JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
Course Structure and Syllabi for M.Pharm-Pharmaceutical Chemistry
(JNTUA-Affiliated Pharmacy Colleges 2017-18)

I YEAR - I Semester

S. No	Course Code	Subjects	L	T	P	C
1	17S01101	Modern Pharmaceutical Analytical Techniques	4	-	-	4
2	17S02101	Advanced Organic Chemistry -I	4	-	-	4
3	17S02102	Advanced Medicinal chemistry	4	-	-	4
4	17S02103	Chemistry of Natural Products	4	-	-	4
5	**17S02104**	**Pharmaceutical Analysis Practical for Pharmaceutical Chemistry**	**-**	**-**	**6**	**3**
6	**17S02105**	**Pharmaceutical Chemistry Practical I**	**-**	**-**	**6**	**3**
7	17S02106	Seminar/Assignment	-	-	7	4
		Total	16	-	19	26

I YEAR II Semester

S. No	Course Code	Subject	L	T	P	C
1	17S02201	Advanced Spectral Analysis	4	-	-	4
2	17S02202	Advanced Organic Chemistry -II	4	-	-	4
3	17S02203	Computer Aided Drug Design	4	-	-	4
4	17S02204	Pharmaceutical Process Chemistry	4	-	-	4
5	17S02205	Pharmaceutical Chemistry Practical II	-	-	6	3
6	17S02206	Pharmaceutical Chemistry Practical III	-	-	6	3
7	17S02207	Seminar/Assignment	-	-	7	4
		Total	16	-	19	26

III SEMESTER

S.No	Subject Code	Subject	L	T	P	C
1.	17S01301	Research Methodology and Biostatistics	4	-	-	4
2.	17S02301	Journal Club	1	-	-	1
3.	17S02302	Teaching Assignment	10	-	-	2
4.	17S02303	Comprehensive viva voce	-	-	-	2
5.	17S02304	Discussion / Presentation (Proposal presentation)	-	-	2	2
6.	17S02305	Research Work	-	-	28	14
Total			15	-	30	25

IV SEMESTER

S.No	Subject Code	Subject	L	T	P	C
1.	17S02401	Journal Club	1	-	-	1
2.	17S02402	Research work	31	-	-	16
3.	17S02403	Discussion/ Final Presentation	3	-	-	3
Total			35	-	-	20

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Pharm – I year I Sem. (Pharmaceutical Chemistry)

L	T	P	C
4	0	0	4

(17S01101) MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

Scope

This subject deals with various advanced analytical instrumental techniques foridentification, characterization and quantification of drugs. Instruments dealt areNMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know about chemicals andexcipients

- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

THEORY **60 HOURS**

1. 11 hrs

a. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV Visible spectroscopy.

b. IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling,

Instrumentation of Dispersive and Fourier -Transform IR Spectrometer, Factors

affecting vibrationalfrequencies and Applications of IR spectroscopy

c. Spectroflourimetry: Theory of Fluorescence, Factorsaffecting fluorescence, Quenchers,

Instrumentation andApplications of fluorescence spectrophotometer.

d. Flame emission spectroscopy and Atomic absorptionspectroscopy: Principle,

Instrumentation, Interferences andApplications.

2. 11hrs

NMR spectroscopy: Quantum numbers and their role in NMR,Principle, Instrumentation, Solvent requirement in NMR,Relaxation process, NMR signals in various compounds,Chemical shift, Factors influencing chemical shift, Spin-Spincoupling, Coupling constant, Nuclear magnetic double resonance,Brief outline of principles of FT-NMR and 13C NMR. Applicationsof NMR spectroscopy.

3. 11hrs

Mass Spectroscopy: Principle, Theory, Instrumentation of MassSpectroscopy, Different types of ionization like electron impact,chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers

ofQuadrupole and Time of Flight, Mass fragmentation and its rules,Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy

4. 11hrs

Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a)Paper chromatography b) Thin Layer chromatographyc) Ion exchange chromatography d) Column chromatographye) Gas chromatography f) High Performance Liquidchromatographyg) Affinity chromatography

5 11hrs

a. Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following:

a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis

d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing

b. X ray Crystallography: Production of X rays, Different X raydiffraction methods, Bragg's law, Rotating crystal technique, Xray powder technique, Types of crystals and applications of Xray diffraction.

c. Immunological assays: RIA (Radio immuno assay), ELISA, Bioluminescence assays.5hrs

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein,Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler,Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4thedition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rdEdition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume11, Marcel Dekker Series

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M. Pharm – I year I Sem. (Pharmaceutical Chemistry)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17S02101) ADVANCED ORGANIC CHEMISTRY - I

SCOPE

The subject is designed to provide in-depth knowledge about advances inorganic chemistry, different techniques of organic synthesis and theirapplications to process chemistry as well as drug discovery.

Objectives

Upon completion of course, the student shall be to understand

- The principles and applications of reterosynthesis
- The mechanism & applications of various named reactions
- The concept of disconnection to develop synthetic routes for small target molecule.
- The various catalysts used in organic reactions
- The chemistry of heterocyclic compounds

THEORY 60 Hrs

1. 12Hrs

Basic Aspects of Organic Chemistry:

1. Organic intermediates: Carbocations, carbanions, freeradicals, carbenes and nitrenes. Their method offormation, stability and synthetic applications.
2. Types of reaction mechanisms and methods ofdetermining them,
3. Detailed knowledge regarding the reactions,mechanisms and their relative reactivity and orientations.

Addition reactions

a) Nucleophilic uni- and bimolecular reactions (SN1 andSN2)
b) Elimination reactions (E1 & E2; Hoffman &Saytzeff'srule)
c) Rearrangement reaction

2 12Hrs

Study of mechanism and synthetic applications of followingnamed Reactions:

Ugi reaction, Brook rearrangement, Ullmann coupling reactions,Dieckmann Reaction, Doebner-Miller Reaction, SandmeyerReaction, Mitsunobu reaction, Mannich reaction, Vilsmeyer-HaackReaction, Sharpless asymmetric epoxidation, Baeyer-Villigeroxidation, Shapiro & Suzuki reaction, Ozonolysis and Michaeladdition reaction

3 12Hrs

Synthetic Reagents & Applications:

Aluminiumisopropoxide, N-bromosuccinamide, diazomethane,dicyclohexylcarbodimide, Wilkinson reagent, Witting reagent.Osmium tetroxide, titanium chloride, diazopropane, diethylazodicarboxylate, Triphenylphosphine, Benzotriazol-1-yloxy) tris(dimethylamino) phosphoniumhexafluoro-phosphate (BOP).

Protecting groups

a. Role of protection in organic synthesis

b. Protection for the hydroxyl group, including 1,2-and1,3-diols:ethers, esters, carbonates, cyclic acetals&ketals

c. Protection for the Carbonyl Group: Acetals and Ketals

d. Protection for the Carboxyl Group: amides and hydrazides,esters

e. Protection for the Amino Group and Amino acids: carbamatesand amides

4 12Hrs

Heterocyclic Chemistry:

Organic Name reactions with their respective mechanism andapplication involved in synthesis of drugs containing five, sixmembered and fused hetrocyclics such as Debus-Radziszewskiimidazole synthesis, Knorr Pyrazole Synthesis Pinner PyrimidineSynthesis, CombesQuinoline Synthesis, BernthsenAcridineSynthesis, Smiles rearrangement and Traube purine synthesis.

Synthesis of few representative drugs containing thesehetrocyclic nucleus such as Ketoconazole, Metronidazole,Miconazole, celecoxib, antipyrin, Metamizolesodium,Terconazole, Alprazolam, Triamterene, Sulfamerazine,Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine,Quinacrine, Amsacrine, Prochlorpherazine, Promazine,Chlorpromazine,Theophylline , Mercaptopurine and Thioguanine.

5 12Hrs

Synthon approach and retrosynthesis applications

i. Basic principles, terminologies and advantages ofretrosynthesis; guidelines for dissection of molecules.Functional group interconvertion and addition (FGI and FGA)

ii. C-X disconnections; C-C disconnections – alcohols andcarbonyl compounds; 1,2-, 1,3-,1,4-, 1,5-, 1,6-difunctionalizedcompounds

iii. Strategies for synthesis of three, four, five and six-memberedring.

REFERENCES

1. “Advanced Organic chemistry, Reaction, Mechanisms and Structure”, JMarch, John Wiley and Sons, New York.

2. “Mechanism and Structure in Organic Chemistry”, ES Gould, Hold Rinchartand Winston, New York.

3. “Organic Chemistry” Clayden, Greeves, Warren and Woihers.,OxfordUniversity Press 2001.

4. “Organic Chemistry” Vol I and II. I.L. Finar. ELBS, Pearson Education Lts,Dorling Kindersley 9India) Pvt. Ltd.,.

5. A guide to mechanisms in Organic Chemistry, Peter Skyes (OrientLongman, New Delhi).

6. Reactive Intermediates in Organic Chemistry, Tandom and Gowel, Oxford& IBH Publishers.

7. Combinational Chemistry – Synthesis and applications – Stephen RWilson& Anthony W Czarnik, Wiley – Blackwell.

8. Carey, Organic Chemistry, 5th Edition (Viva Books Pvt. Ltd.)

9. Organic Synthesis - The Disconnection Approach, S. Warren, Wily India

10. Principles of Organic Synthesis, ROC Norman and JM Coxan, NelsonThorns.

11. Organic Synthesis - Special Techniques. VK Ahluwalia and R Agarwal,Narosa Publishers.

12. Organic Reaction Mechanisms IVthEdtn, VK Ahluwalia and RK Parashar,Narosa Publishers.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Pharm – I year I Sem. (Pharmaceutical Chemistry)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17S02102) ADVANCED MEDICINAL CHEMISTRY

SCOPE

The subject is designed to impart knowledge about recent advances in the field of medicinal chemistry at the molecular level including different techniques for the rational drug design.

Objectives

At completion of this course it is expected that students will be able to understand

- Different stages of drug discovery
- Role of medicinal chemistry in drug research
- Different techniques for drug discovery
- Various strategies to design and develop new drug like molecules for biological targets
- Peptidomimetics

THEORY 60 Hrs

1. 12Hrs

Drug discovery: Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets.Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptorinteractions, agonists vs antagonists, artificial enzymes.

2 12Hrs

Prodrug Design and Analog design:

a) Prodrug design: Basic concept, Carrier linked prodrugs/Bioprecursors, Prodrugs of functional group, Prodrugstoimprove patient acceptability, Drug solubility, Drugabsorption and distribution, site specific drug deliveryand sustained drug action. Rationale of prodrugdesignand practical consideration of prodrug design.

b) Combating drug resistance: Causes for drugresistance, strategies to combat drug resistance inantibiotics and anticancer therapy, Genetic principles of drug resistance.

c) Analog Design: Introduction, Classical & Non classical,Bioisosteric replacement strategies, rigid analogs,alteration of chain branching, changes in ring size, ringposition isomers, design of stereo isomers andgeometric isomers, fragments of a lead molecule,variation in inter atomic distance.

3 12Hrs

Medicinal chemistry aspects of the following class of drugsSystematic study, SAR, Mechanism of action and synthesis ofnew generation molecules of following class of drugs:

a) Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsantdrugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors,Adrenergic& Cholinergic agents, Antineoplastic and Antiviralagents.

b) Stereochemistry and Drug action: Realization that stereoselectivity is a pre-requisite for evolution. Role of chirality inselective and specific therapeutic agents. Case studies,Enantio selectivity in drug adsorption, metabolism, distributionand elimination.

4 12Hrs

Rational Design of Enzyme InhibitorsEnzyme kinetics & Principles of Enzyme inhibitors, Enzymeinhibitors in medicine, Enzyme inhibitors in basic research,rational design of non-covalently and covalently binding enzymeinhibitors.

5 12Hrs

PeptidomimeticsTherapeutic values of Peptidomimetics, design ofpeptidomimetics by manipulation of the amino acids, modificationof the peptide backbone, incorporating conformational constraintslocally or globally. Chemistry of prostaglandins, leukotrienesandthromboxones.

REFERENCES

1. Medicinal Chemistry by Burger, Vol I –VI.

2. Wilson and Gisvold's Text book of Organic Medicinal and PharmaceuticalChemistry, 12th Edition, Lppincott Williams & Wilkins, WoltessKluwer(India) Pvt.Ltd, New Delhi.

3. Comprehensive Medicinal Chemistry – Corwin and Hansch.

4. Computational and structural approaches to drug design edited by RobertM Stroud and Janet. F Moore

5. Introduction to Quantitative Drug Design by Y.C. Martin.

6. Principles of Medicinal Chemistry by William Foye, 7th Edition, IppincottWilliams& Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.

7. Drug Design Volumes by Arienes, Academic Press, Elsevier Publishers,Noida, Uttar Pradesh..

8. Principles of Drug Design by Smith.

9. The Organic Chemistry of the Drug Design and Drug action by RichardB.Silverman, II Edition, Elsevier Publishers, New Delhi.

10. An Introduction to Medicinal Chemistry, Graham L.Patrick, III Edition,Oxford University Press, USA.

11. Biopharmaceutics and pharmacokinetics, DM.Brahmankar, Sunil B.Jaiswal II Edition, 2014, VallabhPrakashan, New Delhi.

12. Peptidomimetics in Organic and Medicinal Chemistry by Antonio Guarnaand Andrea Trabocchi, First edition, Wiley publishers.

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M. Pharm – I year I Sem. (Pharmaceutical Chemistry)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17S02103) CHEMISTRY OF NATURAL PRODUCTS

SCOPE

The subject is designed to provide detail knowledge about chemistry ofmedicinal compounds from natural origin and general methods of structuralelucidation of such compounds. It also emphasizes on isolation, purification andcharacterization of medicinal compounds from natural origin.

Objectives

At completion of this course it is expected that students will be able tounderstand-

- Different types of natural compounds and their chemistry and medicinal importance
- The importance of natural compounds as lead molecules for new drug discovery
- The concept of rDNA technology tool for new drug discovery
- General methods of structural elucidation of compounds of natural origin
- Isolation, purification and characterization of simple chemical constituents from natural source

THEORY 60 Hrs

1. 12Hrs

Study of Natural products as leads for new pharmaceuticalsfor the following class of drugs

a) Drugs Affecting the Central Nervous System: MorphineAlkaloids

b) Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, andTeniposide

c) Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol

d) Neuromuscular Blocking Drugs: Curare alkaloids

e) Anti-malarial drugs and Analogues

f) Chemistry of macrolid antibiotics (Erythromycin, Azithromycin,Roxithromycin, and Clarithromycin) and β - Lactam antibiotics(Cephalosporins and Carbapenem)

2 12Hrs

a) Alkaloids

General introduction, classification, isolation, purification,molecular modification and biological activity of alkaloids, generalmethods of structural determination of alkaloids, structuralelucidation and stereochemistry of ephedrine, morphine, ergot,emetine and reserpine.

b) Flavonoids

Introduction, isolation and purification of flavonoids, Generalmethods of structural determination of flavonoids; Structuralelucidation of quercetin.

c) Steroids

General introduction, chemistry of sterols, sapogenin and cardiacglycosides. Stereochemistry and nomenclature of steroids,chemistry of contraceptive agents male & female sex hormones(Testosterone, Estradiol, Progesterone), adrenocorticoids(Cortisone), contraceptive agents and steroids (Vit – D).

3 12Hrs

a) Terpenoids

Classification, isolation, isoprene rule and general methods ofstructural elucidation of Terpenoids; Structural elucidation ofdrugs belonging to mono (citral, menthol, camphor), di(retinol,Phytol, taxol) and tri terpenoids (Squalene,Ginsenoside)carotinoids (β carotene).

b) Vitamins

Chemistry and Physiological significance of Vitamin A, B1, B2,B12, C, E, Folic acid and Niacin.

4 12Hrs

a). Recombinant DNA technology and drug discoveryrDNA technology, hybridoma technology, New pharmaceuticalsderived from biotechnology; Oligonucleotide therapy. Genetherapy: Introduction, Clinical application and recent advances ingene therapy, principles of RNA & DNA estimation

b). Active constituent of certain crude drugs used inIndigenous system Diabetic therapy – Gymnemasylvestre,Salacia reticulate, Pterocarpusmarsupiam, Swertiachirata,Trigonellafoenumgraccum; Liver dysfunction – Phyllanthusniruri;Antitumor – Curcuma longa Linn.

5 12Hrs

Structural Characterization of natural compoundsStructural characterization of natural compounds using IR,1HNMR, 13CNMR and MS Spectroscopy of specific drugs e.g.,Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalisglycosides.

REFERENCES

1. Modern Methods of Plant Analysis, Peech and M.V.Tracey, Springer –Verlag, Berlin, Heidelberg.

2. Phytochemistry Vol. I and II by Miller, Jan Nostrant Rein Hld.

3. Recent advances in Phytochemistry Vol. I to IV – ScikelRuneckles,Springer Science & Business Media.

4. Chemistry of natural products Vol I onwards IWPAC.

5. Natural Product Chemistry Nakanishi Gggolo, University Science Books,California.

6. Natural Product Chemistry “A laboratory guide” – Rapheal Khan.

7. The Alkaloid Chemistry and Physiology by RHF Manske, Academic Press.

8. Introduction to molecular Phytochemistry – CHJ Wells, Chapmannstall.

9. Organic Chemistry of Natural Products Vol I and II by GurdeepandChatwall, Himalaya Publishing House.

10. Organic Chemistry of Natural Products Vol I and II by O.P. Agarwal,KrishanPrakashan.

11. Organic Chemistry Vol I and II by I.L. Finar, Pearson education.

12. Elements of Biotechnology by P.K. Gupta, Rastogi Publishers.

13. Pharmaceutical Biotechnology by S.P.Vyas and V.K.Dixit, CBS Publishers.

14. Biotechnology by Purohit and Mathur, Agro-Bios, 13th edition.

15. Phytochemical methods of Harborne, Springer, Netherlands.

16. Burger’s Medicinal Chemistry.

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M. Pharm – I year I Sem. (Pharmaceutical Chemistry)	**L**	**T**	**P**	**C**
	0	**0**	**6**	**3**

(17S02104) PHARMACEUTICAL ANALYSIS PRACTICAL FOR PHARMACEUTICAL CHEMISTRY

1. Analysis of Pharmacopoeial compounds and their formulations by UV Visspectrophotometer, RNA & DNA estimation
2. Simultaneous estimation of multi component containing formulations by UVspectrophotometry
3. Experiments based on Column chromatography
4. Experiments based on HPLC
5. Experiments based on Gas Chromatography
6. Estimation of riboflavin/quinine sulphate by fluorimetry
7. Estimation of sodium/potassium by flame photometry

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M. Pharm – I year I Sem. (Pharmaceutical Chemistry)	**L**	**T**	**P**	**C**
	0	**0**	**6**	**3**

(17S02105) PHARMACEUTICAL CHEMISTRY PRACTICAL - I

To perform the following reactions of synthetic importance

1. Purification of organic solvents, column chromatography
2. Claisen-schimidt reaction.
3. Benzyllic acid rearrangement.
4. Beckmann rearrangement.
5. Hoffmann rearrangement
6. Mannich reaction
7. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments)
8. Estimation of elements and functional groups in organic natural compounds
9. Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data.
10. Some typical degradation reactions to be carried on selected plant constituents
11. Oxidation and free radical coupling
12. Fries rearrangement
13. Perkins reaction

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M. Pharm – I year II Sem. (Pharmaceutical Chemistry)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17S02201) ADVANCED SPECTRAL ANALYSIS

Scope

This subject deals with various hyphenated analytical instrumental techniquesfor identification, characterization and quantification of drugs. Instruments dealtare LC-MS, GC-MS, ATR-IR, DSC etc.

Objectives

At completion of this course it is expected that students will be able tounderstand-

- Interpretation of the NMR, Mass and IR spectra of various organic compounds
- Theoretical and practical skills of the hyphenated instruments
- Identification of organic compounds

THEORY 60Hrs

1. 12Hrs

UV and IR spectroscopy:

Wood ward – Fieser rule for 1,3- butadienes, cyclic dienes and α,β-carbonyl compounds and interpretation compounds of enones.ATR-IR, IR Interpretation of organic compounds.

2 12Hrs

NMR spectroscopy:1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds.

3 12Hrs

Mass Spectroscopy

Mass fragmentation and its rules, Fragmentation of importantfunctional groups like alcohols, amines, carbonyl groups andalkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule,Isotopic peaks, Interpretation of organic compounds.

4 12Hrs

Chromatography:

Principle, Instrumentation and Applications of the following :

a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CEMSg) High Performance Thin Layer chromatography h) Supercritical fluid chromatography i) Ion Chromatography j) I-EC (Ion-Exclusion Chromatography) k) Flash chromatography

5 12Hrs

a). Thermalmethods of analysisIntroduction, principle, instrumentation and application of DSC,DTA and TGA.

b). Raman SpectroscopyIntroduction, Principle, Instrumentation and Applications.

c). Radio immunoassayBiologicalstandardization , bioassay, ELISA, Radioimmunoassay of digitalis and insulin.

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein,Sixth edition, John Wiley & Sons, 2004.

2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler,Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.

3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.

4. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.

5. Quantitative analysis of Pharmaceutical formulations by HPTLC - P DSethi, CBS Publishers, New Delhi.

6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi,3rd Edition, CBS Publishers, New Delhi, 1997.

7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson,Volume 11, Marcel Dekker Series

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M. Pharm – I year II Sem. (Pharmaceutical Chemistry)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17S02202) ADVANCED ORGANIC CHEMISTRY - II

Scope

The subject is designed to provide in-depth knowledge about advances inorganic chemistry, different techniques of organic synthesis and theirapplications to process chemistry as well as drug discovery.

Objectives

Upon completion of course, the student shall able to understand

- The principles and applications of Green chemistry
- The concept of peptide chemistry.
- The various catalysts used in organic reactions
- The concept of stereochemistry and asymmetric synthesis.

THEORY 60 Hrs

1. 12Hrs

Green Chemistry:

a. Introduction, principles of green chemistry

b. Microwave assisted reactions: Merit and demerits of its use,increased reaction rates, mechanism, superheating effects ofmicrowave, effects of solvents in microwave assistedsynthesis, microwave technology in process optimization, itsapplications in various organic reactions and heterocyclessynthesis

c. Ultrasound assisted reactions: Types of sonochemicalreactions, homogenous, heterogeneous liquid-liquid andliquid-solid reactions, synthetic applications

d. Continuous flow reactors: Working principle, advantages andsynthetic applications.

2 12Hrs

Chemistry of peptides

a. Coupling reactions in peptide synthesis

b. Principles of solid phase peptide synthesis, t-BOC and FMOCprotocols, various solid supports and linkers: Activationprocedures, peptide bond formation, deprotectionandcleavage from resin, low and high

HF cleavage protocols,formation of free peptides and peptide amides, purification andcase studies, site-specific chemical modifications of peptides

c. Segment and sequential strategies for solution phase peptidesynthesis with any two case studies

d. Side reactions in peptide synthesis: Deletion peptides, sidereactions initiated by proton abstraction, protonation, overactivationand side reactions of individual amino acids.

3 12Hrs

Photochemical Reactions

Basic principles of photochemical reactions. Photo-oxidation,photo-addition and photo-fragmentation.PericyclicreactionsMechanism, Types of pericyclic reactions such as cycloaddition,electrocyclic reaction and sigmatrophic rearrangement reactionswith examples

4 12Hrs

Catalysis:

a. Types of catalysis, heterogeneous and homogenous catalysis,advantages and disadvantages

b. Heterogeneous catalysis – preparation, characterization,kinetics, supported catalysts, catalyst deactivation andregeneration, some examples of heterogeneous catalysisused in synthesis of drugs.

c. Homogenous catalysis, hydrogenation, hydroformylation,hydrocyanation, Wilkinson catalysts, chiral ligands and chiralinduction, Ziegler-Natta catalysts, some examples ofhomogenous catalysis used in synthesis of drugs

d. Transition-metal and Organo-catalysis in organic synthesis:Metal-catalyzed reactions

e. Biocatalysis: Use of enzymes in organic synthesis,immobilized enzymes/cells in organic reaction.

f. Phase transfer catalysis - theory and applications

5 12Hrs

Stereochemistry & Asymmetric Synthesis

a. Basic concepts in stereochemistry – optical activity, specificrotation, racemates and resolution of racemates, the Cahn,Ingold, Prelog (CIP) sequence rule, meso compounds, pseudoasymmetric centres, axes of symmetry, Fischers D and Lnotation, cis-trans isomerism, E and Z notation.

b. Methods of asymmetric synthesis using chiral pool, chiralauxiliaries and catalytic asymmetric synthesis, enantiopureseparation and Stereo selective synthesis with examples.

REFERENCES

1. “Advanced Organic chemistry, Reaction, mechanisms and structure”, JMarch, John Wiley and sons, New York.

2. “Mechanism and structure in organic chemistry”, ES Gould, Hold RinchartandWinston,NewYork.

3. “Organic Chemistry” Clayden, Greeves, Warren and Woihers.,OxfordUniversity Press 2001.

4. “Organic Chemistry” Vol I and II. I.L. Finar. ELBS, Sixth ed., 1995.

5. Carey, Organic chemistry, 5th edition (Viva Books Pvt. Ltd.)

6. Organic synthesis-the disconnection approach, S. Warren, Wily India

7. Principles of organic synthesis, ROCNorman and JMCoxan, Nelson thorns

8. Organic synthesis- Special techniques VK Ahluwalia and R Aggarwal,Narosa Publishers.

9. Organic reaction mechanisms IV edtn, VK Ahluwalia and RK Parashar,Narosa Publishers.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Pharm – I year II Sem. (Pharmaceutical Chemistry)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17S02203) COMPUTER AIDED DRUG DESIGN

Scope

The subject is designed to impart knowledge on the current state of the arttechniques involved in computer assisted drug design.

Objectives

At completion of this course it is expected that students will be able tounderstand

- Role of CADD in drug discovery
- Different CADD techniques and their applications
- Various strategies to design and develop new drug like molecules.
- Working with molecular modeling softwares to design new drug molecules
- The in silico virtual screening protocols

Theory 60 Hrs

1. 12Hrs

Introduction to Computer Aided Drug Design (CADD)History, different techniques and applications.Quantitative Structure Activity Relationships: BasicsHistory and development of QSAR: Physicochemical parametersand methods to calculate physicochemical parameters: Hammettequation and electronic parameters (sigma), lipophilicityeffectsand parameters (log P, pi-substituent constant), steric effects(Taft steric and MR parameters) Experimental and theoreticalapproaches for the determination of these physicochemicalparameters.

2 12Hrs

Quantitative Structure Activity Relationships: ApplicationsHansch analysis, Free Wilson analysis and relationship betweenthem, Advantages and disadvantages; Deriving 2D-QSARequations.3D-QSAR approaches and contour map analysis.Statistical methods used in QSAR analysis and importance ofstatistical parameters.

3 12Hrs

Molecular Modeling and Docking

a) Molecular and Quantum Mechanics in drug design.

b) Energy Minimization Methods: comparison between globalminimum conformation and bioactive conformation

c) Molecular docking and drug receptor interactions: Rigiddocking, flexible docking and extra-precision docking.Agents acting on enzymes such as DHFR, HMG-CoAreductase and HIV protease, choline esterase (AchE&BchE)

4 12Hrs

Molecular Properties and Drug Design

a) Prediction and analysis of ADMET properties of newmolecules and its importance in drug design.

b) De novo drug design: Receptor/enzyme-interaction and itsanalysis, Receptor/enzyme cavity size prediction, predictingthe functional components of cavities, Fragment based drugdesign.

c) Homology modeling and generation of 3D-structure ofprotein.

5 12Hrs

Pharmacophore Mapping and Virtual ScreeningConcept of pharmacophore, pharmacophoremapping,identification of Pharmacophore features and Pharmacophoremodeling; Conformational search used in pharmacophoremapping.InSilico Drug Design and Virtual Screening TechniquesSimilarity based methods and Pharmacophore based screening,structure based In-silico virtual screening protocols.

REFERENCES

1. Computational and structural approaches to drug discovery, Robert MStroud and Janet. F Moore, RCS Publishers.

2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press,Taylor& Francis group..

3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, ElsevierPublishers.

4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor &Francis.

5. The Organic Chemistry of the Drug Design and Drug action by Richard B.Silverman, Elsevier Publishers.

6. Medicinal Chemistry by Burger, Wiley Publishing Co.

7. An Introduction to Medicinal Chemistry –Graham L. Patrick, OxfordUniversity Press.

8. Wilson and Gisvold's Text book of Organic Medicinal and PharmaceuticalChemistry, Ippincott Williams & Wilkins.

9. Comprehensive Medicinal Chemistry – Corwin and Hansch, PergamonPublishers.

10. Computational and structural approaches to drug design edited by RobertM Stroud and Janet. F Moore

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Pharm – I year II Sem. (Pharmaceutical Chemistry)

L	T	P	C
4	0	0	4

(17S02204) PHARMACEUTICAL PROCESS CHEMISTRY

Scope

Process chemistry is often described as scale up reactions, taking them fromsmall quantities created in the research lab to the larger quantities that areneeded for further testing and then to even larger quantities required forcommercial production. The goal of a process chemist is to develop syntheticroutes that are safe, cost-effective, environmentally friendly, and efficient. Thesubject is designed to impart knowledge on the development and optimization ofa synthetic route/s and the pilot plant procedure for the manufacture of ActivePharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for thedrug development phase.

Objectives

At completion of this course it is expected that students will be able tounderstand

- The strategies of scale up process of apis and intermediates
- The various unit operations and various reactions in process chemistry

THEORY 60 Hrs

1. 12Hrs

Process chemistry

Introduction, Synthetic strategyStages of scale up process: Bench, pilot and large scale process.

In-process control and validation of large scale process.Case studies of some scale up process of APIs.Impurities in API, types and their sources including genotoxicimpurities

2 12Hrs

Unit operations

a) Extraction: Liquid equilibria, extraction with reflux,extraction with agitation, counter current extraction.

b) Filtration: Theory of filtration, pressure and vacuumfiltration, centrifugal filtration,

c) Distillation: azeotropic and steam distillation

d) Evaporation: Types of evaporators, factors affectingevaporation.

e) Crystallization: Crystallization from aqueous, nonaqueoussolutions factors affecting crystallization,nucleation. Principle and general methods of Preparationof polymorphs, hydrates, solvates and amorphous APIs.

3 12Hrs

Unit Processes - I

a) Nitration: Nitrating agents, Aromatic nitration, kineticsand mechanism of aromatic nitration, process equipmentfor technical nitration, mixed acid for nitration,

b) Halogenation: Kinetics of halogenations, typesofhalogenations, catalytic halogenations. Case study onindustrial halogenation process.

c) Oxidation: Introduction, types of oxidative reactions,Liquid phase oxidation with oxidizing agents. NonmetallicOxidizing agents such as H2O2, sodium hypochlorite,Oxygen gas, ozonolysis.

4 12Hrs

Unit Processes - II

a) Reduction: Catalytic hydrogenation, Heterogeneousand homogeneous catalyst; Hydrogen transfer reactions,Metal hydrides. Case study on industrial reductionprocess.

b) Fermentation: Aerobic and anaerobic fermentation.Production of

i. Antibiotics; Penicillin and Streptomycin,

ii. Vitamins: B2 and B12

iii. Statins: Lovastatin, Simvastatin

c) Reaction progress kinetic analysis

i. Streamlining reaction steps, route selection,

ii. Characteristics of expedient routes, characteristics ofcost-effective routes, reagent selection, familiesofreagents useful for scale-up.

5 12Hrs

Industrial Safety

a) MSDS (Material Safety Data Sheet), hazard labels ofchemicals and Personal Protection Equipment (PPE)

b) Fire hazards, types of fire & fire extinguishers

c) Occupational Health & Safety Assessment Series 1800(OHSAS-1800) and ISO-14001(EnvironmentalManagement System), Effluents and its management

REFERENCES

1. Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever-Changing Climate-An Overview; K. Gadamasetti, CRC Press.

2. Pharmaceutical Manufacturing Encyclopedia, 3rd edition, Volume 2.

3. Medicinal Chemistry by Burger, 6th edition, Volume 1-8.

4. W.L. McCabe, J.C Smith, Peter Harriott. Unit operations of chemicalengineering, 7th edition, McGraw Hill

5. Polymorphism in Pharmaceutical Solids .Dekker Series Volume 95 Ed: HG Brittain (1999)

6. Regina M. Murphy: Introduction to Chemical Processes: Principles,Analysis, Synthesis

7. Peter J. Harrington: Pharmaceutical Process Chemistry for Synthesis:Rethinking the Routes to Scale-Up

8. P.H.Groggins: Unit processes in organic synthesis (MGH)

9. F.A.Henglein: Chemical Technology (Pergamon)

10. M.Gopal: Dryden's Outlines of Chemical Technology, WEP East-WestPress

11. Clausen,Mattson: Principle of Industrial Chemistry, Wiley Publishing Co.,

12. Lowenheim& M.K. Moran: Industrial Chemicals

13. S.D. Shukla & G.N. Pandey: A text book of Chemical Technology Vol. II,Vikas Publishing House

14. J.K. Stille: Industrial Organic Chemistry (PH)

15. Shreve: Chemical Process, Mc Grawhill.

16. B.K.Sharma: Industrial Chemistry, Goel Publishing House

17. ICH Guidelines

18. United States Food and Drug Administration official website www.fda.gov

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M. Pharm – I year II Sem. (Pharmaceutical Chemistry)	**L**	**T**	**P**	**C**
	0	**0**	**6**	**3**

(17S02205) PHARMACEUTICAL CHEMISTRY PRACTICALS – II

1. Synthesis of organic compounds by adapting different approachesinvolving (3 experiments)

a) Oxidationb) Reduction/hydrogenationc) Nitration

2. Comparative study of synthesis of APIs/intermediates by different syntheticroutes (2 experiments)
3. Assignments on regulatory requirements in API (2 experiments)
4. Comparison of absorption spectra by UV and Wood ward – Fieser rule
5. Interpretation of organic compounds by FT-IR
6. Interpretation of organic compounds by NMR
7. Interpretation of organic compounds by MS
8. Determination of purity by DSC in pharmaceuticals
9. Identification of organic compounds using FT-IR, NMR, CNMR and Massspectra
10. To carry out the preparation of following organic compounds

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M. Pharm – I year II Sem. (Pharmaceutical Chemistry)	**L**	**T**	**P**	**C**
	0	**0**	**6**	**3**

(17S02206) PHARMACEUTICAL CHEMISTRY PRACTICALS – III

1. Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizineHCl).
2. Preparation of 4-iodotolene from p-toluidine.
3. NaBH4 reduction of vanillin to vanillyl alcohol
4. Preparation of umbelliferone by Pechhman reaction
5. Preparation of triphenyl imidazole
6. To perform the Microwave irradiated reactions of synthetic importance(Any two)
7. Determination of log P, MR, hydrogen bond donors and acceptors ofselected drugs using softwares
8. Calculation of ADMET properties of drug molecules and its analysis using softwares Pharmacophore modeling
9. 2D-QSAR based experiments
10. 3D-QSAR based experiments
11. Docking study based experiment
12. Virtual screening based experiment
13. Synthesis purification and identification of the following compounds employing some medicinal compounds.

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M. Pharm – III Sem. (Pharmaceutical Chemistry)

L	T	P	C
4	0	0	4

(17S01301) RESEARCH METHODOLOGY & BIOSTATISTICS

UNIT – I

General Research Methodology: Research, objective, requirements,practical difficulties, review of literature, study design, types of studies,strategies to eliminate errors/bias, controls, randomization, crossover design,placebo, blinding techniques.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size,factors influencing sample size, dropouts, statistical tests of significance, typeof significance tests, parametric tests(students “t” test, ANOVA, Correlationcoefficient, regression), non-parametric tests (wilcoxan rank tests, analysis ofvariance, correlation, chi square test), null hypothesis, P values, degree offreedom, interpretation of P values.

UNIT – III

Medical Research: History, values in medical ethics, autonomy, beneficence,non-maleficence, double effect, conflicts between autonomy andbeneficence/non-maleficence, euthanasia, informed consent, confidentiality,criticisms of orthodox medical ethics, importance of communication, controlresolution, guidelines, ethics committees, cultural concerns, truth telling,online business practices, conflicts of interest, referral, vendor relationships,treatment of family members, sexual relationships, fatality.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care,quarantine, surveillance, diagnosis, treatment and control of disease, personalhygiene, location of animal facilities to laboratories, anesthesia, euthanasia,physical facilities, environment, animal husbandry, record keeping, SOPs,personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medicalresearch, and additional principles for medical research combined withmedical care.

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COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Hours per week			Credits
			L	T	P	
1.	21S01101	Modern Pharmaceutical Analytical Techniques	4	-	-	4
2.	21S02101	Advanced Organic Chemistry-I	4	-	-	4
3.	21S02102	Advanced Medicinal Chemistry-I	4	-	-	4
4.	21S02103	Chemistry of Natural Products	4	-	-	4
5.	21S01105	Modern Pharmaceutical Analytical Techniques Lab	-	-	6	3
6.	21S02104	Advanced Medicinal Chemistry-I Lab	-	-	6	3
7.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	2	-	-	0
8.	21S02105	Seminar/Assignment	-	1	6	4
		Total	18	1	18	26

SEMESTER – II

S.No.	Course codes	Course Name	Hours per week			Credits
			L	T	P	
1.	21S02201	Advanced Organic Chemistry-II	4	-	-	4
2.	21S02202	Advanced Medicinal Chemistry-II	4	-	-	4
3.	21S02203	Computer Aided Drug Design	4	-	-	4
4.	21S02204	Pharmaceutical Process Chemistry	4	-	-	4
5.	21S02205	Advanced Organic Chemistry-II Lab	-	-	6	3
6.	21S02206	Advanced Medicinal Chemistry-II Lab	-	-	6	3
7.	21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	2	-	-	0
8.	21S02207	Seminar/Assignment	-	1	6	4
		Total	18	1	18	26

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COURSE STRUCTURE & SYLLABI
SEMSTER - III

S.No.	Course codes	Course Name	Hours per week			Credits
			L	T	P	
1.	21DRM101	Research Methodology and Intellectual Property Right	4	-	-	4
2.	21SOE301d 21SOE301c 21SOE301e	**Open Elective** Biological Screening methods Entrepreneurship Management Pharmacoepidemiology and Pharmacoeconomics	3	-	-	3
3.	21S02301	Teaching Practice/Assignment	-	-	4	2
4.	21S02302	Comprehensive viva voce	-	-	4	2
5.	21S02303	Research Work - I	-		24	12
		Total	7	-	32	23

SEMESTER - IV

S.No.	Course codes	Course Name	Hours per week			Credits
			L	T	P	
1.	21S02401	Co-Curricular Activities	2			2
2.	21S02402	Research Work - II	3		30	18
		Total	5		30	20

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COURSE STRUCTURE & SYLLABI

Course Code	MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES	L	T	P	C
21S01101		4	0	0	4
	Semester	I			

Course Objectives:

The course is designed to impart the knowledge in the field of Pharmaceutical Analysis. The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC, different chromatographic methods and other important topics are taught to enable the students to understand and apply the principles involved in the determination of different bulk drugs and their formulation. In addition to the theoretical aspects, the basic practical knowledge relevant to the analysis is also imparted.

Course Outcomes (CO): Student will be able to

- Modern Analytical Techniques and can apply the theories in analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments
- Apply their knowledge in developing the new methods for the determination and validate the procedures.

UNIT – I

UV-Visible spectroscopy

Introduction, Theory, Laws, and Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy.

UNIT - II

IR spectroscopy

Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier -Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation.

UNIT - III

NMR spectroscopy

Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and ^{13}C NMR. Applications of NMR spectroscopy

UNIT – IV

Mass Spectroscopy

Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.

UNIT – V

Chromatography

Introduction to chromatography and classification of chromatographic methods based on the mechanism of separation, Principle, instrumentation, selection of solvents; chromatographic parameters, factors affecting resolution, applications of the following:

a) Thin Layer chromatography; b) High Performance Thin Layer Chromatography
c) Paper Chromatography; d) Column chromatography
e) Gas chromatography; f) High Performance Liquid chromatography

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COURSE STRUCTURE & SYLLABI

g) Affinity chromatography; h) Gel Chromatography
i)Hyphenated techniques :

- Ultra High Performance Liquid chromatography- Mass spectroscopy
- Gas Chromatography-Mass Spectroscopy

Textbooks:

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
3. Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley& Sons, 1982.

Reference Books:

4. Spectrometric Identification of Organic compounds - Robert M Silverstein,Sixth edition, John Wiley & Sons, 2004.
5. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler,Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
6. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
7. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4thedition, CBS Publishers, New Delhi, 1997.
8. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
9. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi,3rd Edition, CBS Publishers, New Delhi, 1997.
10. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol11, Marcel. Dekker Series
11. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley esternLtd., Delhi.
12. Organic Chemistry by I. L. Finar
13. Quantitative Analysis of Drugs by D. C. Garrett
14. HPTLC by P.D. Seth
15. Indian Pharmacopoeia 2007
16. High Performance thin layer chromatography for the analysis of medicinal plants by Eike
17. Reich, Anne Schibli
18. Introduction to instrumental analysis by Robert. D. Braun

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COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED ORGANIC CHEMISTRY - I	L	T	P	C
21S02101		4	0	0	4
	Semester	I			

Course Objectives:

The course structure is designed to give the knowledge of organic chemistry at an advanced level and mainly aimed at the stereochemistry and different organic named reactions including preparations of reactive intermediates.

Course Outcomes (CO): Student will be able to

- Position to design a stereo selective synthesis of new chemical entities (NCE) for the treatment of different diseases in new drug discovery Program.

UNIT - I

Stereochemistry

Elements of symmetry, simple axis of symmetry. Notation, relative configuration and absolute configuration. Compounds with a chiral carbon atom, compounds with other quadrivalent chiral atoms. Optical isomerism in compounds containing no chiral atom, biphenyl, allenes, compounds with exocylic double bonds and spirans. Chirality due to helical shape.cis / trans, E – Z isomerism resulting from double bonds, monocyclic compounds, fused ring system. Racemic modifications and methods for resolution of racemic mixtures. Asymmetric synthesis and stereo – selective synthesis.

UNIT - II

a. Reactive Intermediates: Definitions, generation, stability, structure and reactivity of free radicals carbocations, carbanions, carbenes, Nitrenes/Nitrenium ions.
b. Concepts of aromaticity and antiaromaticity, nonbenzenoid aromatic compounds.
c. Mechanisms of organic reactions: Free radical, Electrophilic, Nucleophilic reactions of aliphatic and aromatic compounds

UNIT - III

Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations.

a) Addition reactions
b) Nucleophilic uni- and bimolecular reactions (SN1 andSN2)
c) Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule)

UNIT - IV

Electrocyclic, pericyclic and sigmotropic reactions: Introduction, terminology and mechanism, with suitable examples.

UNIT - V

Study of mechanism and synthetic applications of following named Reactions:

Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Miller Reaction, Mitsunobu reaction, Sandmeyer Reaction, Mannich reaction, Vilsmeyer-Haack Reaction, Ozonolysis and Michael addition reaction

Textbooks:

1. Francis A. Carey & Richard J. Sunberg, Advanced Org. Chemistry, III rd Edition, Par B; Reactions and synthesis, Plenum Press, New York, London, LatestEdition.
2. Eliel I. Ernest and Samuel h, Stereochemistry of Org. Compounds, John Wiley and sons, New York, 2003Edition.

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COURSE STRUCTURE & SYLLABI

3. Roland E. Lehr & Alan P Marchard, Orbital Symmetry: A Problem-Solving approach, Academic Press, New York LatestEdition.
4. J. March, Advanced Org. Chemistry, Reactions Mechanisms and Structure,4th
5. Edition, John Wiley & Sons, New York LatestEdition
6. I. L. Finar, Organic Chemistry,ELBS
7. Herbert O. Modern Synthesis Reactions IInd Edition W.A. Beenamis Inc. Menco Park California
8. W. Carruthers, Some Modern Methods of Org. Synthesis, III rd Edition, Cambridge University Press,Cambridge.

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COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED MEDICINAL CHEMISTRY – I		L	T	P	C
21S02102			4	0	0	4
Pre-requisite		Semester	I			

Course Objectives:

The course contents are mainly aimed to have advanced knowledge of rational drug design including QSAR and molecular modeling and also aimed at the identification of lead molecule from natural sources for the development of new drugs.

Course Outcomes (CO): Student will be able to

- The application of basic knowledge of pharmaceutical-chemical aspects of drugs that are in clinical use in defining, analyzing and proposing actions related to the research and implementation of new laboratory methods for detecting and monitoring diseases and effects and/or efficacy of the therapy.
- Interpretation of the results of laboratory analysis by the clinical aspects by knowing the pharmacotherapeutic groups of drugs, their classification, and the most important representatives.
- The assurance of positive interactions with patients, colleagues, health professionals and the public.

UNIT – I

a) Physicochemical properties in relation to biological action
b) Modern methods of Drug Discovery target validation**:** Introduction to discovery of lead molecule, methods, rational drug discovery models. Target structure, active site identification and methods of validation.

UNIT – II

Prodrug Design and Analog design

a) Prodrug design: Basic concept, Carrier linked prodrugs/Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design.

b) Combating drug resistance: Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance.

c) Analog Design: Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance.

UNIT – III

Medicinal chemistry aspects of the following class of drugs Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs: Anti-hypertensive drugs, Anti convulsant drugs, COX1 & COX2 inhibitors, H1 & H2 receptor antagonist, Antineoplastic and Antiviralagents.

UNIT – IV

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M.PHARM. IN PHARMACEUTICAL CHEMISTRY

COURSE STRUCTURE & SYLLABI

Stereochemistry and Drug action: Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination.

UNIT – V		

Structure based drug design

Inhibitors of HIV-I Prokinase, Structural studies of HIV-I Reverse transcriptase and implications for drug design, Bradykinin receptor antagonists, Design of purine nucleoside and Phosphorylase inhibitors, Aldose Reductase Inhibitors, Thrombin inhibitors. Rhinoviral-Capsid-biding Inhibitors.

Textbooks:

1. Berger's Medicinal Chemistry and Drug Design. 6thEdition.
2. Korolkovas Essentials of Medicinal Chemistry
3. Purcell Strategies of Drug Design
4. Corwin, Hansen Comprehensive Medicinal Chemistry
5. William O Foye Medicinal Chemistry
6. Structure based Drug Design by Pandi Veerapandion.
7. Stenlake, Foundation of Molecular Pharmacology- Pharma Med Press, volume I&II

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M.PHARM. IN PHARMCAEUTICAL CHEMISTRY

COURSE STRUCTURE & SYLLABI

Course Code	CHEMISTRY OF NATURAL PRODUCTS	L	T	P	C
21S02103		4	0	0	4
	Semester	**I**			

Course Objectives:

The contents of Unit I mainly aimed to identify lead molecules from the natural sources. The contents of Unit II &III are mainly designed to have the knowledge of alkaloids and steroids especially structural elucidation of few important compounds. The contents of Unit IV and V are to offer an understanding of utilization of natural products for the preparation of new molecules for the treatment of different diseases like cancer, malaria etc.

Course Outcomes (CO): Student will be able to

- Position to explore the natural lead compounds for the treatment of different diseases like cancer, malaria, diabetes etc

UNIT – I

Extraction: Introduction, definition, factors influencing the choice of extraction, principles of extraction methods, types of extraction (extraction of plant drugs by microwave assisted techniques wherever applicable) and their merits and demerits.
Selection and purification of solvents for extraction
Carbohydrates: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Glucose.
Glycosides: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of cardiac glycosides-Digoxin.
Vitamins: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Ascorbic Acid.

UNIT – II

Steroids: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Cholesterol.
Terpenoids: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Citral, Menthol and Zingiberene.
Isoprene and Special Isoprene rule.
Anti-biotics: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Penicillin.

UNIT – III

Amino acids: Introduction, Definition, Classification, Nomenclature, Source, Importance.
General Preparation and Properties of Amino acids.
Peptides: Introduction, Definition, Classification, Synthesis, determination of structure of Peptides.
Proteins: Introduction, Definition, Classification, Properties, Structure of protein, Chemistry of Insulin.
Alkaloids: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Quinine.
Purines: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Caffeine.

UNIT – IV

Natural Pigments: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Carotene.
Plant Hormones: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Auxins.

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COURSE STRUCTURE & SYLLABI

Fats and Oils: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Properties and analysis of fixed oils, fats and waxes.

UNIT – V

Natural products as markers for new drug discovery:

- The role of natural products as potential new drug discovery.
- The role of natural products chemistry in drug discovery.
- Selection and optimization of lead compounds for further development with suitable examples.

Chromatography: Introduction, Definition, Classification, general principles of different chromatographic techniques, and applications of TLC, HPTLC, Column, Paper, HPLC, GC in the isolation, separation and purification of natural products.

Spectroscopy: General principles and applications of UV, IR, HNMR, C^{13} NMR, Mass Spectroscopy in the structural elucidation of natural products.

Stereoisomerism: Introduction, Definition, Types, Concept of stereoisomerism taking examples of natural products.

Textbooks:

1. Finar IL. Organic Chemistry-stereochemistry and the chemistry of natural products. 5th ed. vol2. Delhi: Dorling Kindersley (India) Pvt. Ltd.,2006.
2. Morrison RT, Boyd RN. Organic Chemistry. 6th ed. Delhi: Pearson education Pvt. Ltd.,2003.
3. Pelletier SW. Alkaloids-chemical & biological perspectives. vol 1-15. London: Pergamon;2001.
4. Steroids by Fischer &Fischer
5. Evans WC. Trease and evanspharmacognosy. 15th ed. Edinburgh: Saunders.2004.
6. Ataur Rahman. Chemistry of naturalproducts
7. Bhat SV, Nagasampagi BA, SivakumarM. Chemistry of natural products. New Delhi: Narosa Publishing House;2005.
8. Agrawal OP. Organic chemistry-natural products. 30th ed. vol 1-2. Meerut: Goel Publishing House;2006.
9. Wallis TE. Textbook of pharmacognosy. 5th ed. New Delhi: CBS Publishers & Distributors;2002.
10. Abraham DJ, editor. Burger's medicinal chemistry and drug discovery. 6th ed. vol 1-6, Singapore: John Wiley & Sons,2007.
11. Lemke TL, Williams DA, Roche VF, Zito SW. Foye's principles of medicinal chemistry. 6th ed. New Delhi: Wolters Kluwer/ Lippincott Williams & Wilkins.2008.
12. Block JH, Beale JM, editor. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry. 11th ed. Baltimore: Lippincott Williams & Wilkins;2004.
13. Jerry M. Advanced organic chemistry-reactions, mechanisms, and structure. 4th ed. Kundli: Replika Press Pvt. Ltd;2003.
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15. Rama Rao AVSS. A text book of biochemistry. 9th ed. Delhi: Rajkamal electric press,2004.
16. Remington: The science and practice of pharmacy. 21st ed., vol. I & II, Lippincatt Willams&Wilkings, New Delhi,2005.

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M.PHARM. IN PHARMCAEUTICAL CHEMISTRY

COURSE STRUCTURE & SYLLABI

Course Code	MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES LAB		L	T	P	C
21S01105			0	0	6	3
Pre-requisite		Semester	I			

List of Experiments

1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis Spectrophotometer.
2. Simultaneous estimation of multi component containing formulations by UV Spectrophotometry
3. Effect of pH and solvent on UV –Spectrum
4. Determination of Molar absorption coefficient
5. Estimation of riboflavin/ quinine sulphate by fluorimetry
6. Study of quenching effect by fluorimetry
7. Estimation of sodium or potassium by flame photometry
8. Colorimetric determination of drugs by using different reagents
9. Quantitative determination of functional groups
10. Experiments based on Column chromatography
11. Experiments based on HPLC
12. Experiments based on Gas Chromatography

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COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED MEDICINAL CHEMISTRY – I LAB		L	T	P	C
21S02104			0	0	6	3
Pre-requisite		Semester	I			

List of Experiments

1. Synthesis of any two drugs from the following classes of drugs (Minimum two from each class)
   a. Analgesics, NSAIDS and antipyretic
   b. CNS and CVS drugs
2. Isolation and characterization of
   a. Eugenol from Clove
   b. Curcumin fromTurmeric
   c. Sennosides from senna
   d. Hesperidine from Orange Peel
   e. Embelin from EmbelliaRibes
   f. Glycyrrhizin from Glycyrrhiza Glabra
   g. Plumbagin from Plumbago Rosea
   h. Solanine from potatoes
   i. Naringen from Grape Fruit Peel
   j. Trimyristin and Myristin from Nutmeg
   k. Azylic acid from Castor Oil
   l. Pectin from Orange Peel
   m. Lycopene from Tomato Peel
   n. Epicatechin from Cashew Kernel outer covering
   o. Piperine from Black pepper Degradation reaction of following natural products and the identification of the degraded intermediates by micro TLC and qualitative test. Atropine, caffeine, Ephedrine, aponification of Trimyristin.

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Course Code	ADVANCED ORGANIC CHEMISTRY - II	L	T	P	C
21S02201		4	0	0	4
	Semester	II			

Course Objectives:

The content of Unit I and II are mainly aimed at utilization of different synthetic reagents used in the preparation of intermediates and final compounds and also aimed at the principles of green chemistry. Unit III and IV contents are mainly aimed at scale of processes for the preparation of new pharmaceutical agents and also to design different synthetic strategies. Unit V is mainly aimed to utilize the knowledge of chemical library for drug design

Course Outcomes (CO): Student will be able to

- Position to have advanced knowledge of different synthetic reagents and reaction processes, synthetic routes by involving green chemistry principles.
- Techniques to utilize the chemical library of combinatorial chemistry.

UNIT – I

Synthetic Reagents & Application

Lead Tetra Acetate (LTA), N- Bromosuccinimide (NBS), Osmium Tetroxide, Lithium Aluminum Hydride (LAH) and Sodium Borohydride, Dicyclohexylcarbodimide (DCC) and 2,3-dicholro-5,6-dicyano-1,4-benzoquinone (DDQ).

UNIT – II

Catalysis

a. Types of catalysis, heterogeneous and homogenous catalysis, advantages and disadvantages
b. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs.
c. Homogenous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogenous catalysis used in synthesis of drugs
d. Transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions
e. Phase transfer catalysis -theory and applications

UNIT – III

Molecular Rearrangements & their applications

1. Carbon to Carbon Migration: Wagner – Meerwin rearrangement, Claisen rearrangement and benzil – benzilic acid rearrangement.
2. Carbon to Nitrogen Migration: Hoffmann rearrangement, Curtius rearrangement and Lossen rearrangement, Beckman rearrangement.
3. Carbon to Oxygen Migration: Baeyer – Villiger rearrangement, Rearrangement of hydro peroxides and Wittig rearrangement

UNIT – IV

Chemistry of peptides

a. Coupling reactions in peptide synthesis
b. Principles of solid phase peptide synthesis, t-BOC and FMOC protocols, various solid supports and linkers: Activation procedures, peptide bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and

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COURSE STRUCTURE & SYLLABI

peptide amides, purification and case studies, site-specific chemical modifications of peptides

c. Segment and sequential strategies for solution phase peptide synthesis with any two case studies Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, over activation and side reactions of individual aminoacids.

UNIT – V

Green Chemistry

a. Introduction, principles of green chemistry

b. Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis

c. Ultrasound assisted reactions: Types of sono chemical reactions, homogenous, heterogeneous liquid- liquid and liquid-solid reactions, synthetic applications

Textbooks:

1. W. Carruthers, Some Modern Methods of Org. Synthesis, III rd Edition, Cambridge University Press, Cambridge(1988)
2. Gorgy Keri and Istarian Toth, Molecular Patho-mechanisms and New Trends in Drug Research – Taylor and Francis Group, London2003
3. R. K. Mackie, A Guidebook to Organic Thesis – PrenticeHall
4. T.W. Greene and PGM Warts, Protecting Groups – JohnWilley
5. Michael B. Smith, Organic Synthesis
6. Organic synthesis- Special techniques VK Ahluwaliaand R Aggarwal, NarosaPublishers.
7. “Organic Chemistry” VolI and II. I.L. Finar. ELBS, Sixth ed.,1995.
8. “Advanced Organic chemistry, Reaction, mechanisms and structure”, J March, John Wiley and sons, NewYork.
9. Principles of organic synthesis, ROC Norman and JM Coxan, Nelsonthorns
10. Carey, Organic chemistry, 5th edition (Viva Books Pvt.Ltd.)

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Course Code	ADVANCED MEDICINAL CHEMISTRY – II	L	T	P	C
21S02202		4	0	0	4
	Semester	II			

Course Objectives:

The course contents of Unit I and Unit II are mainly aimed at enzyme inhibitors for the treatment of different CNS and CVS diseases. Unit III contents are aimed to have advanced knowledge of the developments of antipsychotic agents. The remaining contents are aimed to design prodrugs, peptidomimetic agents and recombinant DNA products.

Course Outcomes (CO): Student will be able to

- The student would be in a position to involve in the development of different enzyme inhibitors, prodrugs and also equipped with different biotechnological techniques of recombinant DNA products.

UNIT – I

Enzyme Inhibitors I

A detailed study of the following types of enzyme inhibitors, related drugs and their pharmaceutical significance:

a) Prostaglandin Synthetase (Cycloxygenase &Lipoxygenase Inhibitors)
b) Phosphodiesterase (PDE) Inhibitors
c) Carbonic Anhydrase Inhibitors.
d) Beta-Secretase.

UNIT – II

Enzyme Inhibitors II

a. Angiotensin Converting Enzyme (ACE)Inhibitors
b. Acetyl Cholinesterase (Ach E) Inhibitors.
c. HMG-CoAinhibitors
d. Protease inhibitors

UNIT – III

Antipsychotic Agents

Role of Dopamine, Serotonin, Glutamate and their receptors. SAR and Pharmacokinetics of Ticyclic Neuroleptics, Butyrophenones and Benzamides. A brief account of non – benzodiazepine agonist.

UNIT – IV

Peptidomimetics Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. Chemistry of prostaglandins, leukotrienes and thromboxones.

UNIT – V

Biotechnologically produced drugs: Biotechnology of Recombinant DNA, Process of Recombinant proteins, Immunogencity of biotechnologically produced drugs.
Recombinant drug products: Hormones, cytokinins, interferons, Interleukins, enzymes, vaccines and monoclonal antibody drugs.

Textbooks:

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COURSE STRUCTURE & SYLLABI

1. Berger's Medicinal Chemistry and Drug Design. 6th Edition
2. Korolkovas Essentials of MedicinalChemistry
3. William O Foye MedicinalChemistry
4. Lednicer, Organic Chemistry of DrugSynthesis
5. Ariens, Drug Design, AcademicPress
6. Purcell Strategies of DrugDesign
7. Corwin, Hansen Comprehensive MedicinalChemistry
8. Richard B. Silvermann, Org. Chemistry of Drug Design and drugAction
9. Smith and Williams, Introduction to principles of Drug Design – Harwood AcademyPress
10. Gyorgy Keri &IstdanToth Molecular Pathomechanism and New Trends in Drug Research, Taylor & FrancisPub
11. Thomas Nogrady, Medicinal Chemistry. A biochemical Approach, Oxford Univ.Press.

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COURSE STRUCTURE & SYLLABI

Course Code	COMPUTER AIDED DRUG DESIGN	L	T	P	C
21S02203		4	0	0	4
	Semester	II			

Course Objectives:

The subject is designed to impart knowledge on the current state of the art techniques involved in computer assisted drug design.

Course Outcomes (CO): Student will be able to

- Role of CADD in drug discovery
- Different CADD techniques and their applications
- Various strategies to design and develop new drug like molecules.
- Working with molecular modeling softwares to design new drug molecules
- The in silico virtual screening protocols

UNIT – I

Introduction to Computer Aided Drug Design (CADD) History, different techniques and applications. Quantitative Structure Activity Relationships: Basics History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects(Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters.

UNIT – II

Quantitative Structure Activity Relationships: Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSARequations.3D-QSAR approaches and contour map analysis. Statistical methods used in QSAR analysis and importance of statistical parameters

UNIT – III

Molecular Modeling and Docking

a) Molecular and Quantum Mechanics in drug design.
b) Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation
c) Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE)

UNIT – IV

Molecular Properties and Drug Design

a) Prediction and analysis of ADMET properties of new molecules and its importance in drug design.
b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design.
c) Homology modeling and generation of 3D-structure of protein.

UNIT – V

Pharmacophore Mapping and Virtual Screening Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping. In Silico Drug Design and Virtual Screening Techniques Similarity based methods and Pharmacophore based screening, structure

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based In-silico virtual screening protocols.

Reference Books:

1. Computational and structural approaches to drug discovery, Robert MStroud and Janet. F Moore, RCS Publishers.
2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor& Francisgroup..
3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975,ElsevierPublishers.
4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor&Francis.
5. The Organic Chemistry of the Drug Design and Drug action by Richard B.Silverman, Elsevier Publishers.
6. Medicinal Chemistry by Burger, Wiley Publishing Co.
7. An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford UniversityPress.
8. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ippincott Williams &Wilkins.
9. Comprehensive Medicinal Chemistry – Corwin and Hansch,PergamonPublishers.
10. Computational and structural approaches to drug design edited by RobertMStroud and Janet. F Moore

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COURSE STRUCTURE & SYLLABI

Course Code	PHARMACEUTICAL PROCESS CHEMISTRY	L	T	P	C
21S02204		4	0	0	4
	Semester	II			

Course Objectives:

The goal of a process chemist is to develop synthetic routes that are safe, cost- effective, environmentally friendly, and efficient. The subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.

Course Outcomes (CO): Student will be able to

- The strategies of scale up process of apis and intermediates
- The various unit operations and various reactions in process chemistry

UNIT – I

Process chemistry Introduction, Synthetic strategy Stages of scale up process: Bench, pilot and large- scale process. In-process control and validation of large-scale process. Case studies of some scale up process of APIs. Impurities in API, types and their sources including genotoxic impurities

UNIT – II

Unit operations

a) Extraction: Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction.
b) Filtration: Theory of filtration, pressure and vacuum filtration, centrifugal filtration,
c) Distillation: azeotropic and steam distillation
d) Evaporation: Types of evaporators, factors affecting evaporation.
e) Crystallization: Crystallization from aqueous, nonaqueous solutions factors affecting crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs.

UNIT – III

Unit Processes - I

a) Nitration: Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration,
b) Halogenation: Kinetics of halogenations, types of halogenations, catalytic halogenations. Case study on industrial halogenations process.
c) Oxidation: Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H2O2, sodium hypochlorite, Oxygen gas,ozonolysis.

UNIT – IV

Unit Processes - II

a) Reduction: Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process.
b) Fermentation: Aerobic and anaerobic fermentation.
Production of

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COURSE STRUCTURE & SYLLABI

i. Antibiotics; Penicillin and Streptomycin,
ii. Vitamins: B2 andB12
iii. Statins: Lovastatin, Simvastatin

c) Reaction progress kinetic analysis
i. Streamlining reaction steps, route selection,
ii. Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up.

UNIT – V

Industrial Safety

a) MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment(PPE)
b) Fire hazards, types of fire & fire extinguishers
c) Occupational Health & Safety Assessment Series 1800 (OHSAS-1800) and ISO- 14001 (Environmental Management System), Effluents and its management.

Reference Books:

1. Computational and structural approaches to drug discovery, Robert MStroud and Janet. F Moore, RCS Publishers.
2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor& Francisgroup..
3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975,ElsevierPublishers.
4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor&Francis.
5. The Organic Chemistry of the Drug Design and Drug action by Richard B.Silverman, Elsevier Publishers.
6. Medicinal Chemistry by Burger, Wiley Publishing Co.
7. An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford UniversityPress.
8. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ippincott Williams &Wilkins.
9. Comprehensive Medicinal Chemistry – Corwin and Hansch,PergamonPublishers.
10. Computational and structural approaches to drug design edited by RobertMStroud and Janet. F Moore

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COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED ORGANIC CHEMISTRY – II LAB	L	T	P	C
21S02205		0	0	6	3
	Semester	II			

List of Experiments

1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on Column chromatography
4. Experiments based on HPLC
5. Experiments based on Gas Chromatography
6. Estimation of riboflavin/quinine sulphate by fluorimetry
7. Estimation of sodium/potassium by flame photometry
8. To perform the following reactions of synthetic importance Purification of organic solvents, column chromatography
   a. Claisen-schimidt reaction.
   b. Benzyllic acid rearrangement.
   c. Beckmann rearrangement.
   d. Hoffmann rearrangement
   e. Mannich reaction
9. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4experiments)
10. Estimation of elements and functional groups in organic natural compounds Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data.
11. Some typical degradation reactions to be carried on selected plant constituents

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COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED MEDICINAL CHEMISTRY – II LAB		L	T	P	C
21S02206			0	0	6	3
Pre-requisite		Semester	II			

List of Experiments

1. Synthesis of 4-chlorobenzhydrylpiperazine. (an intermediate forcetirizine HCl).
2. Synthesis of 4-iodotolene from p-toluidine.
3. NaBH4 reduction of vanillin to vanillyl alcohol
4. Synthesis of umbelliferone by Pechhman reaction
5. Synthesis of triphenyl imidazole
6. To perform the Microwave irradiated reactions of synthetic importance(Any two)
7. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares
8. Calculation of ADMET properties of drug molecules and its analysis using softwares Pharmacophore modeling
9. 2D-QSAR based experiments
10. 3D-QSAR based experiments
11. Docking study based experiment
12. Virtual screening based experiment
13. Synthesis purification and identification of the following compounds employing some medicinal compounds.

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COURSE STRUCTURE & SYLLABI

Course Code	RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
21DRM101		4	0	0	4
	Semester	II			

Course Objectives:

To understand the research problem, know the literature studies, plagiarism and ethics. To get the knowledge about technical writing. To analyze the nature of intellectual property rights and new developments and patent rights.

Course Outcomes (CO): Student will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT – I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT – II

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT – III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT – IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT – V

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

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Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New
7. Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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AUDIT COURSE-I

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COURSE STRUCTURE & SYLLABI

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I	Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity

UNIT - II	Lecture Hrs:10

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT - III	Lecture Hrs:10

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.

UNIT - IV	Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V	Lecture Hrs:9

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluatedisasterriskreduction and humanitarian response policy and practice from Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.

Disaster Prone Areas in India:
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics

UNIT - II

Repercussions of Disasters and Hazards:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

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M.PHARM. IN PHARMACEUTICAL CHEMISTRY

COURSE STRUCTURE & SYLLABI

1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies
2. "'New Royal book Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHall OfIndia, New Delhi.
3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

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COURSE STRUCTURE & SYLLABI

Course Code	SANSKRITFOR TECHNICAL KNOWLEDGE	L	T	P	C
21DAC101c		2	0	0	0
	Semester	**I**			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I		
Alphabets in Sanskrit,		
UNIT - II		
Past/Present/Future Tense, Simple Sentences		
UNIT - III		
Order, Introduction of roots		
UNIT - IV		
Technical information about Sanskrit Literature		
UNIT - V		
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics		

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

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COURSE STRUCTURE & SYLLABI

AUDIT COURSE-II

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COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions**.** Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections: Researchdesign**,**Contexts**,**Pedagogy**,**Teachereducation**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof

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3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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COURSE STRUCTURE & SYLLABI

Course Code	STRESSMANAGEMENT BY YOGA	L	T	P	C
21DAC201b		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I		
Definitions of Eight parts of yog.(Ashtanga)		
UNIT - II		
Yam and Niyam.		
UNIT - III		
Do`sand Don't'sin life. i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan		
UNIT - IV		
Asan and Pranayam		
UNIT - V		
i)Variousyogposesand theirbenefitsformind &body ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam		

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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COURSE STRUCTURE & SYLLABI

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
21DAC201c		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1."SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

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COURSE STRUCTURE & SYLLABI

OPEN ELECTIVE

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COURSE STRUCTURE & SYLLABI

Course Code	BIOLOGICAL SCREENING METHODS	L	T	P	C
21SOE301d	(Elective)	3	0	0	3
	Semester	III			

Course Objectives:

The students are going to study about various techniques for screening of drugs for various pharmacological activities and guide lines for handling animals and human and animal ethics for screening of drugs.

Course Outcomes (CO): Student will be able to know

- How to handle animals
- About various techniques for screening of drugs for different pharmacological activities
- Guidelines and regulations for screening new drug molecules on animals.

UNIT – I

Drug discovery process:

Principles, techniques and strategies used in new drug discovery. High throughput screening, human genomics, robotics and economics of drug discovery, Regulations. Alternatives to animal screening procedures, cell-line, patch –clamp technique, In-vitro models, molecular biology techniques.

UNIT – II

Bioassays:

Basic principles of bioassays, official bioassays, experimental models and statistical designs employed in biological standardization.

UNIT – III

Toxicity Evaluations

Principles of toxicity evaluations, ED50, LD50 and TD values, International guidelines (ICH recommendations).

Preclinical studies: General principles and procedures involved in acute, sub-acute, chronic, teratogenicity, mutagenicity and carcinogenicity.

UNIT – IV

Screening of drugs

Screening of different classes of drugs using micro-organisms. Vitamin and antibiotic assays. Screening methods involved in toxins and pathogens.

UNIT – V

Enzymatic screening methods

α-glucosidase, α- amylase, DNA polymerase, nucleases, Lasparginase, lipases and peptidases.

Reference Books:

1. Basic and clinical pharmacology by Bertram G. Katzung (International edition) lange medical book / Mc Graw Hill, USA 2001 8th edition
2. Pharmacology by Rang H.P, Dale MM and Ritter JM., Churchill Livingston, London, 4/e
3. Goodman and Gilman's The pharmacological basis of therapeutics (International edition) Mc Graw Hill, USA 2001 10th edition.
4. General and applid toxicology by B.Ballantyne, T.Marrs, P.Turner (Eds) The Mc Millan press Ltd, London.
5. Drug Discovery by Vogel's
6. Drug Discovery and evaluation – Pharmacological assays by H.Gerhard.Vogel, 2nd edition, Springer verlag, Berlin, Heidelberg.
7. Tutorial Pharmacy (Vol I and II) by Cooper and Gunns.

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COURSE STRUCTURE & SYLLABI

Course Code	ENTREPRENEURSHIP MANAGEMENT	L	T	P	C
21SOE301c	(Elective)	3	0	0	3
	Semester	III			

Course Objectives:

This course is designed to impart knowledge and skills necessary to train the students on entrepreneurship management.

Course Outcomes (CO): Student will be able to

On completion of this course it is expected that students will be able to:

- The Role of enterprise in national and global economy
- Dynamics of motivation and concepts of entrepreneurship
- Demands and challenges of Growth Strategies and Networking

UNIT – I

Conceptual Frame Work: Concept need and process in entrepreneurship development. Role of enterprise in national and global economy. Types of enterprise – Merits and Demerits. Government policies and schemes for enterprise development. Institutional support in enterprise development and management.

UNIT – II

Entrepreneur: Entrepreneurial motivation – dynamics of motivation. Entrepreneurial competency – Concepts. Developing Entrepreneurial competencies - requirements and understanding the process of entrepreneurship development, self-awareness, interpersonal skills, creativity, assertiveness, achievement, factors affecting entrepreneur role.

UNIT – III

Launching and Organizing an Enterprise: Environment scanning – Information, sources, schemes of assistance, problems. Enterprise selection, market assessment, enterprise feasibility study, SWOT Analysis. Resource mobilization -finance, technology, raw material, site and manpower. Costing and marketing management and quality control. Feedback, monitoring and evaluation.

UNIT – IV

Growth Strategies and Networking: Performance appraisal and assessment. Profitability and control measures, demands and challenges. Need for diversification. Future Growth – Techniques of expansion and diversification, vision strategies. Concept and dynamics. Methods, Joint venture, coordination and feasibility study.

UNIT – V

Preparing Project Proposal to Start on New Enterprise Project work – Feasibility report; Planning, resource mobilization and implementation.

Textbooks:

Reference Books:

1. Akhauri, M. M. P.(1990): Entrepreneurship for Women in India, NIESBUD, New Delhi.
2. Hisrich, R. D & Brush, C.G. (1996) The Women Entrepreneurs, D.C. Health& Co., Toranto.
3. Hisrich, R.D. and Peters, M.P. (1995): Entrepreneurship – Starting Developing and Managing a New Enterprise, Richard D., Inwin, INC, USA.
4. Meredith, G.G. etal (1982): Practice of Entrepreneurship, ILO, Geneva.
5. Patel, V.C. (1987): Women Entrepreneurship – Developing New Entrepreneurs, Ahmedabad EDII
6. Arya kumar.(2012): Entrepreneurship- Creating and Leading an Entrepreneurial Organization, Pearson

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COURSE STRUCTURE & SYLLABI

Course Code	PHARMACOEPIDEMIOLOGY &	L	T	P	C
21SOE301e	PHARMACOECONOMICS (Elective-I)	3	0	0	3
	Semester	III			

Course Objectives:

This course enables students to understand various pharmacoepidemiological methods and their clinical applications. Also, it aims to impart knowledge on basic concepts, assumptions, terminology, and methods associated with Pharmacoeconomics and health related outcomes, and when should be appropriate Pharmacoeconomic model should be applied for a health care regimen.

Course Outcomes (CO): Student will be able to

- Understand the various epidemiological methods and their applications
- Understand the fundamental principles of Pharmacoeconomics.
- Identify and determine relevant cost and consequences associated with pharmacy products and services.
- Perform the key Pharmacoeconomics analysis methods
- Understand the Pharmacoeconomic decision analysis methods and its applications.
- Describe current Pharmacoeconomic methods and issues.
- Understand the applications of Pharmacoeconomics to various pharmacy settings.

UNIT – I

Introduction to Pharmacoepidemiology

Definition, Scope, Need, Aims & Applications; Outcome measurement: Outcome measures, Drug use measures: Monetary units, Number of prescriptions, units of drug dispensed, defined daily doses, prescribed daily doses, Diagnosis and Therapy surveys, Prevalence, Incidence rate, Monetary units, number of prescriptions, unit of drugs dispensed, defined daily doses and prescribed daily doses, medications adherence measurements.

Concept of risk:

Measurement of risk, Attributable risk and relative risk, Time- risk relationship and odds ratio

UNIT – II

Pharmacoepidemiological Methods

Qualitative models: Drug Utilization Review; Quantitative models: case reports, case series, Cross sectional studies, Cohort and case control studies, Calculation of Odds' ratio, Meta-analysis models, Drug effects study in populations: Spontaneous reporting, Prescription event monitoring, Post marketing surveillance, Record linkage systems, Applications of Pharmacoepidemiology

UNIT – III

Introduction to Pharmacoeconomics

Definition, history of Pharmacoeconomics, Need of Pharmacoeconomic studies in Indian healthcare system. Cost categorization and resources for cost estimation: Direct costs. Indirect costs. Intangible costs. Outcomes and Measurements of Pharmacoeconomics: Types of outcomes: Clinical outcome, Economic outcomes, Humanistic outcomes; Quality Adjusted Life Years, Disability Adjusted Life Years Incremental Cost-Effective Ratio, Average Cost-Effective Ratio. Person Time, Willingness to Pay, Time Trade Off and Discounting.

UNIT – IV

Pharmacoeconomic evaluations

Definition, Steps involved, Applications, Advantages and disadvantages of the following Pharmacoeconomic models: Cost Minimization Analysis (CMA),Cost Benefit Analysis (CBA), Cost Effective Analysis (CEA), Cost Utility Analysis (CUA), Cost of Illness (COI), Cost Consequences

Analysis (COA).

UNIT – V		

Health related quality of life (HRQOL)

Definition, Need for measurement of HRQOL, Common HRQOL measures. Definition, Steps involved, Applications of the following: Decision Analysis and Decision tree, Sensitivity analysis, Markov Modeling, Software used in Pharmacoeconomic analysis, Applications of Pharmacoeconomics

Reference Books:

1. Rascati K L. Essentials of Pharmacoeconomics, Woulters Kluwe rLippincott Williams & Wilkins, Philadelphia.
2. Thomas E Getzen. Health economics. Fundamentals and Flow of Funds. John Wiley & Sons, USA.
3. Andrew Briggs, Karl Claxton, Mark Sculpher. Decision Modeling for Health Economic Evaluation, Oxford University Press, London.
4. K G Revikumar, Pharmacoepidemiology and Pharmacoeconomics Concepts and Practices.
5. Michael Drummond, Mark Sculpher, George Torrence, Bernie O'Brien and Greg Stoddart. Methods for the Economic Evaluation of Health Care Programs Oxford University Press, London.
6. George E Mackinnon III. Understanding health outcomes and Pharmacoeconomics.
7. Graker, Dennis. Pharmacoeconomics and outcomes.
8. Walley, Pharmacoeconomics.
9. Pharmacoeconomic – ed. by Nowakowska – University of Medical Sciences, Poznan.
10. Relevant review articles from recent medical and pharmaceutical literature
11. Guru Prasad Mohanta and P K Manna, Textbook of Pharmacovigilance Concepts and Practice