per IP. Note on "mutual exclusion principle".

UNIT II

H^1 -NMR spectroscopy: Principle, theory, spin-quantum number, energy levels, relaxation process, chemical shift and NMR spectrum, shielding and de-shielding, spin-spin coupling, J – value, Instrumentation, applications, ESR Vs NMR (comparison of principle and application).

Mass Spectrometry: Basic principle, types of peaks in mass spectrum, fragmentation pattern, instrumentation (single and double focusing), ionization techniques, Nitrogen rule, unsaturation index (formula).

UNIT III

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 chlorides and sulphates.

UNIT IV

- Principle of optical activity, optical purity, concept of Optical Rotatory dispersion (ORD), Octant Rule, Circular dichroism Vs ORD.
- XRD: production X-ray, types, Bragg's law, XRD pattern in identification and comparison of polymorphs with examples.
- Radio Immuno Assay & Enzyme Linked Immuno Sorbate Assay : principle, Procedure and application in diagnosis.

UNIT V

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. Derivatization techniques in quantitative Applications. Brief note on GC-MS.

HPLC: Principle, Van Deemter equation, Instrumentation - mobile phase, degassing, pumps, injectors, columns, detectors. Isocratic and gradient elution in RP-HPLC. Various parameters in chromatogram of HPLC, Comparisons between HPTLC Vs HPLC and HPLC Vs GC. Brief note on LC-MS, LC-MS/MS.

Text Books:

1. *R.M. Silvesterin and G.C. Bassler, Spectrometric Identification of Organic Compounds. John Wiley & Sons.*
2. *AH Beckett & Stenlake, Text book of Practical Pharmaceutical chemistry, Vol.II Continuum International Publishing Group, Althone.*
3. *Robert D. Braun, Introduction to Instrumental Analysis. Pharma Med Press.*
4. *Skoog, West and Holler Principles of Instrumental Analysis; Saunders college Publishing, London.*
5. *William Kemp. Organic spectroscopy, wiley edition*

Reference Books:

1. *Hobart. H. Willard and others, Instrumental methods of analysis, CBS publishers and Distributors New Delhi.*
2. *Settle, Handbook of Instrumental Techniques for Analytical Chemistry. Prentice Hall.*
3. *P.D. Sethi, Quantitative analysis of Drugs and Pharmaceuticals. CBS Publishers.*
4. *K. A. Connors, A Textbook of pharmaceutical analysis, Wiley Interscience, NY.*
5. *Pharmacopoeia (IP, BP, USP).*
6. *B.K. Sharma, Instrumental Chemical Analysis, Goel Publishers.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL JURISPRUDENCE	Code	13R00605
Course year	B. Pharm III year	Semester	II
Theory	2 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	2		

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 & A.P. N. D. P.S Rules 1986

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

A study of the salient features of the following.

- a. Prevention of Cruelty to animals Act 1960.
- b. AP State Shops & Establishments Act 1988 & Rules 1990.
- 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. 7th 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.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	MEDICINAL CHEMISTRY – II LAB	Code	13R00606
Course year	B. Pharm III year	Semester	II
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

I. 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. Synthesis of Aspirin from salicylic acid
8. Identification and test for purity for Aspirin tablet as per IP
9. Identification and test for purity for Acetazolamide tablet as per IP
10. Identification and test for purity for propranolol tablet as per IP
11. Identification and test for purity for Diclofenac sodium tablet as per IP
12. Identification and test for purity for Paracetamol tablet as per IP

II. DEMO/WORKSHOP:

Microwave assisted organic synthesis, Purification of synthesized compounds (Column chromatography)

III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION

Antibiotic discovery in the twenty-first century: Current trends and future perspectives, Current Trends in β -Lactam based β -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
ANANTHAPURAMU**

<i>Subject</i>	PHARMACEUTICAL TECHNOLOGY – II LAB	<i>Code</i>	13R00607
<i>Course year</i>	B. Pharm III year	<i>Semester</i>	II
<i>Theory</i>	3 hrs/week	<i>Tutorial</i>	NIL
<i>End exam</i>	50 marks	<i>Internal</i>	25 marks
<i>credits</i>	2		

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. Parenterals:
 - 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)

III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION

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

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACOLOGY – II LAB	Code	13R00608
Course year	B. Pharm III year	Semester	II
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

I. 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.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL ANALYSIS–II LAB	Code	13R00609
Course year	B. Pharm III year	Semester	II
Theory	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal exam	25 marks
credits	2		

I. EXPERIMENTS

1. Determination of λ - max of KMnO_4 (Visible)
2. Determination of λ - max of ciprofloxacin (any one drug) (UV)
3. Determination of isobestic point of any 2 drugs.
4. Assay of Riboflavin-Colorimetric method.
5. Assay of Ibuprofen (any one drug)-UV-spectro photometry-calibration curve method.
6. Assay of Paracetamol-UV-spectro photometry-A(1%,1cm) method
7. Assay of Thiamine by Fluorimetry.
8. Study of quenching effect of quinine by Fluorimetry.
9. Determination of Na/K ions by Flame photometry.
10. Determination of sulphates in calcium gluconate by Nepheloturbidometry.
11. Interpretation of UV and IR Spectra.
12. Interpretation of NMR and Mass Spectra.

II. DEMO/WORK SHOP

1. Demonstration of HPLC, determination of any drug, selection of solvent, mobile phase, stationary phase, and optimization of chromatographic conditions.
2. Demonstration of GC, determination of any drug, selection of solvent, mobile phase, stationary phase, and optimization of chromatographic conditions.
3. Demonstration of gel electrophoresis.

III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION

Determination of two drugs simultaneously by using UV spectrophotometer. criteria in selection of mobile phase, stationary phase & detector in HPLC.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Fluorimeter
2. UV-Spectrophometer
3. TLC kits
4. Electrophoresis equipment
5. Digital balance
6. Chromatographic columns
7. Colorimeter
8. KF titrator
9. Adequate glasswares

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	Communication Skills Lab	Code	13R52601
Course year	B. Pharm. III year	Semester	II
Theory	3 hrs/week	Tutorial	NIL
End exam	----	Internal exam	30 marks
Credits	NIL		

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts.

Course Objective:

- To train students to use language effectively in everyday conversations, to participate in group discussions, to help them face interviews, and sharpen public speaking skills
- To expose the students to a varied blend of self-instructional learner-friendly modes of language learning through computer-aided multi-media instruction.
- To enable them to learn better pronunciation through stress on word accent, intonation, and rhythm.
- To help the second language learners to acquire fluency in spoken English and neutralize mother tongue influence
- To train students to use language appropriately for interviews, group discussion and public speaking

SYLLABUS

1. PHONETICS
 - a. Importance of speaking phonetically correct English
 - b. Production of sounds – Vowels and Consonants
 - c. Uttering words-Stress on words and stress rules
 - d. Uttering sentences-Intonation

2. PRESENTATIONAL SKILLS:
 - a. Prepared speech and Impromptu speech
 - b. JAM (Just A Minute)
 - c. Describing people/object/place
 - d. Body language

3. SPEAKING SKILLS :
 - a. Telephone skills
 - b. Role plays
 - c. Public Speaking
 - d.

4. WRITING SKILLS
 - a. Letter writing
 - b. Report writing
 - c. Resume writing

5. GROUP ACTIVITIES
 - a. Situational dialogues
 - b. Debates and Group Discussions
 - c. Interview Skills

Learning Outcome:

- Becoming active participants in the learning process and acquiring proficiency in spoken English of the students
- Speaking with clarity and confidence thereby enhancing employability skills of the students

MINIMUM REQUIREMENT FOR ELCS LAB:

The English Language Lab shall have two parts:

1. Computer Assisted Language Learning (CALL) Lab:
The Computer aided Language Lab for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.
2. The Communication Skills Lab with movable chairs and audio-visual aids with a P.A. system, Projector, a digital stereo-audio & video system and camcorder etc.

System Requirement (Hardware component):

Computer network with LAN with minimum 60 multimedia systems with the following specifications:

- i) P – IV Processor
 - a) Speed – 2.8 GHZ
 - b) RAM – 512 MB Minimum
 - c) Hard Disk – 80 GB
- ii) Headphones of High quality

SUGGESTED SOFTWARE:

1. Clarity Pronunciation Power – Part I (Sky Pronunciation)
2. Clarity Pronunciation Power – part II
3. K-Van Advanced Communication Skills
4. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
5. *DELTA's key to the Next Generation TOEFL Test: Advanced Skills Practice.*
6. Lingua TOEFL CBT Insider, by Dreamtech
7. English Pronunciation in Use (Elementary, Intermediate, Advanced) CUP
8. Cambridge Advanced Learners' English Dictionary with CD.
9. Oxford Advanced Learner's Compass, 8th Edition
10. Sanjay Kumar & Pushp Lata. 2011. Communication Skills, OUP

REFERENCE BOOKS:

1. **A Textbook of English Phonetics for Indian Students** 2nd Ed T. Balasubramanian. (Macmillian),2012.
2. **A Course in Phonetics and Spoken English**, [Dhamija Sethi](#), Prentice-Hall of India Pvt.Ltd
3. **Strengthen Your Steps**, Maruthi Publicaions, 2012.
4. **Speaking English Effectively**, 2nd Edition Krishna Mohan & NP Singh, 2011. (Mcmillan).
5. **Listening in the Language Classroom**, John Field (Cambridge Language Teaching Library),2011
6. **A Hand book for English Laboratories**, E.Suresh kumar, P.Sreehari, Foundation Books,2011
7. **English Pronunciation in Use. Intermediate & Advanced** ,Hancock, M. 2009. CUP
8. **Basics of Communication in English** ,Soundararaj, Francis. 2012.. *New Delhi: Macmillan*
9. **Spoken English** (CIEFL) in 3 volumes with 6 cassettes, OUP.
10. **English Pronouncing Dictionary**, Daniel Jones Current Edition with CD.Cambridge, 17th edition, 2011

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACOGNOSY – III	Code	13R00701
Course year	B. Pharm IV year	Semester	I
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

A) Phytochemical Screening: Preparation of extracts, screening of alkaloids, saponins, cardiac glycosides, flavonoids, tannins and anthraquinones in plant extracts. Identification and estimation of various phytoconstituents.

B) Plant tissue culture: History, types, media requirements, methodology for establishment of cell cultures; growth measurements, viability measurements and applications. Micropropagation, immobilization, hairy root culture.

UNIT II

Introduction, classification and study of different chromatographic methods and their applications in evaluation of bio drugs. Concept of finger printing and marker compound analysis.

UNIT III

A) Study of traditional drugs-common and vernacular names, sources, chemical constituents and uses of Kantakari, Malkanguni, Shatavari, Tylophora, Bilva, Kalijeeri, Rasna, Aparmarga, Gokhuru, Guduchi, Bach, Amla, Guggul, Kalimusali, Punarnava, Chirata and Brahmi.

B) General introduction to Indian Systems of Medicine like Ayurveda, Siddha, Unani and Homeopathy.

C) Methods of preparation of formulations in Ayurveda like churnas, lehyas, tailas, asavas and aristas.

UNIT IV

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 Neutraceuticals: Garlic, Spirulina, Soya and Royal jelly.

C) Introduction and importance of trade in herbal medicine, herbal cosmetics and Indian herbal drug industry.

UNIT V

A) Natural dyes and their applications in pharmacy.

B) Study of mineral drugs- Bentonite, Kaolin, Keiselghur and Talc

C) Study of natural products from natural sources

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 Robert, Tyler.*
5. *Tutorial Pharmacy by Cooper and Gunn.*

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. *USP, IP and BP. Ayurvedic Pharmacopoeia of India.*
6. *Ayurvedic Pharmacopoeia of India, Published by Govt of India.*
7. *Herbal Drug Industry by Eastern Publishers.*
8. *Peach K and Tracey MV, Modern methods of Plant analysis, Narose publishing house, New Delhi.*
9. *Ayurvedic Formulary of India, Govt of India Publication.*
10. *The Wealth of India, All volumes, CSIR, New Delhi.*
11. *Harbone JB; Phytochemical methods, Champman and Hall.*
12. *Plant Tissue culture By Razdan*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	BIOPHARMACEUTICS AND PHARMACOKINETICS	Code	13R00702
Course year	B. Pharm IV year	Semester	I
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development and clinical setting.

Biopharmaceutics: Passage of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis) factors influencing absorption – physiochemical, physiological and pharmaceutical. Biopharmaceutical Classification System (BCS) and its significance

UNIT II

Drug distribution in the body, Factors influencing distribution. Plasma protein binding, binding sites, factors influencing protein binding.

UNIT III

Pharmacokinetics

Significance of plasma drug concentration measurement.

Compartment model: Definition and scope. Pharmacokinetics of drug absorption – Zero order and first order absorption rate constant using Wagner Nelson and Loo-riegelman method. Volume of distribution and distribution coefficient.

Comparative kinetics: One compartment and Determination of Pharmacokinetic parameters from plasma and urine data after drug administration by oral and parenteral routes.

Curve fitting (Method of Residuals) Regression procedures.

Clearance concept, Mechanism of Renal clearance, clearance ratio, determination of renal clearance.

Non-linear pharmacokinetics with special reference to one compartment model after I.V. Drug administration, Michelis Menten Equation, detection of non-linearity (Saturation mechanism). Determination of K_m and V_m .

UNIT IV

Clinical pharmacokinetics

Definition and scope. Dosage adjustment in patients with renal and hepatic failure. Pharmacokinetic drug interactions and its significance in combination therapy.

UNIT V

Bioavailability and bioequivalence.

Measures of bioavailability, C_{max} , T_{max} and Area Under the Curve (AUC). Design of single dose bioequivalence study. Overview of regulatory requirements for conduction of bio-equivalence studies.

Bio availability and bio equivalence including evaluation testing protocols.

- a. *In vitro* dissolution studies for solid dosage forms methods, interpretation of dissolution data *invitro*, *invivo* correlations.
- b. Bioavailability testing protocol and procedures.
- c. *In vivo* methods of evaluation – statistical treatment.

Text Books:

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

Reference Books:

1. *Modern pharmaceutics by Banker. Marcel Dekker Inc., NY*
2. *L. lachman, H.A.Lieberman, JL. Kanig, the theory and practice of industrial pharmacy, Varghese publ house, Mumbai.*
3. *Ronald & trouser. Clinical pharmacokinetics concepts & applications. 3rd ed, wolters kluwer Pvt Ltd., 2007.*
4. *Robert E notary, Biopharmaceutics and pharmacokinetics – an introduction, marcel dekker inc., NY*
5. *Basic pharmacokinetics by Hedaya, CRC press.*
6. *AR. Gennerio Remington: the science and practice of pharmacy, vol 1 &2 Lippincott Williams & wilkins, Philadelphia, 2004.*

Reference Books:

1. *J.G. Hardman and Lee E. Limbard, Good Mann & Gilman, The Pharmacological basis of therapeutics, Mc Grawhill, Health Professions Dvn.*
2. *H.P Rang, M. M. dale & J.M. Ritter, Pharmacology, Church hill living stone, 4th Ed.*
3. *J. Crossland, Lewis 's Pharmacology, Church living stone.*
4. *Ruth Woodrow, Essentials of Pharmacology for Health Occupations. Delmar Cenage Learning.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	MEDICINAL CHEMISTRY – III	Code	13R00704
Course year	B. Pharm IV year	Semester	I
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

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 IV.

UNIT I

Histamine and Antihistaminic agents- H1-Antagonists: Chlorpheniramine*, Triprolidine, Phenindamine, Diphenhydramine*, Doxylamine succinate, Tripeleminamine, Antazoline phosphate, Cyclizine, Meclizine*, Buclizine, Promethazine*, Methdilazine, Cyproheptadine, Azatadine maleate, Fexofenadine, Loratadine, Desloratadine, Cetrizine, Acrivastin, H2 Antagonists: Cimetidine, Famotidine, Ranitidine*, Omeprazole*, Esomeprazole, Lansoprazole, Pantoprazole, Rabeprazole, Sucralfate, Misoprostol. Note on H3-Agonist and antagonists. SAR – H1 and H2 receptor antagonists.

UNIT II Synthetic antibacterials and antifungal agents

Sulphonamides and quinolones: Cotrimaxazole, Sulphacetamide*, Sulphaquanidine, sulfisoxazole*, sulfadoxime, trisulfapyrimidines, triple sulfa, Norfloxacin, Ciprofloxacin, Ofloxacin*, Levofloxacin. SAR- Sulphonamides, Fluroquinolones.

Urinary antiseptics: Nitrofurantoin*, Furazolidine, Nitrofurazole, Methenamine.

Antifungal agents: Clotrimazole*, Itraconazole, Ketoconazole, Miconazole*, Fluconazole, Amphotericin B, Nystatin, Griseofulvin*. SAR- azoles.

UNIT III Anti-paracytic and antimycobacterial agents

Antimalarials: Life cycle, Chloroquine*, Amodiaquine, Primaquine, Quinacrine*, Artemisinin, Pyrimethamine, Atovaquone and Proguanil. SAR – 4 -aminoquinolines, Aminoacridines.

Antiamoebics and anthelmintics: Metronidazole, Tinidazole*, Dilaxanide, Iodoquinol, DEC*, Thiabendazol, Piperazine, Mebendazole*, Albendazole, Dimercaprol, Niclosamide, Pyrantel Pamoate, Ivermectin. SAR- Azole

Antimycobacterials: Isoniazid*, Ethambutol*, Pyrazinamide, Rifampicin, Thioacetazone, 4-Asa, Cycloserins, Dapsone*, Clofazimine.

UNIT IV Antiviral and antineoplastic agents

Antiviral: Viral replication, Amantidine*, Acyclovir*, Oseltamivir, Idoxuridine, Zidovudine*, Lamivudine, Stavudine, Efavirenz, Didanosine, Tenofovir, Zalcitabine, Emitricitabine, Nevirapine, Ritonavir, Saquinavir. SAR- RTIs, NNRTIs.

Antineoplastic: Chlorambucil*, Cyclophosphamide, Ifosamide, Thiatepa, Lomustine, Busulfan, Carmustine*, Cisplatin, Procarbazine, Streptazocin, Methotrexate, 5-FU, Cytarabine, 6-Mp, Thioguanine, Vidarabine, Tamoxifen. Chemistry of anticancer antibiotics, A note on Newer agents. SAR – Alkylating agents, Nitroso ureas, Antimetabolites.

UNIT V Basic concepts of Drug Design and discovery

Concept on ligand, targets, lead molecules, Pharmacophore. Basis of structure based and ligand based drug design, note on Combinatorial chemistry, SAR, QSAR. Stereochemistry in drug design with suitable examples.

Text Books:

1. JH Block & JM Beale (Eds), *Wilson & Giswold's Text book of organic Medicinal Chemistry and pharmaceutical chemistry*, 11th Ed, Lipcolt, Raven, Philadelphia, 2004
2. William O. Foye, *Textbook of Medicinal Chemistry*, Lea Febiger, Philadelphia.
3. *An Introduction to Medicinal Chemistry* by Graham. L. Patrick, Oxford University publishers.
4. Rama Rao Nadendla, *Medicinal Chemistry*; Mc Millan Publishers.

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.*
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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL INDUSTRY MANAGEMENT AND QUALITY ASSURANCE	Code	13R00705
Course year	B. Pharm IV year	Semester	I
Theory	2 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	2		

UNIT I Features of Business Organisations & 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.

UNIT II

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

Organisation of Distribution and Marketing: Functions of Marketing, Marketing Mix, 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.

Audits in pharma industry : Various types of audits and insurance.

UNIT IV

Introduction to Good Manufacturing Practices: Schedule – M (India), CFR 21 Part 210 and 211 of US FDA, CGMP, GLP.

Introduction Drug Regulatory Agencies: Indian CDSCO, US FDA, EMEA, Canadian HPFBI, and Australian TGA. Introduction to NDA, ANDA, IND, ICH, patent law and ISO.

UNIT V

Introduction to quality assurance, quality control, Process validation (prospective, retrospective & concurrent), cleaning validation (sampling procedure and acceptance criteria), analytical method validation, EQUIPMENTS validation (DQ,IQ,OQ,PQ), SOP and STP. Types of documents in Quality assurance.

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.*
4. *NK Jain, Pharmaceutical product development, CBS publishers.*

Reference Books:

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

4. *Robert. A. Nash, Pharmaceutical Process Validation, 3rd Ed Marcel Dekker, 2003.*
5. *S.H. Willing, M.M Tucherman and W.S. Hitchings IV, Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control, Marcel Dekker, Inc., New York.*
6. *Leon Shargel Isadore Kanfer, Generic Drug Product Development, Solid Oral Dosage Forms, Marcel Dekker.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACOGNOSY – III LAB	Code	13R00706
Course year	B. Pharm IV year	Semester	I
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

I.EXPERIMENTS:

1. Determination of moisture content.
2. Determination of Ash values, water soluble ash, acid insoluble ash.
3. Determination of extractive values.
4. Isolation of quinine from Cinchona
5. Isolation of vasicine from Vasaka leaves.
6. Preparation of herbal formulations like, herbal syrups, churnas and the like.
7. TLC of any one alkaloid and one glycoside.
8. Preparation and evaluation of any one herbal cosmetic.
9. Preparation and evaluation of any one Ayurvedic formulation.
10. Phytochemical screening of a plant material.
11. Paper chromatography of any one type of phytoconstituents.

II.DEMO/WORKSHOP:

Column chromatography of plant extract, estimation of any one phytoconstituent by Modern chromatographic methods.

III.SEMINAR/ASSIGNMENT/GROUP DISCUSSION:

Related to theory syllabus.

Text Books:

- 1 *Practical Pharmacognosy*. - C.K. Kokate Nirali Prakashan
2. *Practical Pharmacognosy* - Iyengar Manipal press limited

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Water bath
2. Hotplates
3. Soxhlet extractor
4. Microscopes
5. Glass slides
6. Muffle furnace
7. Incinerator
8. Crucible
9. Colorimeter
10. Analytical balance
11. Heating mantle
12. Adequate glassware's

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	BIOPHARMACEUTICS & PHARMACOKINETICS LAB	Code	13R00707
Course year	B. Pharm IV year	Semester	I
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

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.

II. DEMO/ WORKSHOP

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

III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION

Chronopharmacokinetics.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACOLOGY – III LAB	Code	13R00708
Course year	B. Pharm IV year	Semester	I
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

I. EXPERIMENTS (To use appropriate software's for animal experimentation)

1. Experiments on Isolated tissue Preparations:
 - a. Calculate the PA₂ value of atropine using acetylcholine as an agonist on rat ileum preparation.
 - b. Calculate the PA₂ value of chlorpheniramine using histamine as an agonist on guinea pig ileum preparation.
 - c. Find out the strength of the given sample (e.g. Acetylcholine, Histamine, 5-HT. Oxytocin etc.) using a suitable isolated muscle preparation by
 - i. Interpolation bioassay
 - ii. Matching or bracketing bioassay
 - iii. Three point bioassay
 - iv. Four point bioassay
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 (analgesiometers)
 - 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. *In vitro* antioxidant activity
- c. Screening of antihistaminic activity (histamine chamber)

C. SEMINAR/ ASSIGNMENT/ GROUP DISCUSSION

- a. Pharmacokinetic studies and their principles.
- b. *In vitro-in vivo* correlation studies
- c. Pharmacovigilence
- 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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	MEDICINAL CHEMISTRY – III LAB	Code	13R00709
Course year	B. Pharm IV year	Semester	I
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

I. EXPERIMENTS:

1. Synthesis of hydrazones of benzoic acid
2. Synthesis of Eosin from Fluoroscein
3. Synthesis of benzilic acid from benzil
4. Synthesis of Sulphanilamide
5. Synthesis of 1,4- naphthaquinone from naphthalene
6. Synthesis of ortho iodo benzoic acid from anthranilic acid
7. Synthesis of Diazo amino benzene from aniline
8. Synthesis of acid hydrazides from salicylic acid
9. Synthesis of chalcones
10. Assay of Sulpha methoxazole (anti bacterial)
11. Assay of Glibenclamide (hypoglycaemic agent)
12. Assay of Metronidazole (antiprotozoal)
13. Assay of Isoniazid (anti tubercular)
14. Assay of Diethylcarbamazine (antihelmentic)
15. Assay of Compound benzoic acid (anti fungal)

II. DEMO/WORKSHOP

Vacuum drying, Chemdraw, Chems sketch, Recrystallization process, Separation of ternary mixtures

III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION

Water in phase transfer catalysis, Current topics on Cancer, Antibiotics, Anti-oxidants and chemotherapy of infectious diseases.

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.
3. I.P. – 1996.
4. P.D.Sethi – Quantative Analysis of Drugs in Pharmaceuticals. Formulations, CBS Publishers.
5. B.P. - 2004.

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 thermost
9. Distillation unit
10. Oven
11. Adequate glass wares

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	NOVEL DRUG DELIVERY SYSTEMS	Code	13R00801
Course year	B. Pharm IV year	Semester	II
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I Fundamentals of Controlled Drug Delivery System:

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

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

Mucoadhesive Delivery Systems: Mechanism of bioadhesion, mucoadhesive materials, formulation and evaluation of mucoadhesive-based systems.

UNIT IV

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

UNIT V

Miscellaneous delivery systems: Introduction, Principle and applications of Floating drug delivery, colon specific drug delivery and Ocular drug delivery.

Text Books:

1. N.K. Jain, *Advances in Control & Novel drug delivery*, CBS Publishers.
2. L. Lachman, H.A. Lieberman and J.L. Kanig, *Theory & Practice of industrial pharmacy* by, Lea & Febieger, Philadelphia Latest Edn.

Reference Books:

1. Robinson JR and Vincent HL. *Controlled drug delivery fundamentals and applications*, 2nd ed, marcel dekker 2005.
2. Lippincott Williams and Wilkins, *Remington Pharmaceutical Sciences*
3. E.A Rawlkins, *Bentley's Text Book of Pharmaceutics*, Elbs publ
4. HC Ansel, *Introduction to Pharmaceutical Dosage forms* 3rd Indian Ed; K M Varghese & Co., Bombay
5. Yiew Chien, *Novel drug delivery systems*, 2nd ed, marcel dekker 2003.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL BIOTECHNOLOGY	Code	13R00802
Course year	B. Pharm IV year	Semester	II
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

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, tetracyclin, 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*, 2nd Ed, Publ- Panima publication co-operation, New Delhi.
2. P. F. Stanbury & A. Whitaker, *Principles of fermentation technology*, Pergamon Press.
3. J. D. Watson, *Recombinant DNA technology*. 2nd Edition, W.H. Freeman 1992.
4. 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. Kielsliched *“Biotechnology”* Vol 6, Verlegchemic, Switzerland.
3. PF Standury & A. Whitaker, *“Principles of fermentation Technology”* Pergamon Press, Oxford.
4. A. Wiseman, *Handbook of enzyme biotechnology*. 3rd Edition Elis Horwood.
5. Alexande M Moo-young, *Comprehensive Biotechnology*, Pergamon Press, New York.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	CHEMISTRY OF NATURAL DRUGS	Code	13R00803
Course year	B. Pharm IV year	Semester	II
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

General structural elucidation of natural products

General extraction procedure for various phytoconstituents, techniques in identification for alkaloids, glycosides, steroids, terpenes, flavonoids, phenols, lignans, resins, carbohydrate and proteins. 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 II

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, Hyoscine, Hydrolytic products of these – Tropine and Scopolin. Relationship between tropine & pseudotropine. Biological actions and uses of tropane alkaloids. Homatropine.

Rauwolfia alkaloids: Structures and uses of Reserpine, Rescinnamine, Deserpidine, ajmaline, syrosingapine. 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, Ethysergide.

UNIT III

Terpenes & Terpenoids:

Introduction to Volatile oils, terpene vs terpenoids, Classification, isoprene, special isoprene and gem-dialkyl rules.

Sources and structures (Including isomerism), general extraction procedure and Pharmaceutical uses 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, alfa-terpeneol and ionones. Conversion and interconversion of camphor into camphoric acid, camphoronic acids, p-cymene, Borneol, isoborneol.

UNIT IV

Steroids: Introduction, nomenclature and classification of steroids. Stereochemistry of Cholesterol. Structure and uses of Bile acids, steroidal hormones. Different Sources of steroidal drugs like diosgenin, cholesterol, stigmasterol and ergosterol. synthesis of progesterone and testosterone. Synthetic oestrogens like diethyl stilbosterol, hexosterol, 17-alpha ethinyl oestradiol, Interconversions of Estrone, Estriol, Estradiol. Chemistry of keto and non keto adreno corticoids. A note on anabolic

steroids (Structure 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.

UNIT V

Vitamins: Classification, structure and related function in enzyme and physiological activity. Chemistry of thiamine, riboflavin, Niacin, Pyridoxine, Vitamin A, D, E, K. structural elucidation of Riboflavin, Vitamin D.

Text Books:

- 1) *JB Harborne, Phyto Chemical methods. Springer.*
- 2) *I L Finar, Organic chemistry, Vol. 1 & 2, the English language book society, London, New Delhi.*
- 3) *O.P.Agarwal, Natural products by. Vol.1 & 2, Goel publications – Meerut.*

Reference Books:

1. *RT 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.*
4. *RM. Acheson, an introduction to the chemistry of heterocyclic compounds, Interscience NY.*
5. *Duquesn & others, Practical pharmacognocoy, CBS Publ.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	STATISTICAL METHODS AND COMPUTER APPLICATIONS	Code	13R00804
Course year	B. Pharm IV year	Semester	II
Theory	3 hrs/week	Tutorial	1hr/week
End exam	70 marks	Internal exam	30 marks
Credits	3		

UNIT I

Basics of Statistics:

Types of data, Collection of data, Variables and variation, sample, population, statistic and parameter, Measures of central tendency, Measures of Dispersion, Coefficient of variation Graphical representation of data: Histogram, Semilogarithmic plots, bar, pie diagrams, binomial, Poisson and Normal distributions, kurtosis and skewness.

UNIT II

Correlation and Regression:

Correlation Spearman coefficient of correlation, Pearson's rank correlation, Regression analysis, linear regression

Statistical Inference: Basics of testing hypothesis: Null Hypothesis, Alternate Hypothesis, Level of Significance, Confidence interval, Standard errors, parametric and non-parametric tests used in pharmaceutical experiments

UNIT III

ANOVA:

one way and two way analysis, CRD, RBD, Latin square designs, SQC, Applications of statistical concepts in pharmaceutical sciences

UNIT IV

Introduction to Computers:

Components of computers, computer languages, use of computers, Introduction to operating system.

MS-OFFICE: MS-WORD, MS-EXCEL, MS-POWERPOINT. Information technology: Internet and world wide web, Search strategies.

UNIT V

Computer applications in pharmaceutical and clinical studies, computer validation- introduction

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.

Text Books:

1. *Biostatistics* by R.S. Shukla and P.S.Chandel-S.Chand.
2. *Pranab Kumar Benarjee, Introduction to Biostatistics.*
3. *Fundamentals of Statistics* by Khan and Khanum.
4. *Pharmaceutical Statistics 5th edition* by Sanford Bolton, Tuscon, Arizone, USA AND Charles Bon - *Biostudy solutions, LLC Wilmington, North Carolina, USA.*
5. *RonMansfiled, Working in Microsoft office.*
6. *Text book of Statistical Methods and Computer applications* by Dr.Ramakrishna Prasad.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	CLINICAL AND HOSPITAL PHARMACY	Code	13R00805
Course year	B. Pharm IV year	Semester	II
Theory	2 hrs/week	Tutorial	1 hr/week
End exam	70 marks	Internal exam	30 marks
Credits	2		

UNIT I Introduction to clinical pharmacy:

- a. Prospects and perspectives of clinical pharmacy in national and international scenario, scope of clinical pharmacy
- b. Therapeutic Drug Monitoring.
- c. Clinical Pharmacokinetics and individualization of Drug Therapy.
- d. Concept of Essential Drugs and Rational Drug use.

UNIT II Introduction to daily activities of Clinical pharmacist

- a. Drug therapy monitoring (Medication chart review)
- b. Adverse Drug Reactions & Drug Interactions
- c. Patient counseling
- d. Drug and poison information.
- e. Ward round participation.

UNIT III Clinical laboratory tests and interpretation of test results.

- a. Hematological (complete blood picture)
- b. Pulmonary function tests
- c. Tests associated with cardiac disorders
- d. 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:

1. *A Textbook of clinical pharmacy practice: Essential concepts and skills. Dr G Parthasarathi et al. Orient Longmann pvt ltd. ISSN: 8125026*
2. *Leon shargel, comprehensive pharmacy review, Latest Edition*
3. *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 Dvn.*
2. *Health Education and Community Pharmacy, NK Jain, CBS, Publ. and Distributors New Delhi.*
3. *Hospital pharmacy by Hassan.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	NOVEL DRUG DELIVERY SYSTEMS LAB	Code	13R00806
Course year	B. Pharm IV year	Semester	II
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

I. EXPERIMENTS:

1. Preparation and evaluation of Matrix Tablets
2. Formulation and evaluation of Film Coated Tablets.
3. Formulation and evaluation of Enteric Coated Tablets.
4. Preparation and evaluation of Transdermal Drug Delivery Systems.
5. Formulation and evaluation of Mucoadhesive Delivery Systems.
6. Evaluation of Market Sustained Release Formulations.
7. Preparation and evaluation of microspheres.

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. Leon Shargel Isadore Kanfer, Generic Drug Product Development, Solid Oral Dosage Forms, Marcel Dekker.
2. Lippincott Williams and Wilkins, Remington Pharmaceutical Sciences
3. E.A Rawlkins, Bentley's Text Book of Pharmaceutics, Elbs publ
4. HC Ansel, Introduction to Pharmaceutical Dosage forms 3rd Indian Ed; K M Varghese & Co., Bombay
5. S.H. Willing, M.M Tucherman and W.S. Hitchings IV, Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control, Marcel Dekker, Inc., New York
6. Gilbert S. Banker and Christopher T Rhodes, Modern Pharmaceutics, IVth ed, marcel dekker, usa, 2005.
7. Controlled drug delivery systems by Robinson.
8. Yiew Chien, novel drug delivery systems, 2nd ed, marcel dekker 2003.
9. Robert. A. Nash, Pharmaceutical Process Validation, 3rd Ed Marcel Dekker, 2003.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	PHARMACEUTICAL BIOTECHNOLOGY LAB	Code	13R00807
Course year	B. Pharm IV year	Semester	II
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

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

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	CHEMISTRY OF NATURAL DRUGS LAB	Code	13R00808
Course year	B. Pharm IV year	Semester	II
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

S.No Name of the experiment

- 1 Preparation of different alkaloidal reagents, like Dragendorff, Mayer, Wagner's, Hager's etc and testing of some alkaloids and plant extracts using these reagents. Identification of alkaloids by specific colour tests.
- 2 Tests for steroids, steroidal glycosides, cardiac glycosides.
- 3 Test for flavonoids and their glycosides.
- 4 Tests for anthraquinones, saponin glycosides.
- 5 TLC of strychnine in extract of Nux vomica.
- 6 TLC of Menthol in mentha oil.
- 7 TLC of Digoxin in extract of digitalis.
- 8 TLC of quercetin in plant extracts.
- 9 Extraction and isolation of caffeine from tea leaves.
- 10 Extraction and isolation of piperine from black pepper.
- 11 Extraction of nicotine from tobacco.
- 12 Extraction of Atropine from Datura.
- 13 Estimation of phenolic content in plant extract (Demonstration only)
- 14 Degradation of a phytoconstituent and its confirmation by micro TLC.

Seminar/Assignment related to theory syllabus

References:

1. Practical Pharmacognosy, CK 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-Scientechics, Bristol.
5. Indian Pharmacopoeia. 1966.
6. Peach K and Tracey MV, Modern methods of Plant analysis, Narose publishing house, New Delhi.
7. Herbal Pharmacopoeia, IDMA, India.

LIST OF MINIMUM EQUIPMENTS REQUIRED

1. Soxhlet extraction apparatus
2. Heating mantle
3. Steam distillation apparatus
4. TLC kit
5. Water bath
6. Hot plates
7. Oven

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU**

Subject	STATISTICAL METHODS AND COMPUTER APPLICATIONS LAB	Code	13R00809
Course year	B. Pharm IV year	Semester	II
Practical	3 hrs/week	Tutorial	NIL
End exam	50 marks	Internal	25 marks
credits	2		

I. Experiments

- 1 Computation of Mean, S.D and Co-efficient of variation
- 2 Computation of Correlation
- 3 Equations of Regression lines
- 4 Fitting a Straight line
- 5 Student t-test
- 6 Chi-square test
- 7 ANOVA-one way
- 8 ANOVA-two way
- 9 CRD Experimentation
- 10 Randomised Block Design
- 11 Latin Square Design
- 12 Construction of x-chart
- 13 Construction of R-chart
- 14 MS-WORD Experiment
- 15 MS-excel and Powerpoint

II. Seminar/Group discussion/Assignment:

1. Applications of statistics in pharmaceutical computations
2. Computer applications in pharmaceutical and clinical studies

References:

1. *Pharmaceutical Statistics 5th edition by Sanford Bolton and Charles Bon.*